

Si-Low 210-A1

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2011 Harnish Blvd.
Billings, MT 59101

Phone: (406)656-4360/(800)523-3888
Fax: (406)656-4363

FAST-WAY LIMITED WARRANTY POLICY

Ideal Manufacturing, Inc., hereinafter referred to as “Manufacturer” warrants FAST-WAY equipment to be free from defect in material and workmanship, under normal use and service, for a period of one (1) year from the date of original purchase. Manufacturer will, at its option, replace or repair at factory in Billings, MT, any part or parts which shall appear, to the satisfaction of the Manufacturer, upon inspection at its factory, to have been defective in material or workmanship. This warranty does not obligate the Manufacturer to bear any transportation charges in connection with replacement or repair of defective parts. This warranty excludes electrical components and damage due to Acts of God, unauthorized modifications, misuse, abuse or negligence to this product.

In order to proceed with a warranty claim, Ideal Manufacturing must be notified of the problem. A new part will be shipped out prepaid (Ground UPS). If the customer requests that the part be expedited that shipping charge will be charged to the owner.

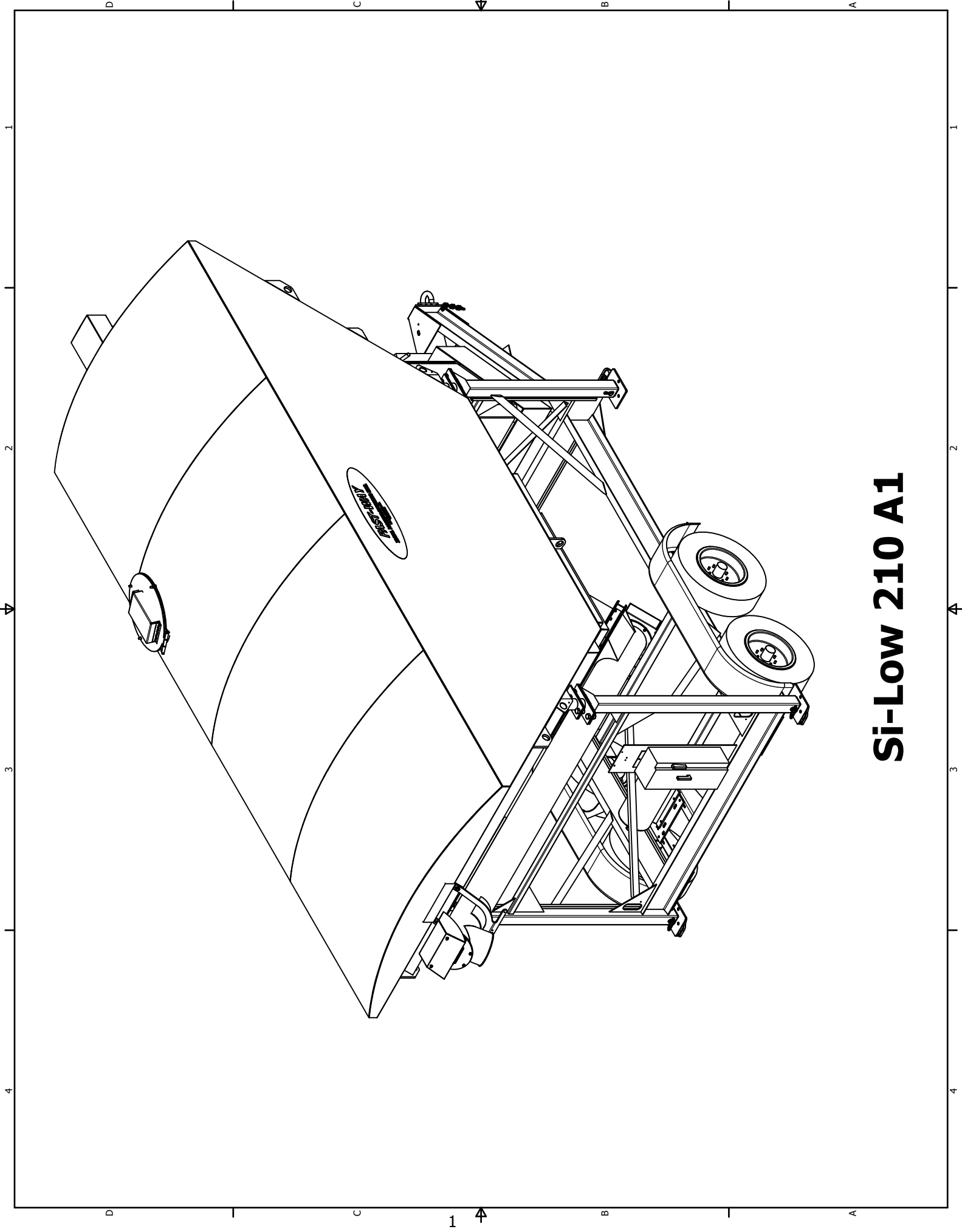
The part that is being warranted must be returned to Ideal Manufacturing postage prepaid. When the new part is shipped out, it will go out with an invoice and a warranty part return number. The defective part must be returned to Ideal Manufacturing, Inc freight prepaid, with the warranty part return number. At that time the invoice will be considered paid in full.

This warranty is exclusive and in lieu of all other obligation, liabilities or warranties. In no event shall Ideal Manufacturing be liable or responsible for incidental or consequential damage or for any other direct or indirect damage loss, cost, expense or fee.

This warranty shall not apply to any products or parts that have been altered or repaired without written consent of Ideal Manufacturing.

Labor to remove and reinstall defective product or parts will be paid from a labor rate and schedule only. Consult Ideal Manufacturing for that rate and schedule.

For further information on returning your product or questions concerning Ideal Manufacturing warranty, please contact Ideal Manufacturing.



Si-Low 210 A1

440 / 460 VOLT THREE PHASE

COMBINATION STARTER
513-CJB-A2H-1-42-6P
15 HP 3 PHASE 440 V
NEMA SIZE 2
30 AMP CIRCUIT BREAKER

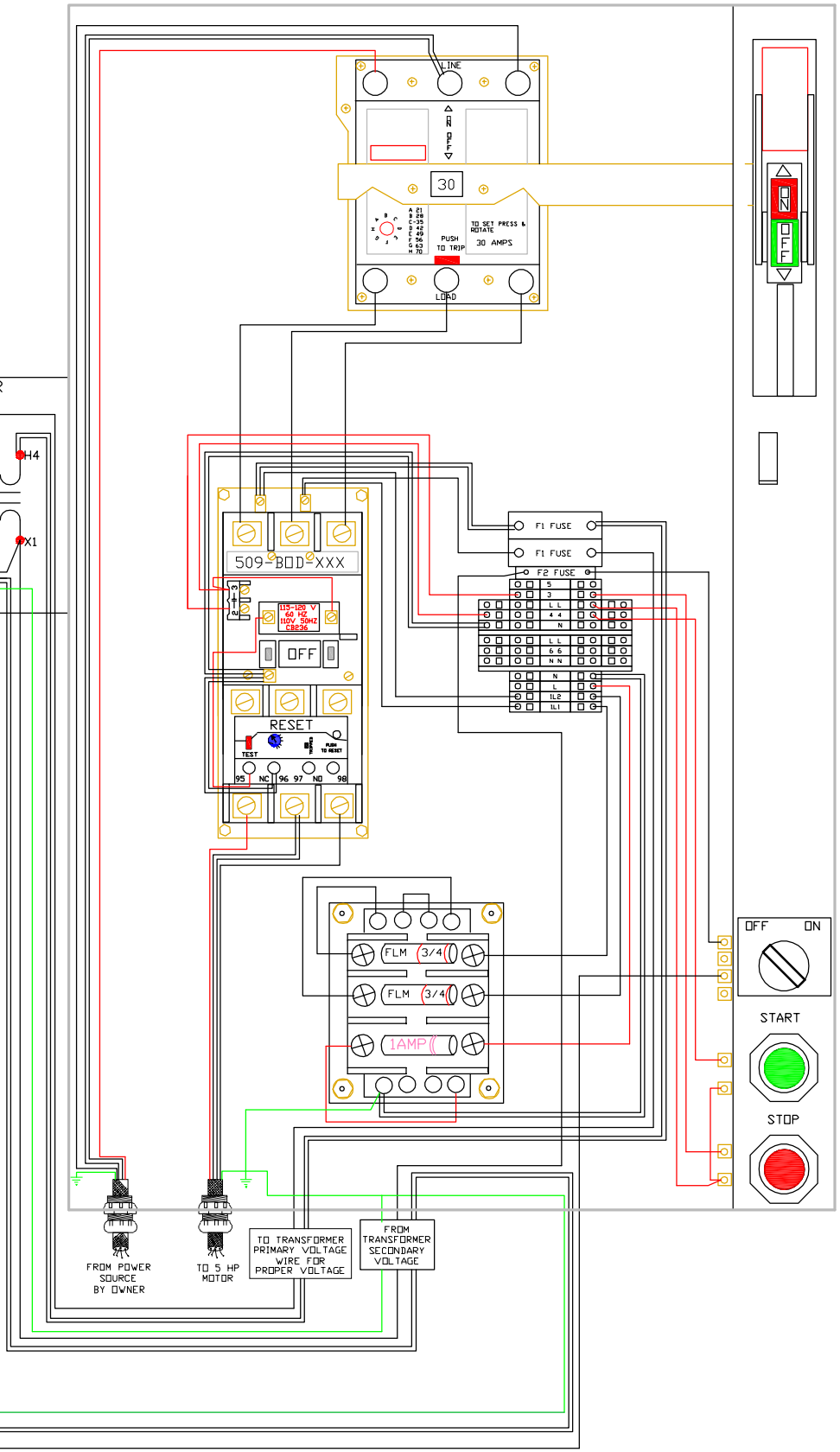
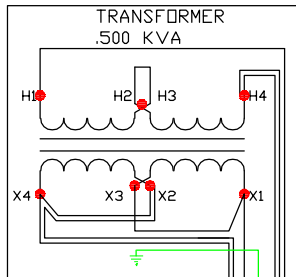
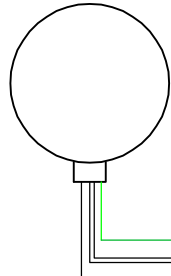
509-BOD-XXX STARTER
592-A2HC OVERLOAD RELAY
1497-N2PK 80 VA TRANSFORMER
PRIMARY FUSE 1 AMP/KLDR
SECONDARY FUSE .75 AMP/FLM
ENCLOSURE SIZE
10"W X 26 3/8"H X 8 7/32" DEEP

TRANSFORMER
.500 KVA #PE0280
DOUBLE FUSE HOLDER
F1 FUSE 3A 600V
#PE0931
FUSE #PE0932

SINGLE FUSE HOLDER
#PE0933
F2 FUSE 6.25A 250V
FUSE #PE0934

SWITCH OFF ON
#P00765

110 VOLT AC
OPTIONAL VIBRATOR



LEGEND

- WHITE
- RED
- BLACK
- GREEN

REVISIONS			IDEAL MANUFACTURING INC
NO	DATE	DESCRIPTION	281 HARRISH BLVD, BILLINGS MT, 59101 PHONE: (406)656-4360 FAX: (406)656-4363
			SI-Low 210 A1 ELECTRICAL CONTROL PANEL
			440 / 460 VOLT 3 PHASE PRIMARY 110 V SECONDARY
			4/11/2009

240 VOLT THREE PHASE

COMBINATION STARTER
 513-CJA-A2J-1-6P-42
 15 HP 3 PHASE 240 V
 NEMA SIZE 2
 100 AMP CIRCUIT BREAKER

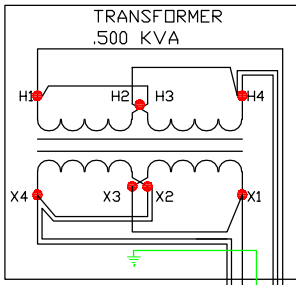
509-COD-XXX STARTER
 592-A2JD OVERLOAD RELAY
 1497--B-BASX-3N 80 VA TRANSFORMER
 PRIMARY FUSE 1 AMP/KLDR
 SECONDARY FUSE .75 AMP/FLM
 ENCLOSURE SIZE
 10"W X 26 3/8"H X 8 7/32" DEEP

TRANSFORMER
 .500 KVA #PEQ280

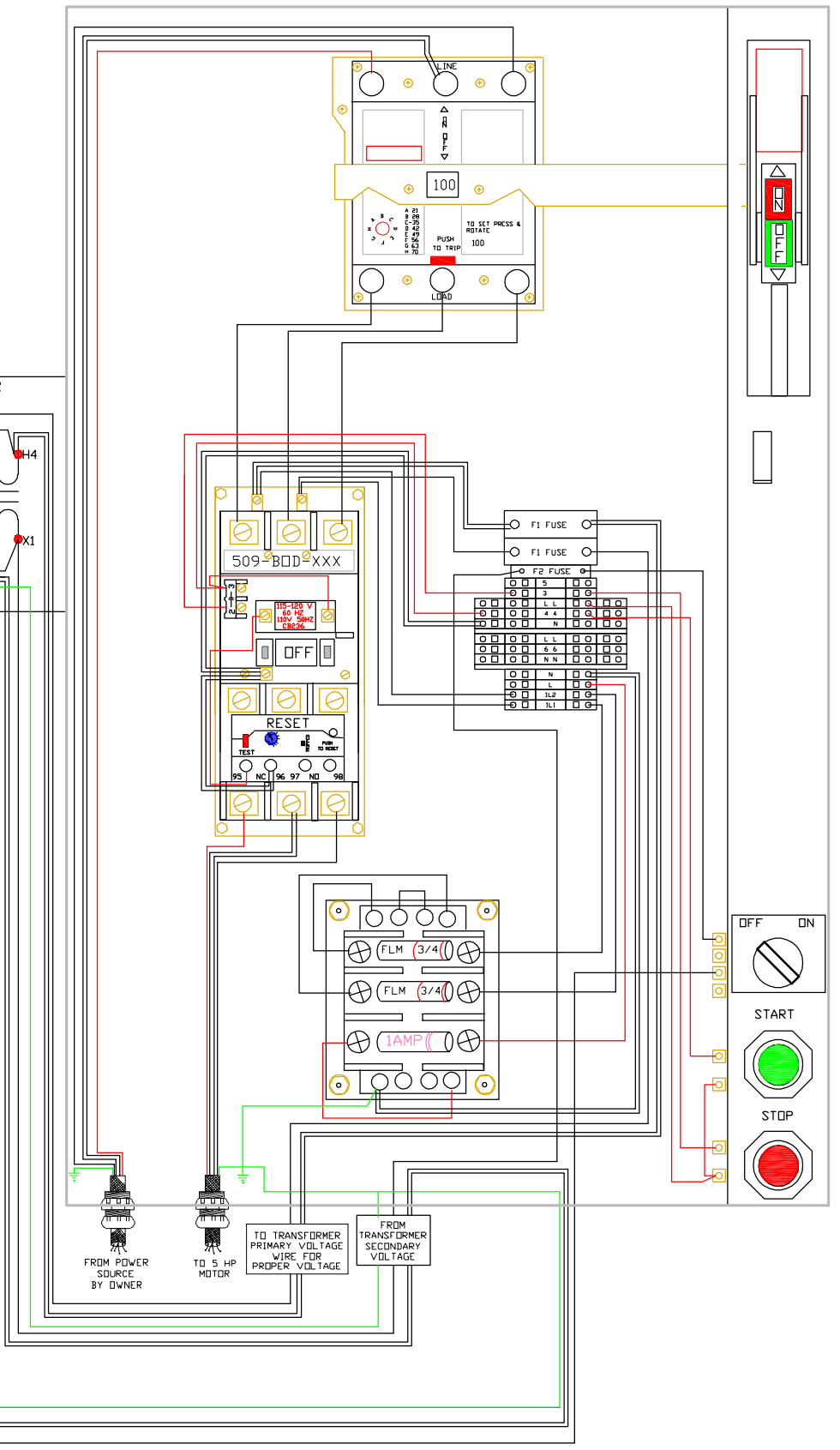
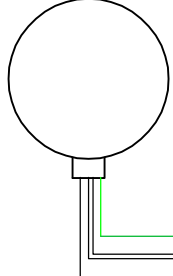
DOUBLE FUSE HOLDER
 F1 FUSE 3A 600V
 #PED931
 FUSE #PEQ932

SINGLE FUSE HOLDER
 #PED933
 F2 FUSE 6.25A 250V
 FUSE #PEQ934

SWITCH OFF ON
 #PO0765



110 VOLT AC
 OPTIONAL VIBRATOR



LEGEND

—	WHITE
—	RED
—	BLACK
—	GREEN

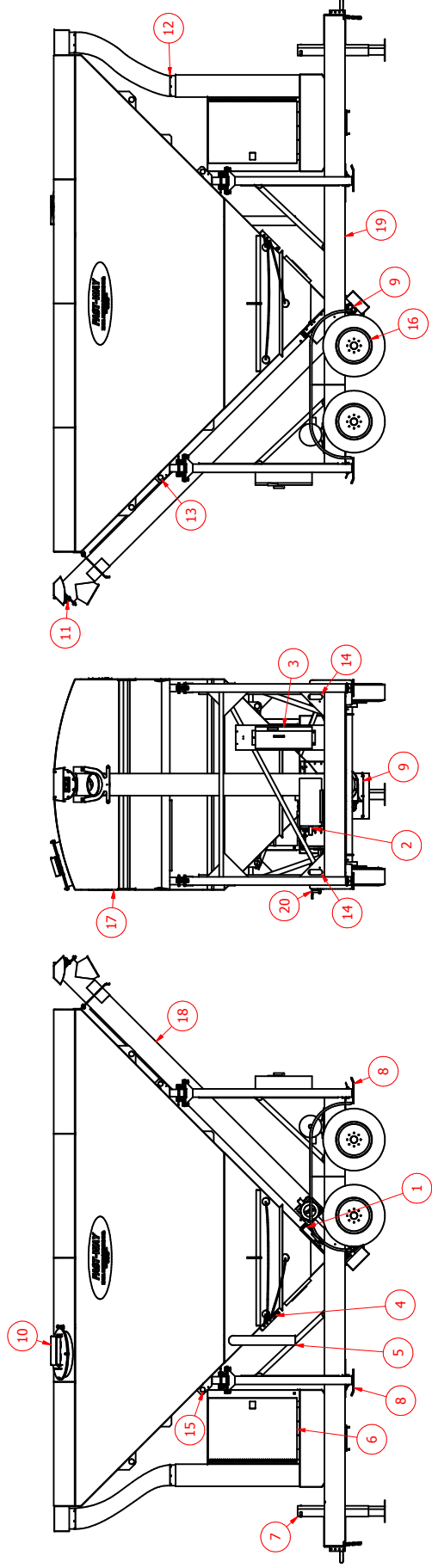
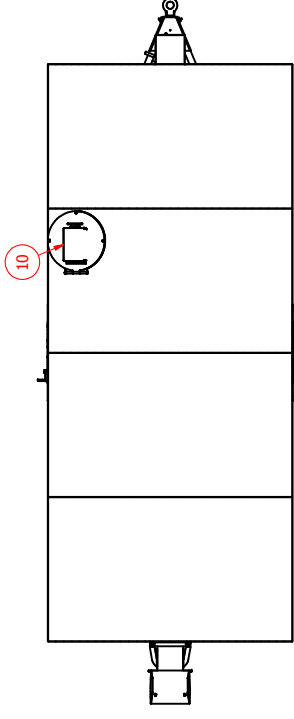
REVISIONS		
NO	DATE	DESCRIPTION

IDEAL MANUFACTURING INC. 2011 HARNISH BLVD, BILLINGS MT, 59102 PHONE: (406)656-4360 FAX: (406)656-4363	
SI-LOW 210 A1 ELECTRICAL CONTROL PANEL	
240 VOLT 3 PHASE PRIMARY 110 V SECONDARY	
THB 4/11/2019	

Si-Low 210 A1
MAIN COMPONENT LIST

REF#	DESCRIPTION	
1	Auger to Silo Slide Gate	
2	Speed Reducer and Electric Motor	
3	Electrical Box	
4	Aeration System	
5	Fill Pipe	
6	Bag Type Dust Collector and Clean Out Hopper	
7	Side-Wind Tongue Jack	
8	Adjustable Leg Assembly	
9	Auger Drive Assembly	
10	Man Hole	
11	Upper Bearing Assembly	
12	Vent Hose	
13	Red Side Marker	
14	Red Brake Light	
15	Amber Side Marker	
16	Tire and Axle Assembly	
17	Cement Silo 200 Barrel capacity (30 tons)	
18	Auger	
19	Main Frame	
20	Hand Crank for Slide Gate	

Si-Low 210 A1 General Lay Out



Si-Low 210-A1

PREPARING SILO FOR TRANSPORT

1. Most important is to be positive that all cement has been removed from silo, auger and bag-house.
2. Using a rubber mallet, hit the sidewalls of hopper section of silo; listening for a hollow sound. Clean out remaining cement. A bag of floor dry will aid in cleaning out the auger by opening the manhole on top of the silo, pour the floor dry inside of the cement silo. Turn auger on, open discharge gate. Run auger until the floor dry no longer comes out of discharge end of auger. Turn auger off and close discharge gate.
3. Disconnect air supply.
4. Disconnect electrical supply. **CAUTION! Only a qualified person should do this.**
5. Using side-wind tongue jack, raise front of cement silo until all weight is off both front legs...
6. Remove keepers from both front leg pins, slowly remove leg pins. **CAUTION! Inner leg will fall to ground. STAY CLEAR WHEN REMOVING LEG PINS.**
7. Using handle on leg pad, raise leg until pin can be installed in first hole. Install leg pin through hole, install keeper. Repeat on second leg at front of cement silo.
8. Using side-wind tongue jack, lower front of cement silo until all weight is on both rear legs.
9. Remove keepers from both leg pins; slowly remove leg pins. **CAUTION! Inner leg will fall to ground. STAY CLEAR WHEN REMOVING LEG PINS!**
10. Using handle on leg pad, raise leg until leg pin can be installed in first hole. Install leg pin through hole and install keeper. Repeat on second leg at rear of cement silo.
11. Using side-wind tongue jack, raise front of cement silo until tow vehicle can back under pintle hitch.
12. Back tow vehicle under pintle hitch, using top-wind tongue jack, lower front of cement silo onto tow vehicle hitch, secure latch. Hook safety chains and break-away cable to tow vehicle. Plug in lights, check lights for proper operation.
13. Raise top-wind jack to full up position. See drawing (Adjustable Legs) on page 23.
14. Clean all debris of silo before towing.

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SET UP PROCEDURE

1. Select a level site with solid footing for setting up and operating cement silo.
2. Block tires, to keep cement silo from moving, before unhooking tow vehicle..
3. Unhook tow vehicle, move vehicle away from cement silo.
4. Remove keepers from both leg pins at rear of cement silo. Slowly remove leg pins. CAUTION! Inner leg will fall to ground; STAY CLEAR WHEN REMOVING LEG PINS! See page 23.
5. Using side-wind tongue jack, lower front end of silo until leg pins can be installed in second hole in rear legs.
6. Install leg pins through holes in both rear legs; install keepers.
7. Remove keepers from both leg pins, at front of silo. Slowly remove leg pins CAUTION! Inner leg will fall to ground. STAY CLEAR WHEN REMOVING LEG PINS!
8. Using side-wind tongue jack, raise front of cement silo until leg pins can be installed in second hole in front legs
9. Install leg pins through holes in both front legs; install keepers.
10. Using side-wind jack, lower front of cement silo until all weight is off jack.
11. Check cement silo for level and stability. Correct as needed..
12. Connect electric power to disconnect box at rear of cement silo, using qualified person See page 2 and 3 for diagram. Check for proper rotation of Auger. Correct as needed.
13. Connect air supply to valve. Silo fluidizer aerators require 10.2 CFM @ 90 PSI with a 60 gallon tank. See drawing #110 on page 25.

SAFETY RULES

Follow instructions. Don't take chances. If you don't know, ask. When setting up lowering or putting equipment into traveling position, follow all instructions in operator's manual.

Correct or report unsafe conditions. If you are not sure of how to correct a hazard, report it and get help.

Help keep everything clean and orderly. Trips or falls can cause serious injuries.

Use the right tools and equipment for the job. Use them safely. Replace all machine guards after repairs.

Report all injuries and get first aid or medical treatment promptly.

Use, adjust and repair equipment only when authorized.

Use prescribed protective equipment. Keep it in good condition. Wear your hard hat, safety climbing devices or belt. Wear safe clothing to protect you from material being handled, cold or hot. Wear dust mask when conditions require them. Gloves, safety glasses or eye protection, and ear plugs for noise.

Don't horseplay; avoid distracting others.

When lifting, bend your knees and get help for heavy loads.

Don't repair or adjust equipment while in motion. Shut off power at source, gasoline engines or electric motors.

Gasoline, L.P. gases fumes are highly explosive.

CYCLO BEVEL BUDDYBOX LUBRICATION

NOTES: Total amount of oil needed is 0.4 gallons. Output section use 0.44 gallons. Input section use 0.22 gallons. Omala Oil 100, 150 installed at factory.

1. Cyclo input section on small units is greased packed from the factory and is maintenance free for 20,000 operating hours
2. Cyclo vertical section of units is grease packed and requires periodic replenishment.
3. Consult factory if greased lubrication of gear output section is required.
4. Before reinstalling plugs, reapply Teflon tape to threads to prevent leakage.
5. "G" denotes grease lubricated as standard.

Standard Oils

Ambient Temperature (°F)	ChevronTexaco	Exxon Oil	Mobil Oil	Shell Oil	BP Oil
14 to 41°	EP Gear Compound 68	Spartan EP 68	Mobilgear 626 (ISO) VG 68)	Omala Oil 68	Energol GR-XP 68
32 to 95°	EP Gear Compound 100, 150	Spartan EP 100 EP 150	Mobilgear 627, 629 (ISO) VG 100, 150)	Omala Oil 100, 150	GR-XP 100 GR-XP 150
86 to 122°	EP Gear Compound 220, 320, 460	Spartan EP 220 EP 320 EP 460	Mobilgear 630, 632 633, 634 (ISO VG 220-460)	Omala Oil 220, 320 460	Energol GR-XP 220 GR-XP 320 GR-XP 460

Oil Fill Quantities

Unit U.S. Gallons

*G = Grease

Frame Size	Y1		Y2		Y3		Y4		Y5		Y6	
	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input
2A100, 2A105		G		G		G		G		G		G
2A110, 2A115	0.29	G	0.26	G	0.29	G	0.26	G	0.45	G	0.42	G
2A120, 2A125		G		G		G		G		G		G
2A140, 2A145		0.08		G		0.08		G		0.08		0.08
2B120, 2B125		G		G		G		G		G		G
2B140, 2B145	0.48	0.12	0.37	G	0.48	0.12	0.48	G	0.61	0.12	0.66	0.12
2B160, 2B165		0.20		G		0.20		G		0.20		0.20
2C140, 2C145		0.12		G		0.12		G		0.12		0.12
2C160, 2C165	0.87	0.20	0.92	G	0.87	0.20	1.16	G	0.95	0.20	1.4	0.20
2C170, 2C175		0.28		G		0.28		G		0.28		0.28
2D160, 2D165	1.16	0.18	1.32	G	1.16	0.18	1.11	G	1.48	0.18	1.59	0.18
2D170, 2D175		0.24		G		0.24		G		0.24		0.24
2E170, 2E175	1.95	0.24	1.93	G	1.95	0.24	1.59	G	1.90	0.24	2.80	0.24

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OPERATING PROCEDURE

A. CHARGING SILO

1. Close silo discharge gate, (REF# 1)
2. Air pump cement through filler pipe, (REF# 5))
3. You must open ball valve on side of bag-house to operate vibrator to clean filter bags each time after filling silo. (REF #6). Vibrator requires 4.5 CFM @ 60 PSI or 5.5 CFM @ 80 PSI. Or open side doors and manually shake bags.
4. Open cleanout gate, at bottom of bag-house hopper, remove over flow cement from hopper; close gate. (REF #6)

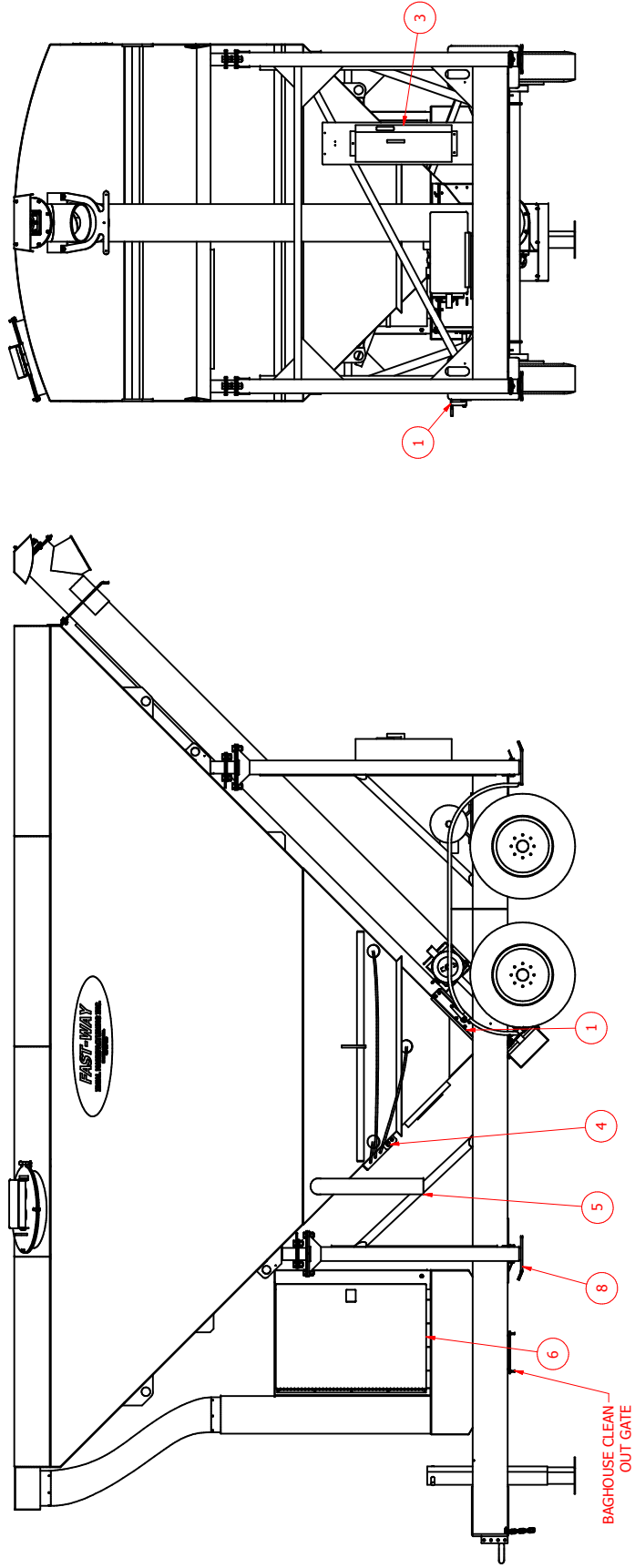
B. AUGER OPERATION

1. Raise disconnect handle on electrical panel to ON position. (REF #3).
2. Open discharge gate. (REF#1)
3. Turn air supply on. (Supplied by customer)
4. Open ball valve on aerator system for one minute.(REF# 4) Close ball valve. If optional pulse system is purchased turn air valve control to ON position. (REF# 3). (Optional)
5. Push start button, (REF # 3). Auger will start. Turn vibrator on. Optional aerators will pulse on for three seconds, off for seven seconds, until stop button is pushed.

NOTE: If slower delivery of cement is needed; close discharge gate to get desired amount.

6. Fill unit with cement.
7. When unit is filled push stop button, and turn vibrator off. (REF #3)
8. Close discharge gate. (REF # 1).
9. Lower disconnect handle on electrical panel to OFF position. (REF #3).
10. NOTE: The auger should be emptied on last load of the shift. Discharge boot should be rolled up and secured to keep moisture out of auger tube to prevent build up on auger screw.

Si-Low 210 A1 Operating Procedure



Si-Low 210-A 1 AUGER DRIVE COMPONENTS

SL210 A1-201

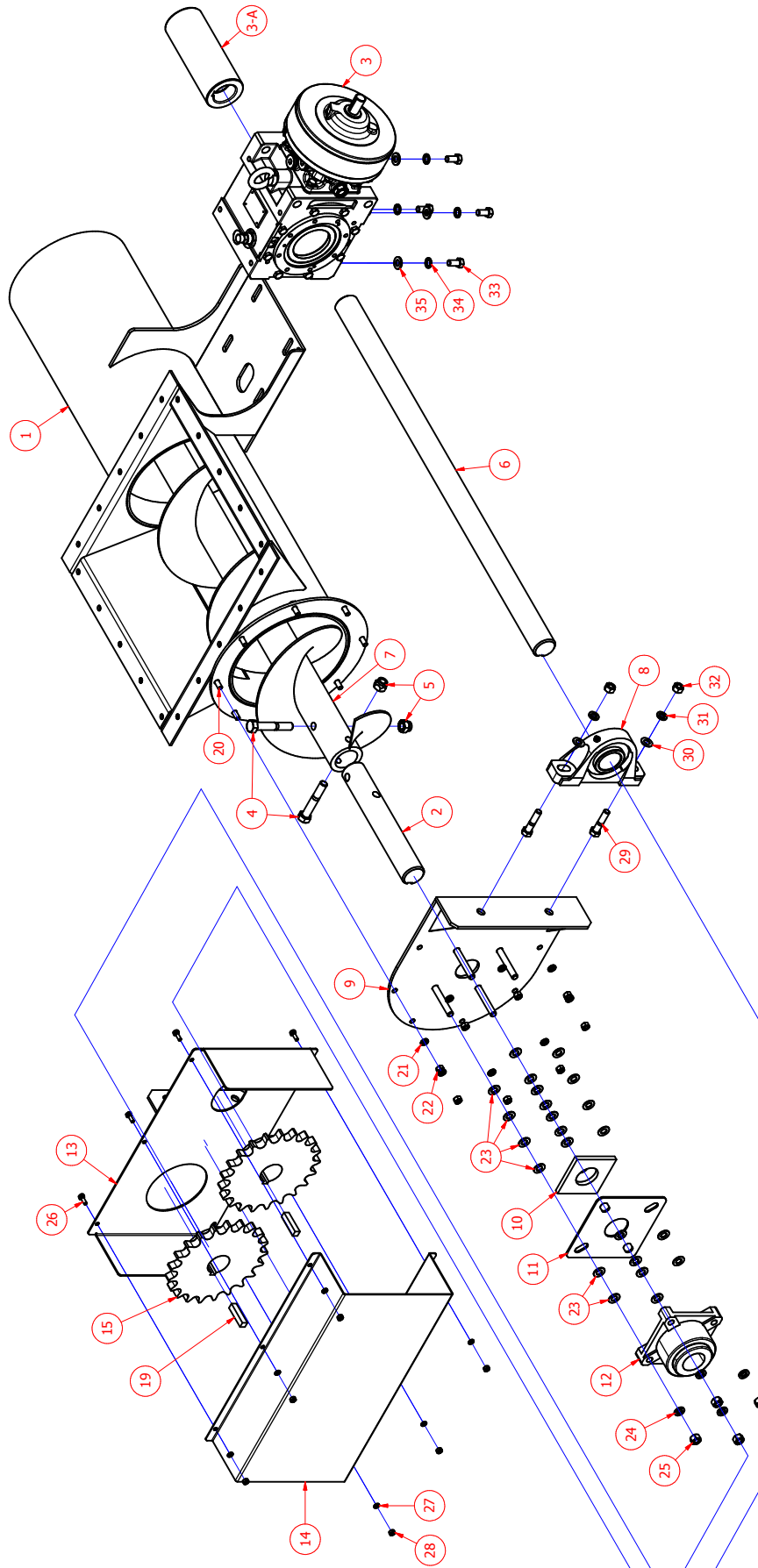
REF NO.	PART NO.	DESCRIPTION	REQ'D
1	SLO301	Auger Assembly	N/A
2	POO677	Electric Motor	1
2-A	POO637	Diesel Engine	1
2-B	POO638	Gas Engine	1
3	POO676	Speed Reducer	1
4	POO679	2TB66 Sheave	1
4-A	POO636	Pulley Clutch (Diesel & Gas Engine)	1
5	POO681	P 1 5/8 Bushing	1
6	POO138	2BK47H Sheave (Electric Motor)	1
6-A	POO649	2BK60H Sheave (Diesel Engine)	1
6-B	POO233	2BK70H Sheave (Gas Engine)	1
7	POO680	H 7/8 Bushing	1
8	SLO310	Drive Mounting Frame	1
9	SLO311	Silo Frame	N/A
10	N/A	1/2-13 x 18 All Thread	2
11	N/A	1/2-13 Hex Nut	16
12	NA	1/2 Lock washer	12
13	NA	1/2 USS Flat washer	16
14	NA	1/2-13 x 2" Hex Bolt	4
15	NA	1/2-13 x 2 1/2" Hex Bolt	4
16	NA	3/8-16 x 1" Hex Bolt	8
17	NA	3/8 Lock Washer	8
18	NA	3/8-16 Hex Nut	8
19	NA	3/8 USS Flat Washer	8
20	NA	M 12 Flat Washer (speed reducer not shown)	4
21	NA	M 12 Lock Washer (speed reducer not shown)	4
22	NA	M 12-1.75 X 25 MM Bolt (speed reducer not shown)	4
23	NA	1/4-20 x 3/4 Hex Bolt	8
24	NA	1/4 Lock Washer	8
25	NA	1/4-20 Hex Nut	8
26	SLO312	Belt Guard Back	1
27	SLO313	Belt Guard Cover	1
28	N/A	3/16 x 3/16 x 1 3/8 Key Stock	1
29	N/A	3/8 x 3/8 x 2 3/4 Key Stock	1
30	POO767	B-96 V Belt	2
31	SLO314	Guard Mount Front	1
32	SLO315	Guard Mount Rear	1

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LOWER AUGER ASSEMBLY SL210 A1-212

REF NO.	PART NO.	DESCRIPTION	REQ'D
1	SLO301	Auger Assembly	N/A
2	SLO343	Lower Auger Shaft	1
3	POO676	Speed Reducer	1
3A	POO795	Bushing	1
4	N/A	5/8-11 x 4 Hex Bolt (not shown)	2
5	N/A	5/8-11 Lock Nut (not shown)	2
6	SLO344	Auger Drive Shaft	1
7	SLO342	Auger Flighting	1
8	POO791	Pillow Block Bearing	1
9	SLO345	Auger Flange Drive End	1
10	POO689	Felt Seal 6 x 6	1
11	SLO346	Felt Seal Plate	1
12	POO790	Flange Block Bearing	1
13	SLO306	Chain Guard Back	1
14	SLO307	Chain Guard Cover	1
15	POO793	Drive Sprocket	2
16	POO688A	Off Set Link (not shown)	1 (if needed)
17	POO688	Roller Chain (not shown)	1
18	POO688B	Master Link (not shown)	1
19	SLO308	1/2 x 1/2 x 2 1/4" Key Stock	2
20	N/A	3/8-16 x 1" Hex Bolt	6
21	N/A	3/8" Lock Washer	6
22	N/A	3/8" Hex Nut	6
23	N/A	1/2 USS Flat Washer	32
24	N/A	1/2 Lock Washer	4
25	N/A	1/2-13 Hex Nut	4
26	N/A	1/4-20 x 1" Hex Bolt	6
27	N/A	1/4" Lock Washer	6
28	N/A	1/4-20 Hex Nut	6
29	N/A	1/2-13 x 3" Hex Bolt	2
30	N/A	1/2 SAE Flat Washer	2
31	N/A	1/2 Lock Washer	2
32	N/A	1/2-13 Hex Nut	2
33	N/A	M 12-1.75 X 25 MM	4
34	N/A	M 12 Lock Washer	4
35	N/A	M 12 Flat Washer	4

LOWER AUGER ASSEMBLY



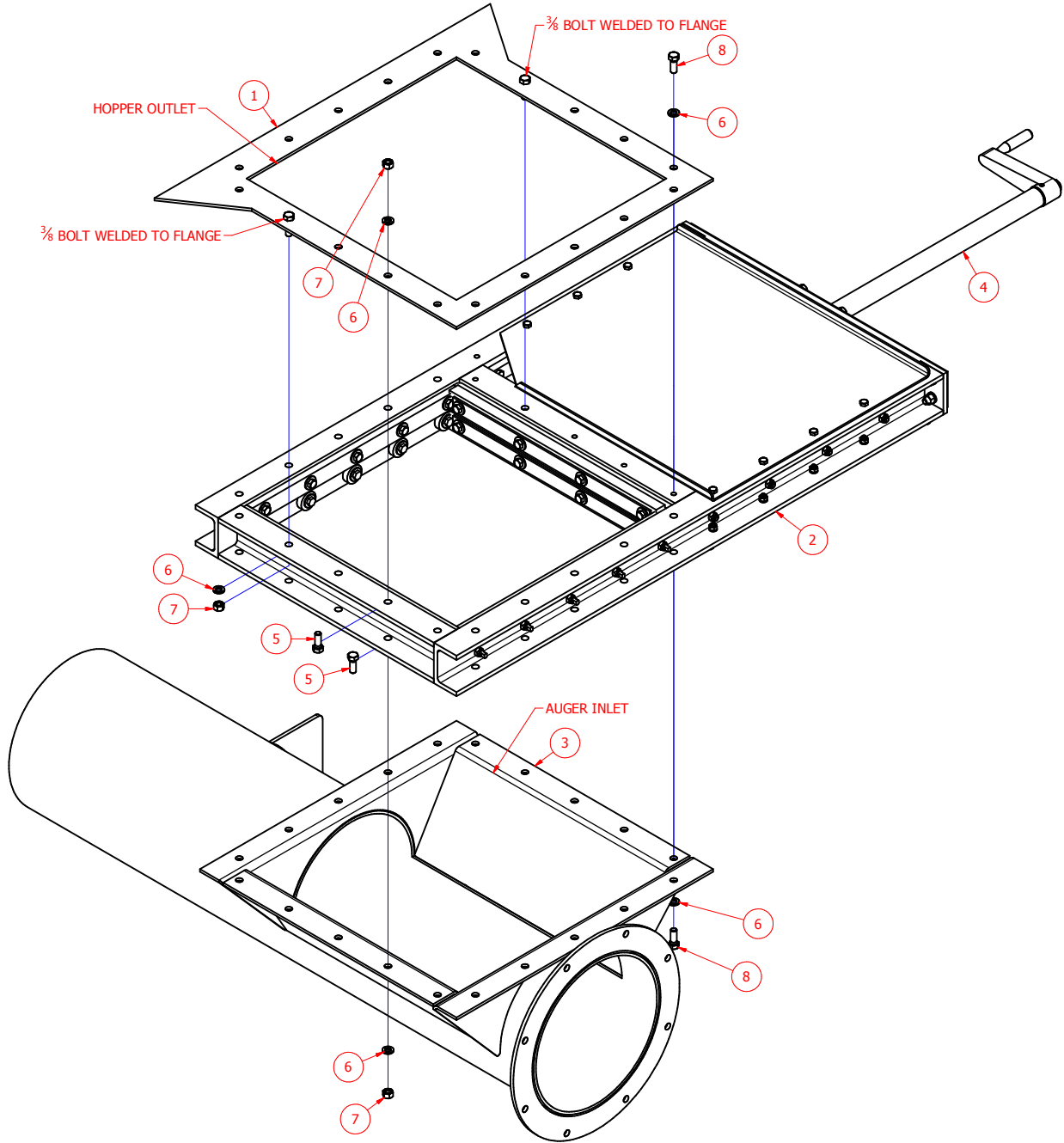
REMOVE ALL BURRS	PROJECTION	DRAWN T. Henry	4/9/2019	2011 Harnish Blvd. Billings MT 59101	Ideal Mfg., Inc. Tel. (406) 656-4360
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CHECKED QA		TITLE	
TOLERANCES ARE:		MFG		SI-LOW 210 A1	
.XX ± .01		APPROVED		SIZE	DWG NO
.XXX ± .005		WEIGHT		C	SL210 A1-212
FRACTIONS ± 1/2				SCALE	
ANGLES ± 1°					
DRILLED HOLE ± 1/4					

Si-Low 210-A1

AUGER TO SLIDE GATE TO SILO SL210 A1-202

REF NO.	PART NO.	DESCRIPTION	REQ'D
1	SLO318	Silo (flange)	1
2	POO783 I	Slide Gate	1
3	SLO301	Auger Assembly	1
4	F00173A	Gate Handle Extension	1
5	N/A	3/8-16 x 1 1/4 Hex Bolt	29
6	N/A	3/8 Lock Washer	40
7	N/A	3/8-16 Hex Nut	31
8	N/A	3/8-16 X 1 Hex Bolt	9

AUGER TO SLIDE GATE TO SILO

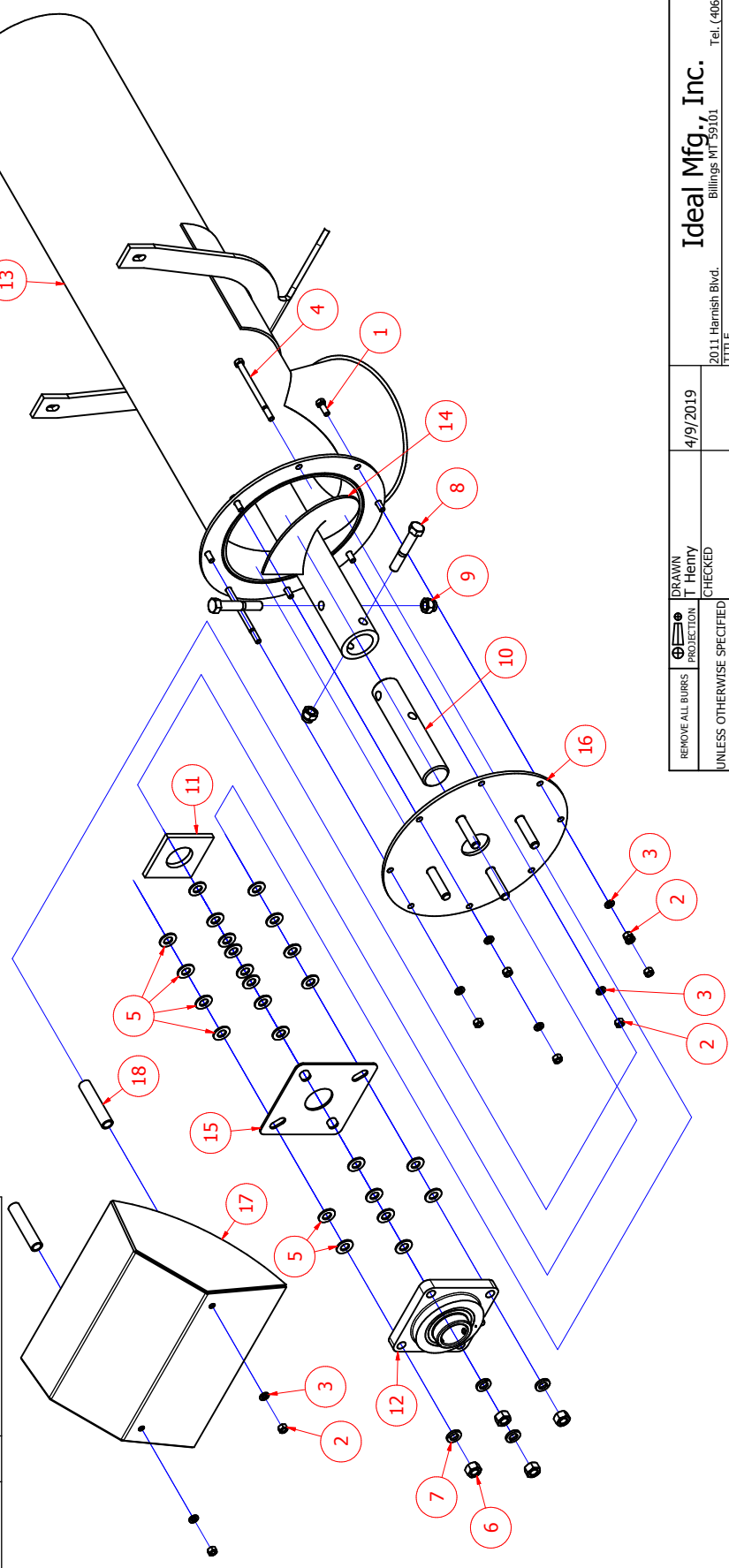


REMOVE ALL BURRS	PROJECTION	DRAWN T Henry	4/9/2019	Ideal Mfg., Inc. 2011 Harnish Blvd. Billings MT 59101 Tel. (406) 656-4360	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: .XX ± .01 .XXX ± .005 FRACTIONS ± 1/32 ANGLES ± 1° DRILLED HOLE ± 1/64		CHECKED			
		QA		Si-Low 210 A1	
		MFG		SIZE	DWG NO
		APPROVED		C	SL210 A1-202
		WEIGHT	241.8 lbmass	SCALE	REV
					SHEET 1 OF 1

4 3 2 1

UPPER AUGER ASSEMBLY

ITEM	PART NUMBER	QTY	DESCRIPTION
1	N/A	6	3/8-16 X 1 HEX BOLT
2	N/A	8	3/8-16 HEX NUT
3	N/A	8	3/8 LOCK WASHER
4	N/A	2	3/8-16 X 5 1/2 HEX BOLT
5	N/A	24	5/8 USS FLAT WASHER
6	N/A	4	5/8-11 HEX NUT
7	N/A	4	5/8 LOCK WASHER
8	N/A	2	5/8-11 X 4 HEX BOLT
9	N/A	2	5/8-11 NYLOCK HEX NUT
10	F00174	1	UPPER AUGER SHAFT
11	POO689	1	FELT SEAL
12	POO792	1	FLANGE BLOCK BEARING
13	SLO301	1	AUGER ASSEMBLY
14	SLO342	1	AUGER FLIGHT ASSEMBLY
15	SLO346	1	FELT SEAL PLATE
16	SLO347	1	UPPER AUGER FLANGE
17	SLO350-1	1	RAIN CAP
18	SLO351-1	2	SPACER

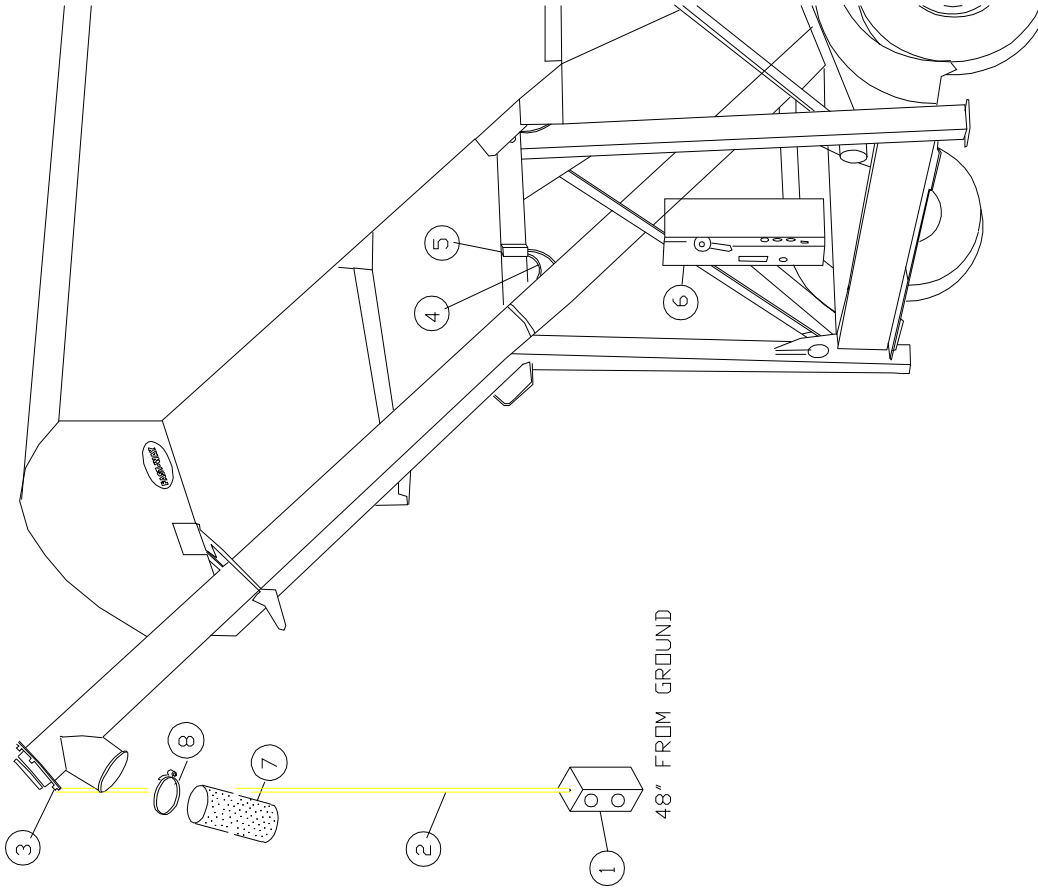


REMOVE ALL DIMS PROJECTION UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: .XX ± .01 .XXX ± .005 FRACTIONS ± 1/2 ANGLES ± 1° DRILLED HOLE ± 1/4	DRAWN T Henry CHECKED QA MFG APPROVED WEIGHT N/A	4/9/2019	Ideal Mfg., Inc. 2011 Harnish Blvd. Billings MT 59101 Tel. (406) 656-4360
TITLE SI-LOW 210 A1		SCALE C	DWG NO SL210 A1-207
SHEET 1 OF 1		REV	REV

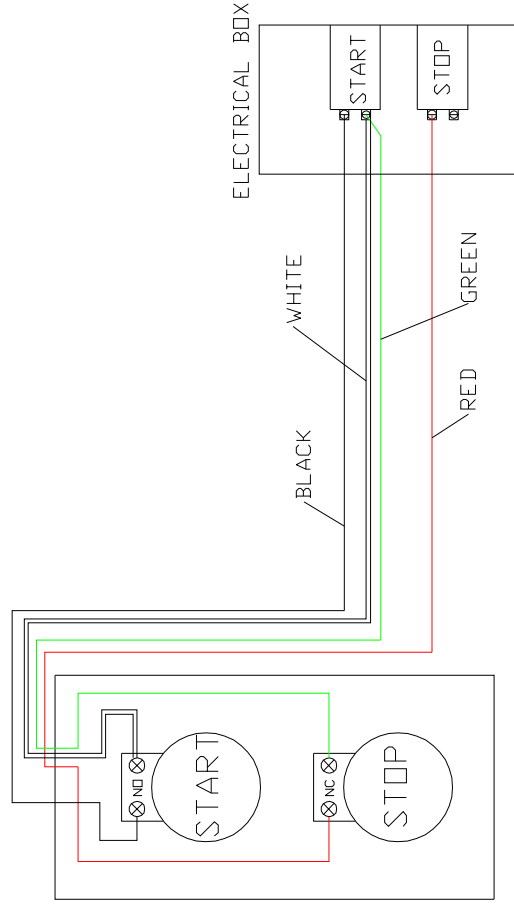
18 4 B I 4

Si-Low 210-A1

OPTIONAL CONTROL SYSTEM



REF NO.	PART NO.	DESCRIPTION	REQ NO
1	POO772	Control Station	1
3	N/A	DG-4 Clamp	2
4	N/A	16/4 Electrical Wire 25'	1
5	PEO246	3- Cord Connector	1
6	POO908	Electrical Box 220 three phase	1
6	POO907	Electrical Box 440 three phase	1
7	POO691	Discharge Boot	1
8	POO121	Hose Clamp	1



NOTE: REMOVE RED JUMPER BETWEEN START AND STOP SWITCHES

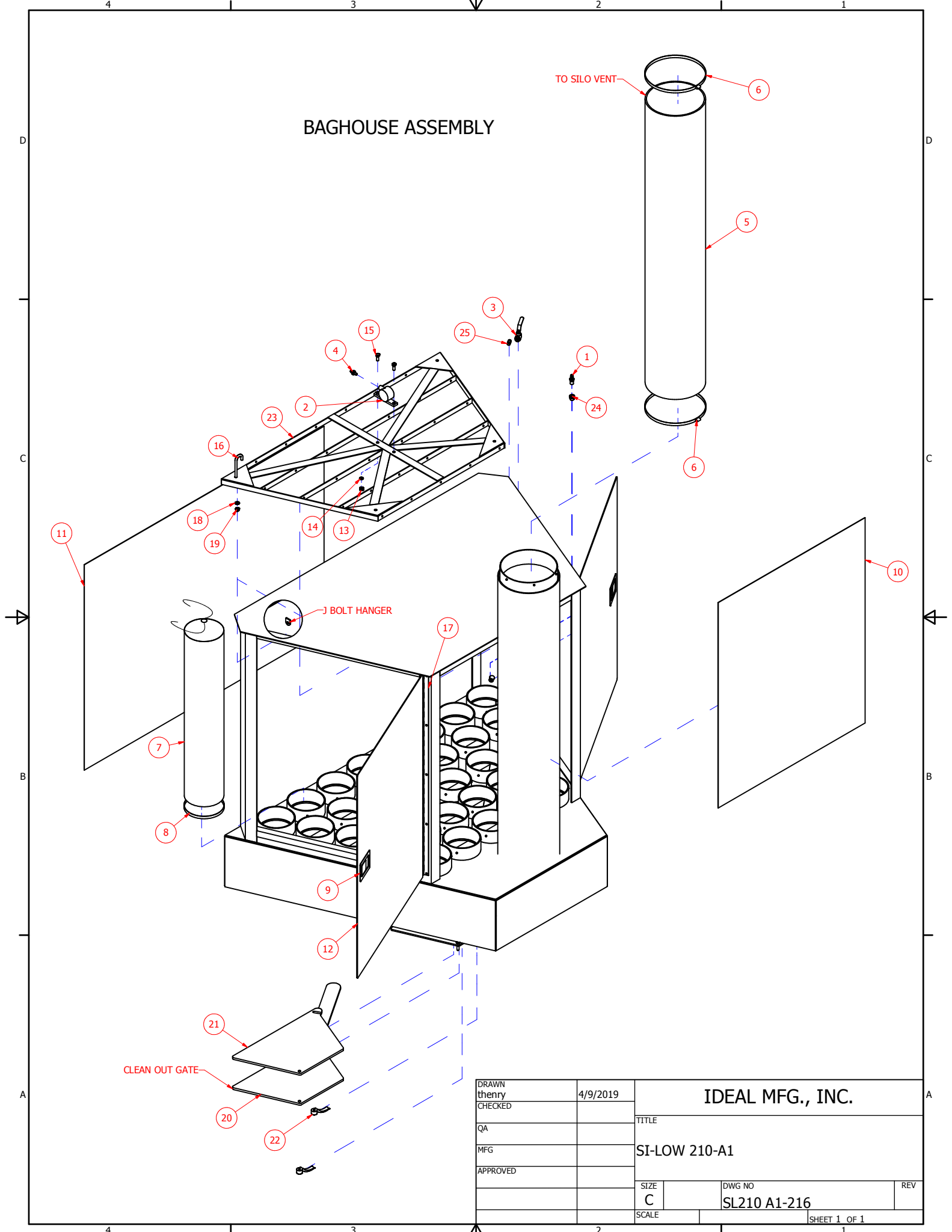
4-13-2015 206 M-09

Si-Low 210-A1

BAGHOUSE ASSEMBLY

REF NO.	PART NO.	DESCRIPTION	REQ'D
	SLO320	Baghouse Hopper	1 (Factory Installed)
1	POO723	1/4 Hose Barb	1
2	POO643	Vibrator	1
3	POO641	¼ Ball Valve	1
4	POO721	1/8 Hose Barb	1
5	POO695	Vent Hose	1
6	POO192	Vent Hose Clamp	2
7	POO364	Filter Bag	32
8	POO193	Filter Bag Clamp	32
9	ID1210	Door Latch	2
10	SLO354	Front Panel	1
11	SLO355	Rear Panel	1
12	SLO356	Door	2
13	NA	3/8-16 Hex Nut	2
14	NA	3/8 Lock Washer	2
15	NA	3/8-16 X 1 Hex Bolt	2
16	POO720	3/8-16 x 5 J Bolt	4
17	FGO104	SS Hinge	2
18	N/A	3/8 Flat Washer	4
19	NA	3/8-16 NyLock Nut	4
20	SLO341	Cleanout Gate	1
21	POO693	Gate Seal	1
22	POO776	EZ Grip Nut	2
23	SLO358	Bag Hanger	1
24	OTO140	1/4 90° Street Elbow	1
25	POO428	1/4 Close Nipple	1

BAGHOUSE ASSEMBLY



DRAWN	4/9/2019	IDEAL MFG., INC.		
thentry		TITLE		
CHECKED		SI-LOW 210-A1		
QA		SIZE	DWG NO	REV
MFG		C	SL210 A1-216	
APPROVED		SCALE	SHEET 1 OF 1	

Si-Low 210-A1

SILO BAGHOUSE

SUBJECT: Silo Baghouse (Air Filtering System)

PURPOSE: To prevent cement dust from entering the atmosphere during the filling process of the storage vessel.

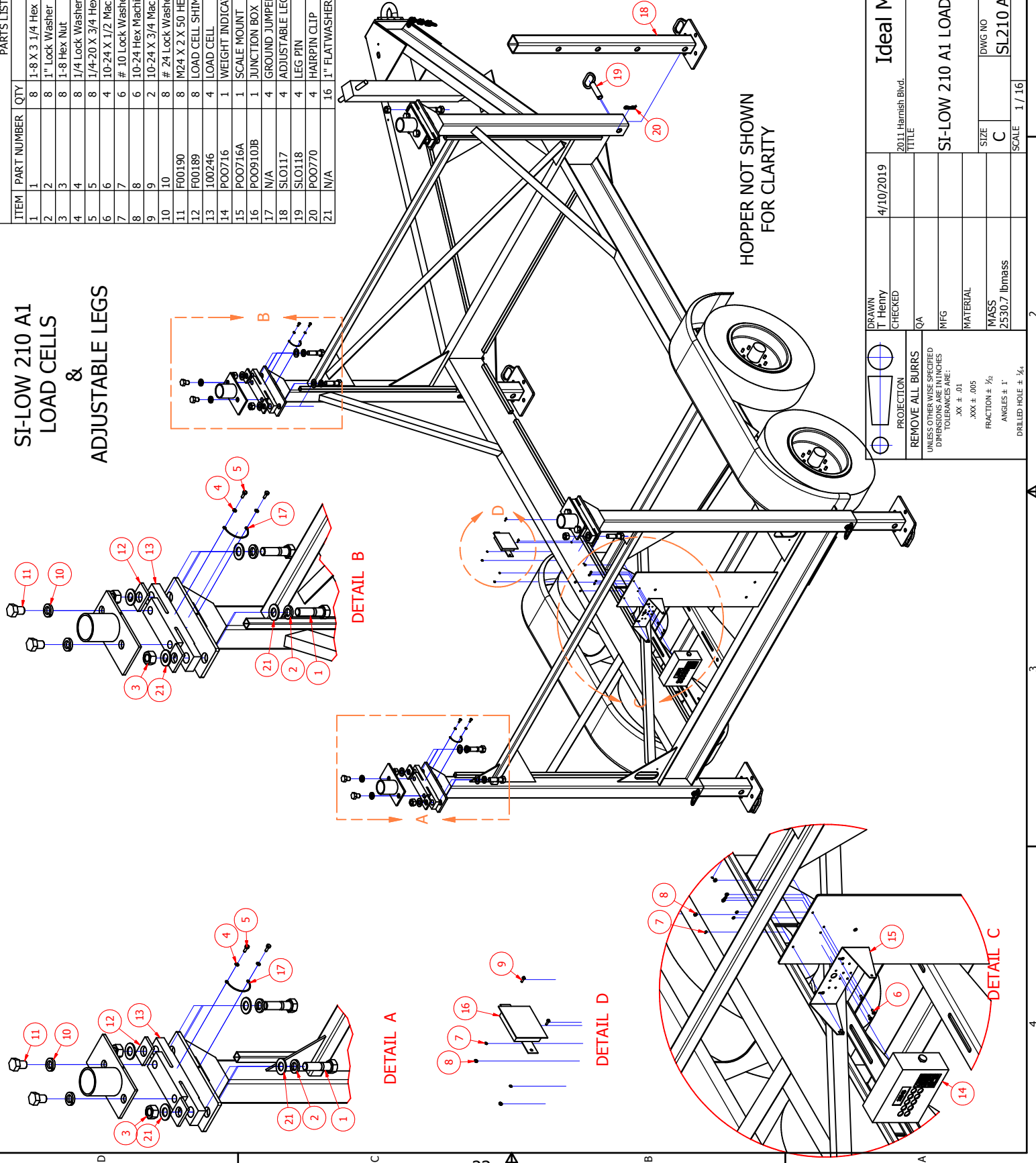
DESCRIPTION: Filters:
Quantity - 32
Material - 10 oz polyester material -
25 cfm per square foot
Filter Surface - (each) 784 sq. in. = 5.44 sq. ft
Total square feet of filter material = 174.2 sq. ft.
Total cfm at 25 cfm per square foot = 4355 cfm

MAINTENANCE: J bolt upper bag mount that facilitates bag shaking by pneumatic vibrator, or manual action to result in filter bag cleaning. Clean out Hopper.

EFFICIENCY: 99.8%

SI-LOW 210 A1 LOAD CELLS & ADJUSTABLE LEGS

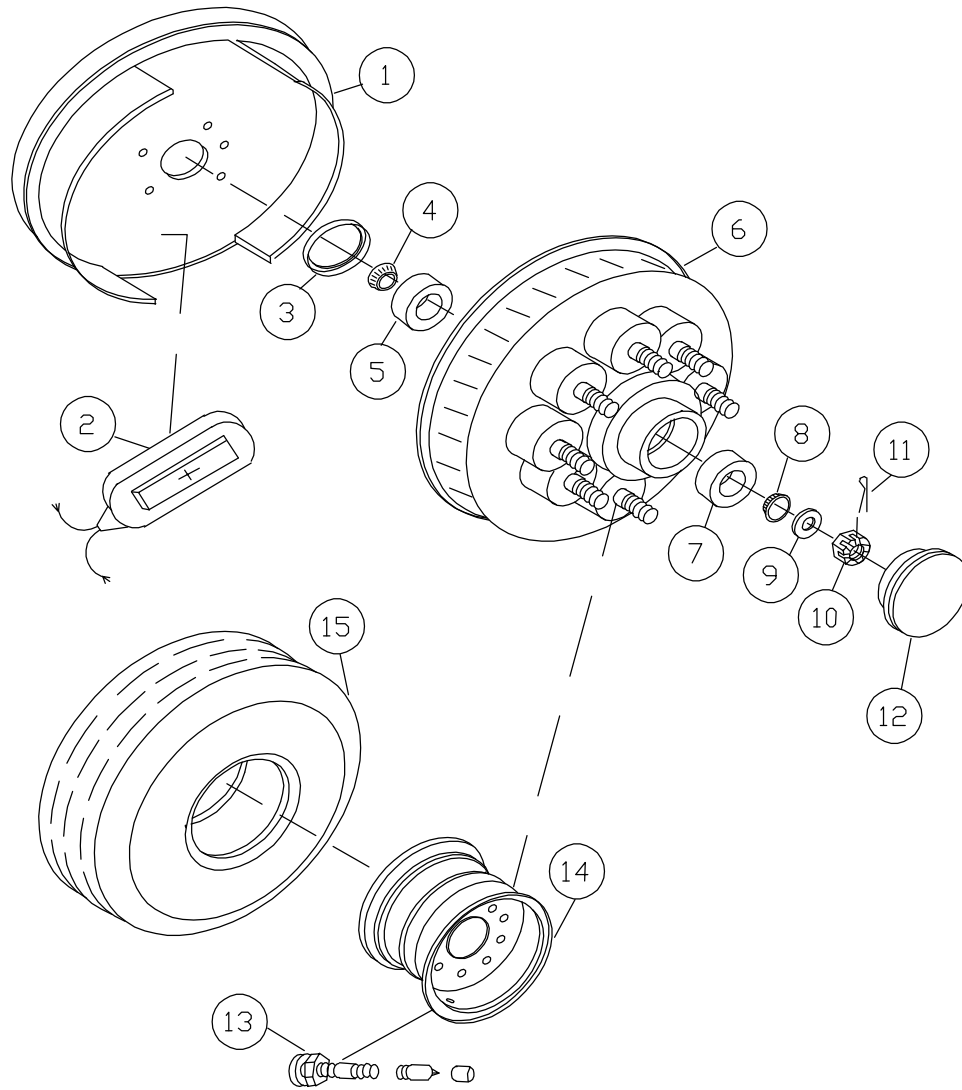
ITEM	PART NUMBER	QTY	DESCRIPTION
1		8	1-8 X 3 1/4 Hex Bolt
2		8	1" Lock Washer
3		8	1-8 Hex Nut
4		8	1/4 Lock Washer
5		8	1/4-20 X 3/4 Hex Bolt
6		4	10-24 X 1/2 Machine Screw
7		6	# 10 Lock Washer
8		6	10-24 Hex Machine Screw Nut
9		2	10-24 X 3/4 Machine Screw
10		8	# 24 Lock Washer (Metric Series)
11	F00190	8	M24 X 2 X 50 HEX BOLT MACHINE TO 1 1/4 LONG
12	F00189	8	LOAD CELL SHIM
13	100246	4	LOAD CELL
14	PO0716	1	WEIGHT INDICATOR
15	PO0716A	1	SCALE MOUNT
16	PO0910JB	1	JUNCTION BOX
17	N/A	4	GROUND JUMPER
18	SLO117	4	ADJUSTABLE LEG
19	SLO118	4	LEG PIN
20	PO0770	4	HAIRPIN CLIP
21	N/A	16	1" FLATWASHER



HOPPER NOT SHOWN
FOR CLARITY

DRAWN T. Henry		4/10/2019	Ideal Mfg., Inc.	
CHECKED			2011 Harnish Blvd. Billings MT 59101	
QA			TITLE	
MFG			SI-LOW 210 A1 LOAD CELLS	
MATERIAL			REV	
MASS			SIZE	
2530.7 lbmass			C	
			DWG NO	
			SL210 A1-208	
			SCALE	
			1 / 16	
			SHEET 1 OF 1	

PROJECTION
REMOVE ALL BURRS
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
.XX ± .01
.XXX ± .005
FRACTION ± 1/32
ANGLES ± 1'
DRILLED HOLE ± 1/64

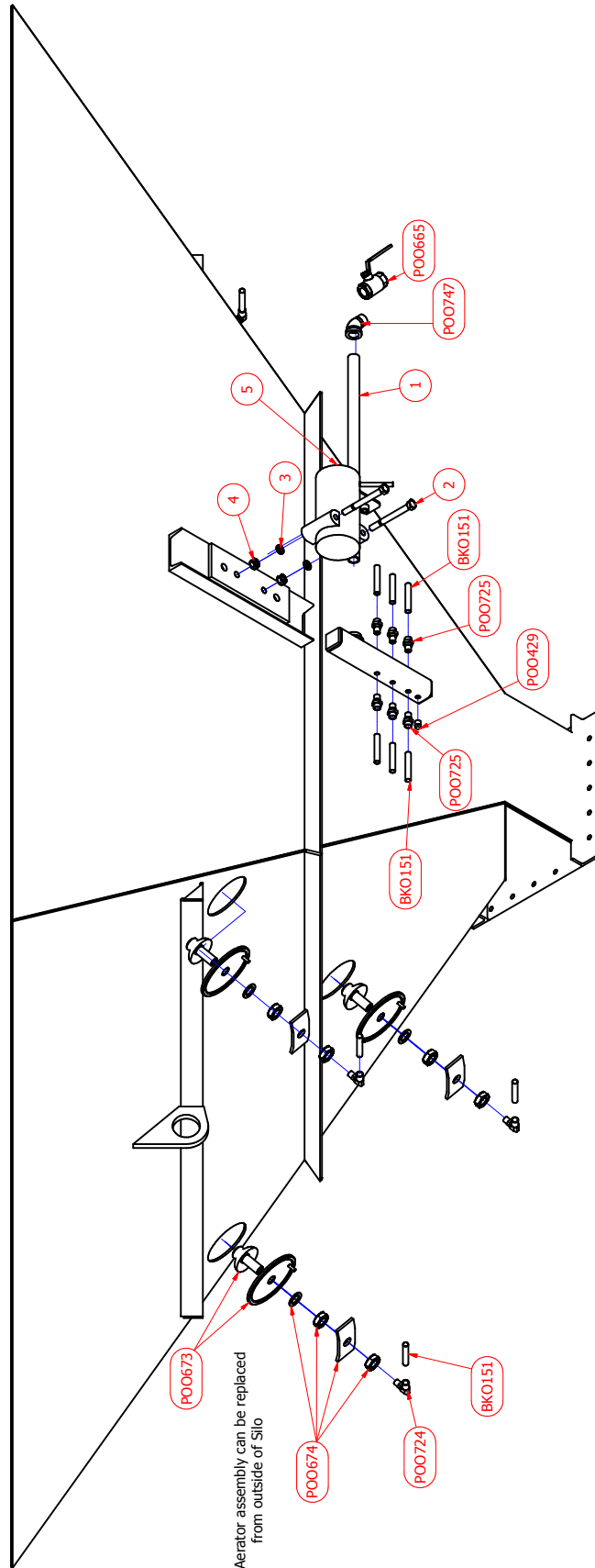


**Si-Low 210-A1
SILO TRAILER WHEEL COMPONENTS**

REF NO.	PART NO.	DESCRIPTION	REQ NO
1	POO831	Right Brake Assembly	2
	POO832	Left Brake Assembly	2
2	POO833	Actuator Magnet Kit	4
3	POO834	Inner Grease Seal	4
4	POO835	Inner Bearing	4
5	POO836	Inner Bearing Race	4
6	POO837	Hub & Brake Drum	4
7	POO838	Outer Bearing Race	4
8	POO839	Outer Bearing	4
9	POO840	Spindle Washer	4
10	POO841	Spindle Nut	4
11	N/A	5/32 x 1 1/2" Cotter Pin	4
12	POO842	Dust Cap	4
13	POO843	Valve Stem Assembly	4
14	POO844	Tire Rim	4
15	POO845	Tire	4
16	POO846	Tire Rim Lug Bolts	32

SI-LOW 210-A1 VIBRATOR & AERATION SYSTEM

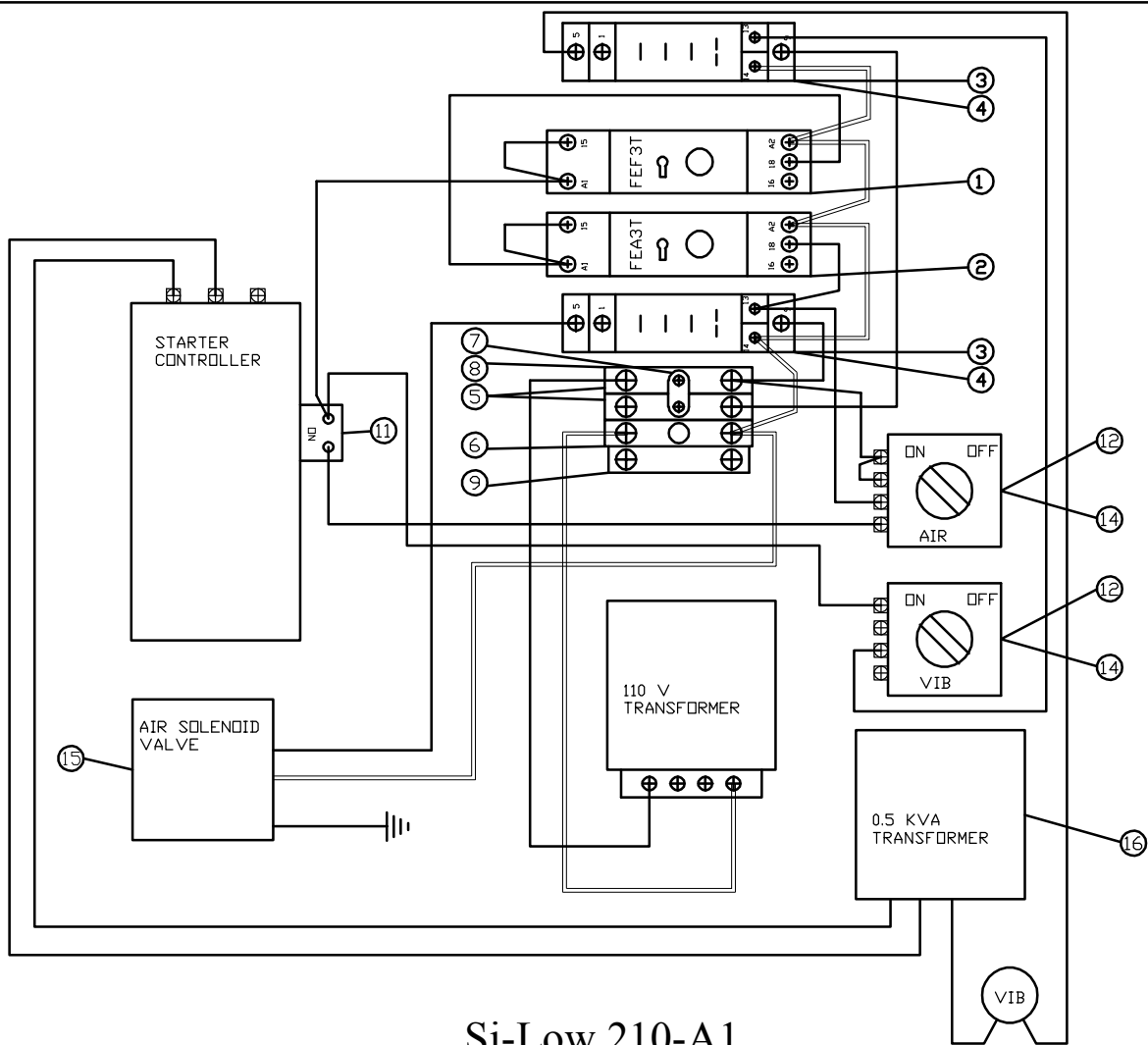
REF. NO.	PART NUMBER	DESCRIPTION	QTY
1	N/A	3/4 SCH 40 PIPE X 28 1/2	1
2	N/A	Hex Bolt 1/2-13 X 5	2
3	N/A	Lock Washer 1/2	2
4	N/A	Hex Nut 1/2-13	2
5	PO0530	VIBRATOR 110 VAC	1
	PO0531	VIBRATOR 12 VDC	
	PO0781	VIBRATOR AIR PISTON	
	BKO151	1/2 POLY TUBE	12
	PO0429	1/4"NPT PLUG	1
	PO0665	3/4" BALL VALVE	1
	PO0673	AERATOR ASSEMBLY	6
	PO0674	EZ IN KIT	6
	PO0724	TUBE FITTING	6
	PO0725	TUBE FITTING	6
	PO0747	45 Deg Street Elbow	1



Note: Aerator assembly can be replaced from outside of Silo

NOTE: See page 26 for wiring for 110 volt AC vibrator.
NOTE: See page 29 for wiring for 12 volt dc vibrator.

DRAWN T.Henry	3/31/2017	IDEAL MFG., INC.	
CHECKED		TITLE	
QA		SI-LOW 210-A1	
MFG		SIZE	DWG NO
APPROVED		C	SL210 A1-210
		SCALE	REV
			1
			SHEET 1 OF 1

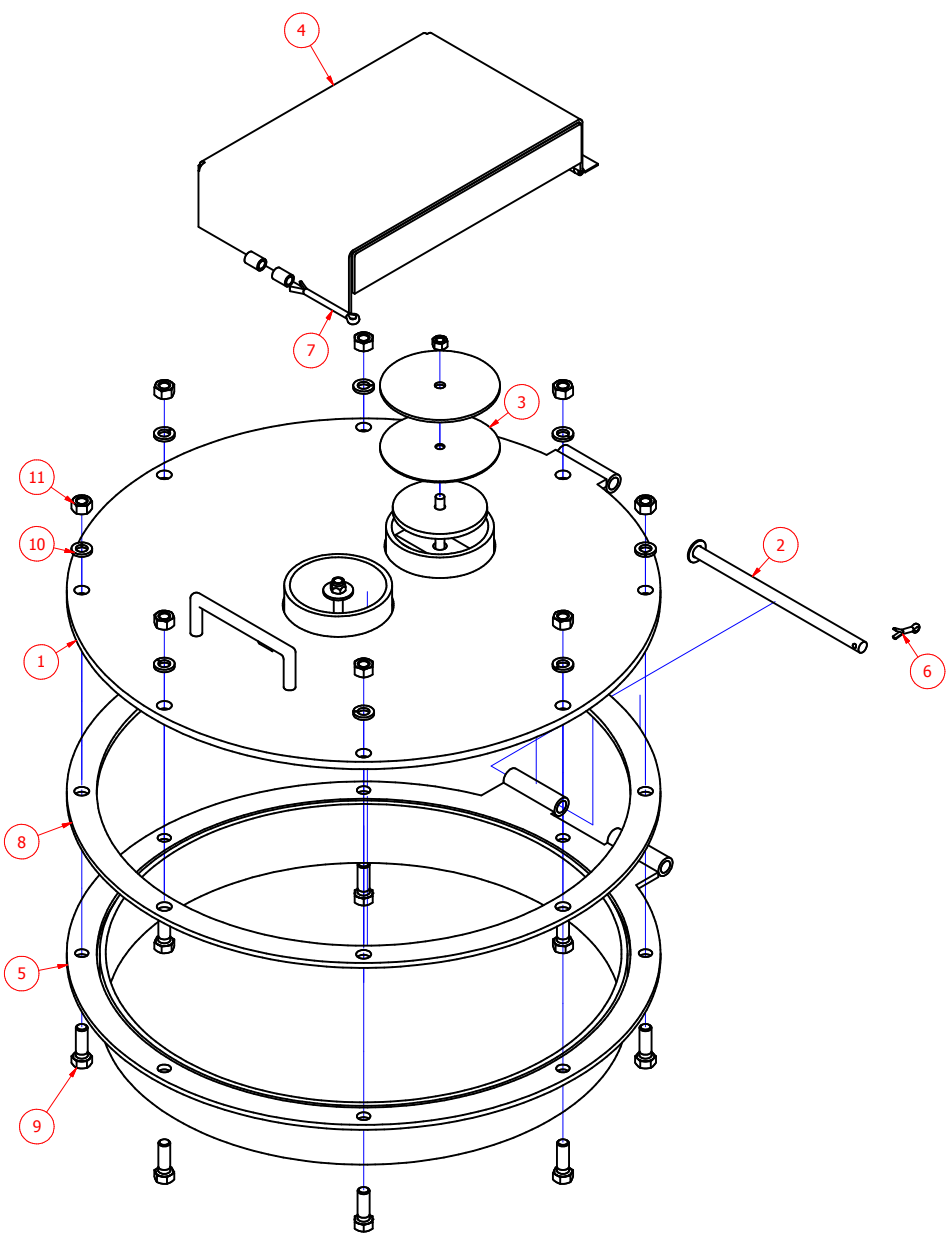


Si-Low 210-A1 VIBRATOR & OPTIONAL PULSE AERATION WIRING

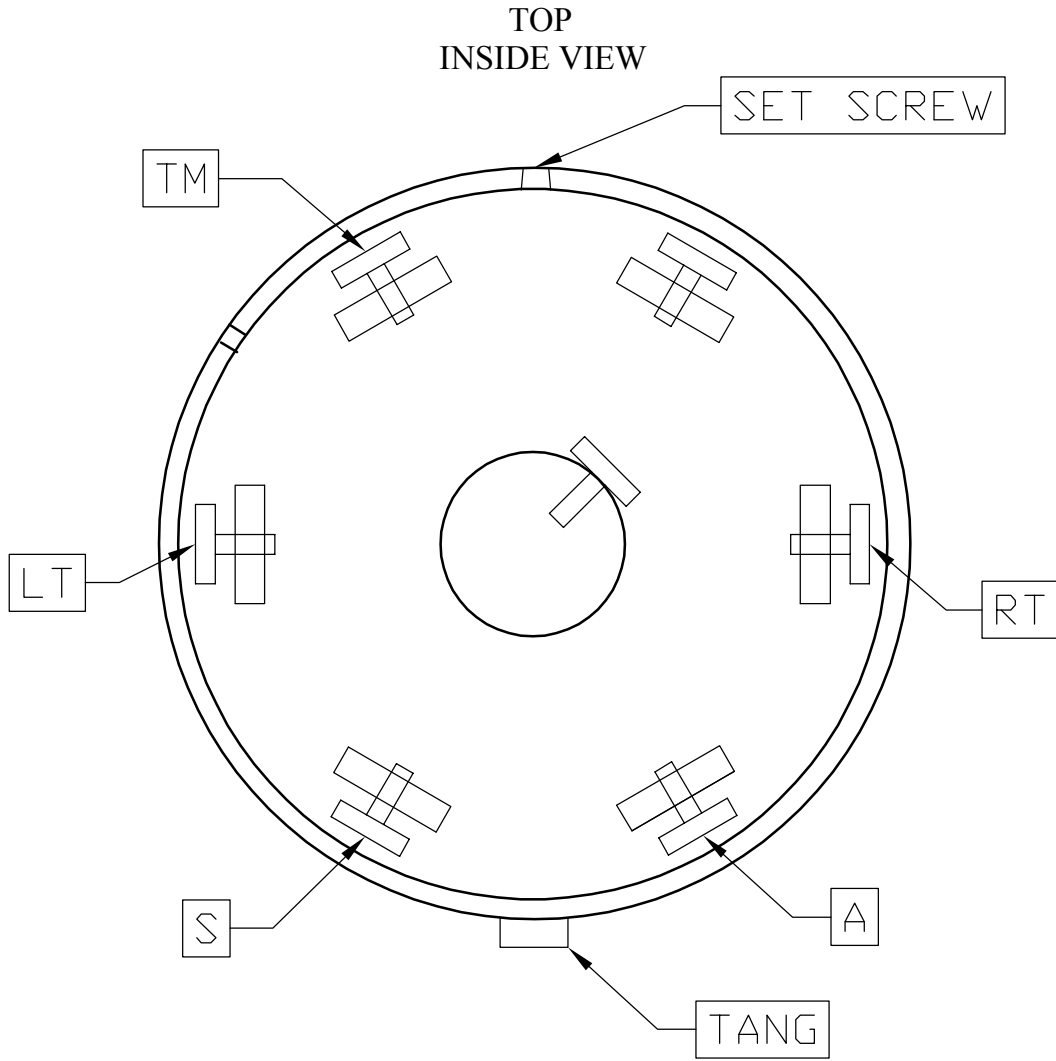
REF NO.	PART NO.	DESCRIPTION	REQ NO
1	POO769	Timer FEF3TU23 (Set at 20 seconds)	1
2	POO769-1	Timer FEA3TU23 (Set at 2 Seconds)	1
3	PEO605	Relay	2
4	PEO605A	Socket Relay	2
5	PEO622	Terminal Block (Black)	2
6	PEO624	Terminal Block (Grey)	1
7	PEO632	Jumper 2 Block	1
8	PEO626	End Barrier	1
9	PEO620	End Anchor	1
10	PEO212	Din Track 4 1/2" (not shown)	1
11	POO771	Auxiliary Contact 595-AB	1
12	POO765	Select Switch 800T-H2D1	2
13			
14	POO766	Name Plate On/Off	2
15	POO768	Asco Air Valve 8210G95	1
16	PEO280	0.5 KVA TRANSFORMER	1

PARTS LIST			
ITEM	PART NUMBER	QTY	DESCRIPTION
1	SLO322	1	MAN HOLE LID
2	SLO131	1	HINGE PIN
3	POO752	2	VALVE SEAL
4	N/A	1	RELIEF LID
5	SLO321	1	MAN HOLE FRAME (FACTORY INSTALLED)
6	N/A	1	Pin - Cotter 3/16 X 1
7	N/A	1	Pin - Cotter 1/4 X 3
8	POO511B	1	MAN HOLE GASKET
9	N/A	8	1/2-13 X 1 1/2 Hex Bolt
10	N/A	8	1/2 Lock Washer
11	N/A	8	1/2-13 Hex Nut

SI-LOW 210 A1 MAN HOLE



<p>PROJECTION REMOVE ALL BURRS</p> <p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: .XX ± .01 .XXX ± .005 FRACTION ± 1/2 ANGLES ± 1' DRILLED HOLE ± 1/4</p>	DRAWN	T Henry	7/26/2019	Ideal Mfg., Inc. 2011 Harnish Blvd. Billings MT 59101 TITLE		
	CHECKED		7/29/2019			
	QA				SI-LOW 210 A1 MAN HOLE	
	MFG					
MATERIAL				SIZE	DWG NO	REV
MASS	94.3 lbmass			C	SL210 A1-220 M	
				SCALE	1 / 4	SHEET 1 OF 1

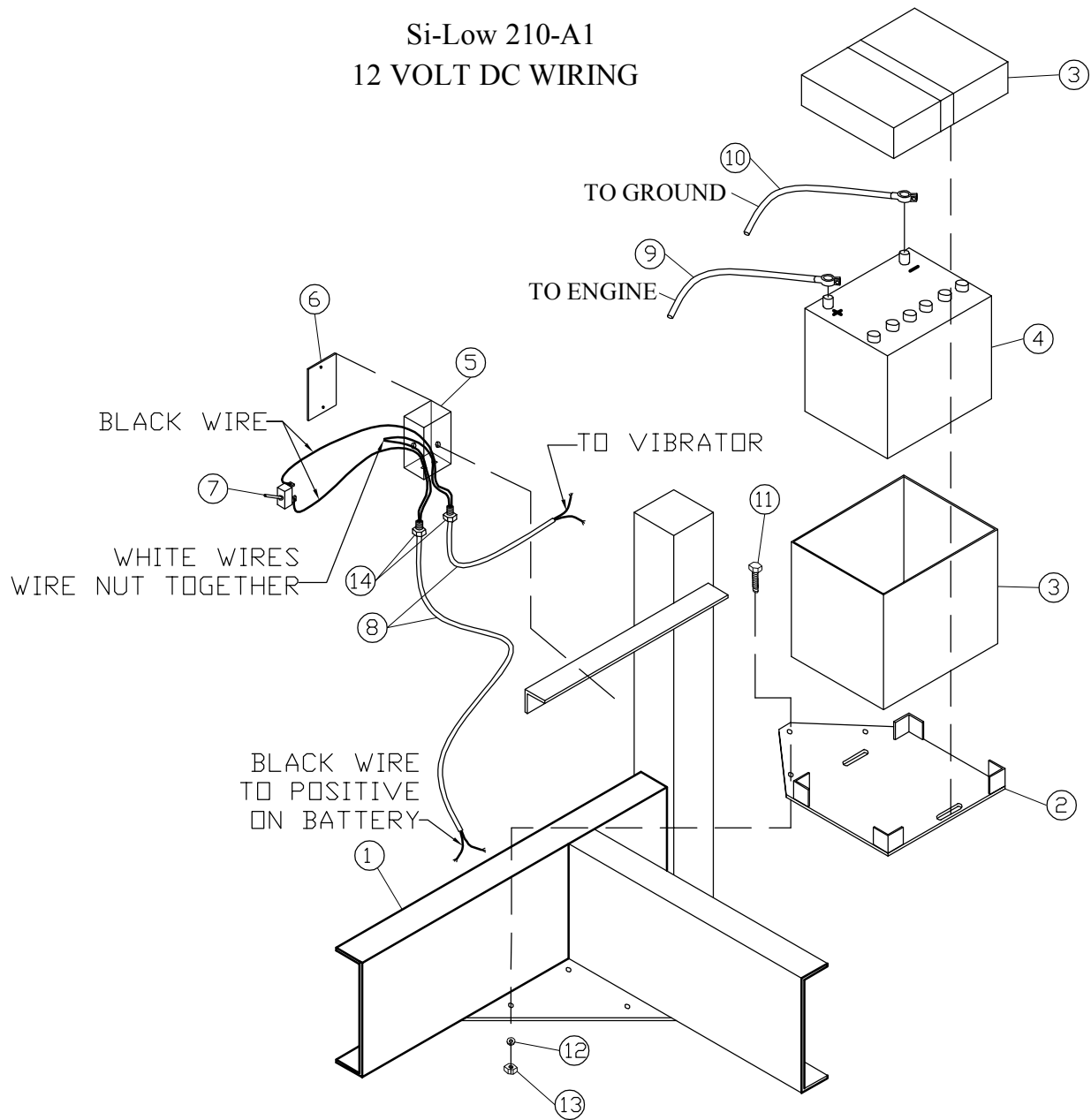


SEVEN POLE PLUG CONNECTOR

	DESCRIPTION	
TM	Tail & Clearance Lights	BROWN
S	Brake Ground	WHITE
RT	Right Signal	GREEN
LT	Left Signal	YELLOW
GD	Ground for Lights	WHITE
A	Hot Wire for Brake	BLACK

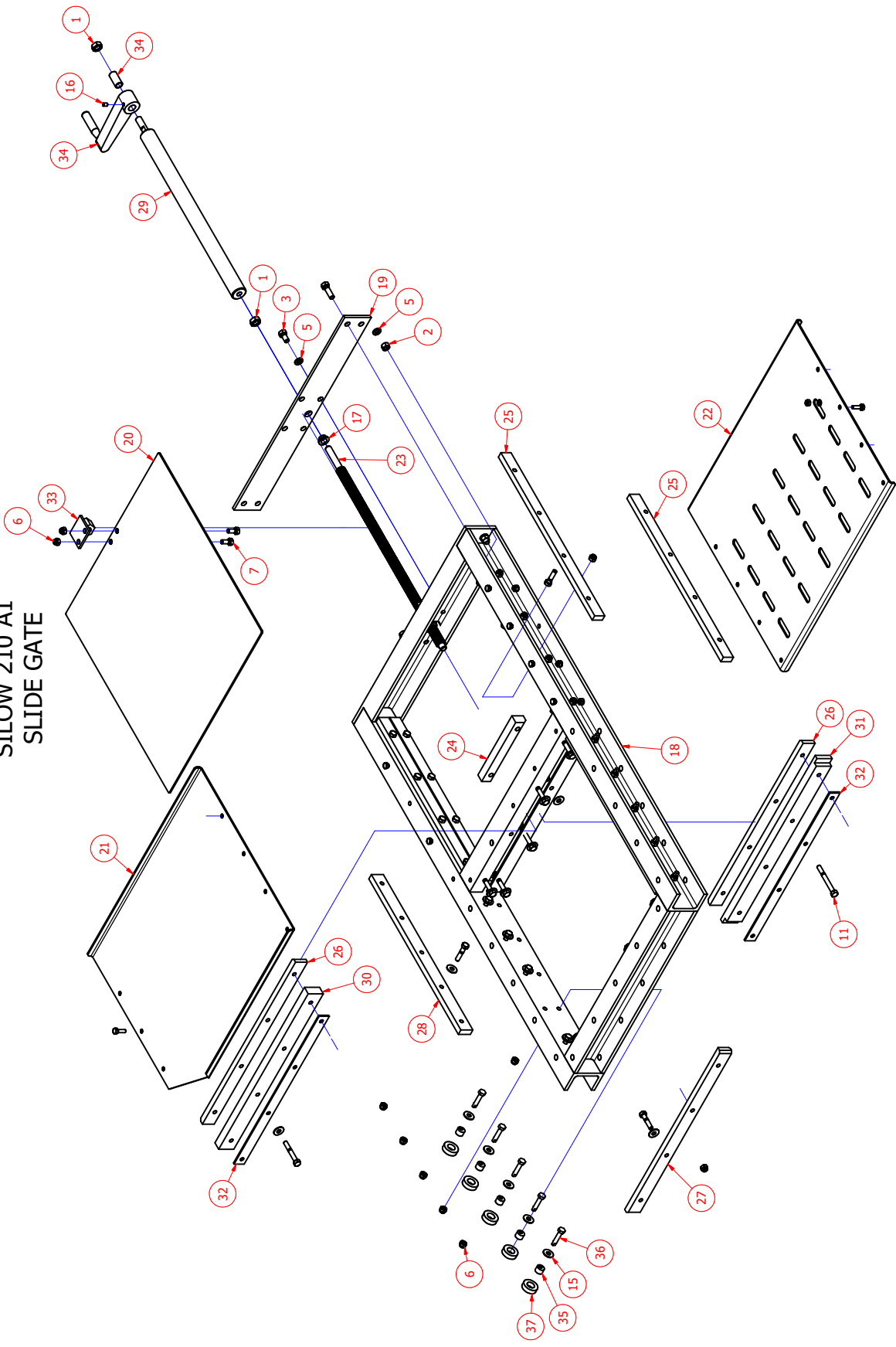
Si-Low 210-A1
ELECTRICAL CONNECTOR FOR TOWING

Si-Low 210-A1 12 VOLT DC WIRING



REF NO.	PART NO.	DESCRIPTION	REQ NO
1	SLO311	Silo Frame	NA
2	SLO349	Battery Mount Plate	1
3	POO374A	Battery Box	1
4	POO374	Battery	1
5	PEO236	Junction Box	1
6	PEO237	Cover Plate	1
7	PEO226D	Toggle Switch	1
8	BKO103	14-2 Cable	10
9	POO797	Positive Battery Cable	10
10	POO268	Ground Cable	1
11	NA	3/8-16 X 1 1/4 Hex Head Bolt	3
12	NA	3/4 Lock Washer	3
13	NA	3/8-16 Hex Nut	3
14	PEO246	1/2" Strain Relief	2
15	POO269	Cable End	1

SILOW 210 A1 SLIDE GATE



		DRAWN T. Henry CHECKED QA	4/11/2019	2011 Harnish Blvd. Bilings MT 59101
REMOVE ALL BURRS UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: .XX ± .01 .XXX ± .005 FRACTION ± 1/32 ANGLES ± 1'		Ideal Mfg., Inc.		
DRILLED HOLE ± 1/64		SILOW 210 A1		
MATERIAL MASS 124.4 lbmass	SIZE C	DWG NO SL210 A1-217	REV	
SCALE 1/16		SHEET 1 OF 1		

**Silow 210 A1
Slide Gate Parts**

ITEM	PART #	DESCRIPTION	QTY
1	N/A	1/2-13 Hex Jam Nut	2
2	N/A	3/8-16 Hex Nut	4
3	N/A	3/8-16 X 3/4 Hex Bolt	4
4	N/A	3/8-16 X 1 1/4 Hex Bolt	4
5	N/A	3/8 Lock Washer	8
6	N/A	5/16 Nylock Hex Nut	50
7	N/A	5/16-18 X 3/4 Hex Bolt	2
8	N/A	5/16-18 X 1 1/4 Hex Bolt	16
9	N/A	5/16-18 X 1 1/2 Hex Bolt	14
10	N/A	5/16-18 X 2 1/4 Hex Bolt	6
11	N/A	5/16-18 X 3 Hex Bolt	2
12	N/A	1/4-20 Hex Nut	15
13	N/A	1/4-20 X 1 Hex Bolt	15
14	N/A	1/4 Lock Washer	15
15	N/A	1/4 Flat Washer	32
16	N/A	1/4-20 X 3/8 Set Screw	1
17	100172	BRONZE FLANGED BEARING 1/2 ID	1
18	F00162	SI-LOW 210A SLIDE GATE FRAME	1
19	F00163	SLIDE GATE END PLATE	1
20	F00164	STAINLESS STEEL GATE	1
21	F00165	TOP GUARD	1
22	F00166	BOTTOM GUARD	1
23	F00167 WW	AUGER GATE ROD	1
24	F00168	ACME ROD BUSHING	1
25	F00169	GATE GUIDE	4
26	F00170	CENTER SEAL	2
27	F00171	END SEAL	1
28	F00172	SIDE SEAL	2
29	F00173A	GATE HANDLE EXTENSION (21 inches long)	1
30	F00183	TOP FELT SEAL	1
31	F00184	BOTTOM FELT SEAL	1
32	F00185	SEAL PLATE	2
33	POO782A	ACME NUT WITH PLATE	1
34	POO782C	CRANK HANDLE WITH BUSHING	1
35	SLO453	ECCENTRIC SHAFT	10
36	SLO454	BOLT FOR ECCENTRIC SHAFT	10
37	SLO455	ROLLER	10

440 / 460 VOLT THREE PHASE WITH OPTIONAL REMOTE CONTROL

COMBINATION STARTER
513-CJB-A2H-1-42-6P
15 HP 3 PHASE 440 V
NEMA SIZE 2
30 AMP CIRCUIT BREAKER

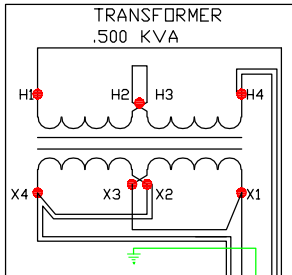
509-BOD-XXX STARTER
592-A2HC OVERLOAD RELAY
1497-N2PK 80 VA TRANSFORMER
PRIMARY FUSE 1 AMP/KLDR
SECONDARY FUSE .75 AMP/FLM
ENCLOSURE SIZE
10"W X 26 3/8"H X 8 7/32" DEEP

TRANSFORMER
.500 KVA #PED280

DOUBLE FUSE HOLDER
F1 FUSE 3A 600V
#PED931
FUSE #PED932

SINGLE FUSE HOLDER
#PED933
F2 FUSE 6.25A 250V
FUSE #PED934

SWITCH OFF ON
#P00765



OPTIONAL EQUIPMENT
FOR REMOTE START AND STOP
NOTE: WHEN USING THE REMOTE START AND
STOP OPTION ALL STOP COMMANDS
MUST BE WIRED IN SERIES

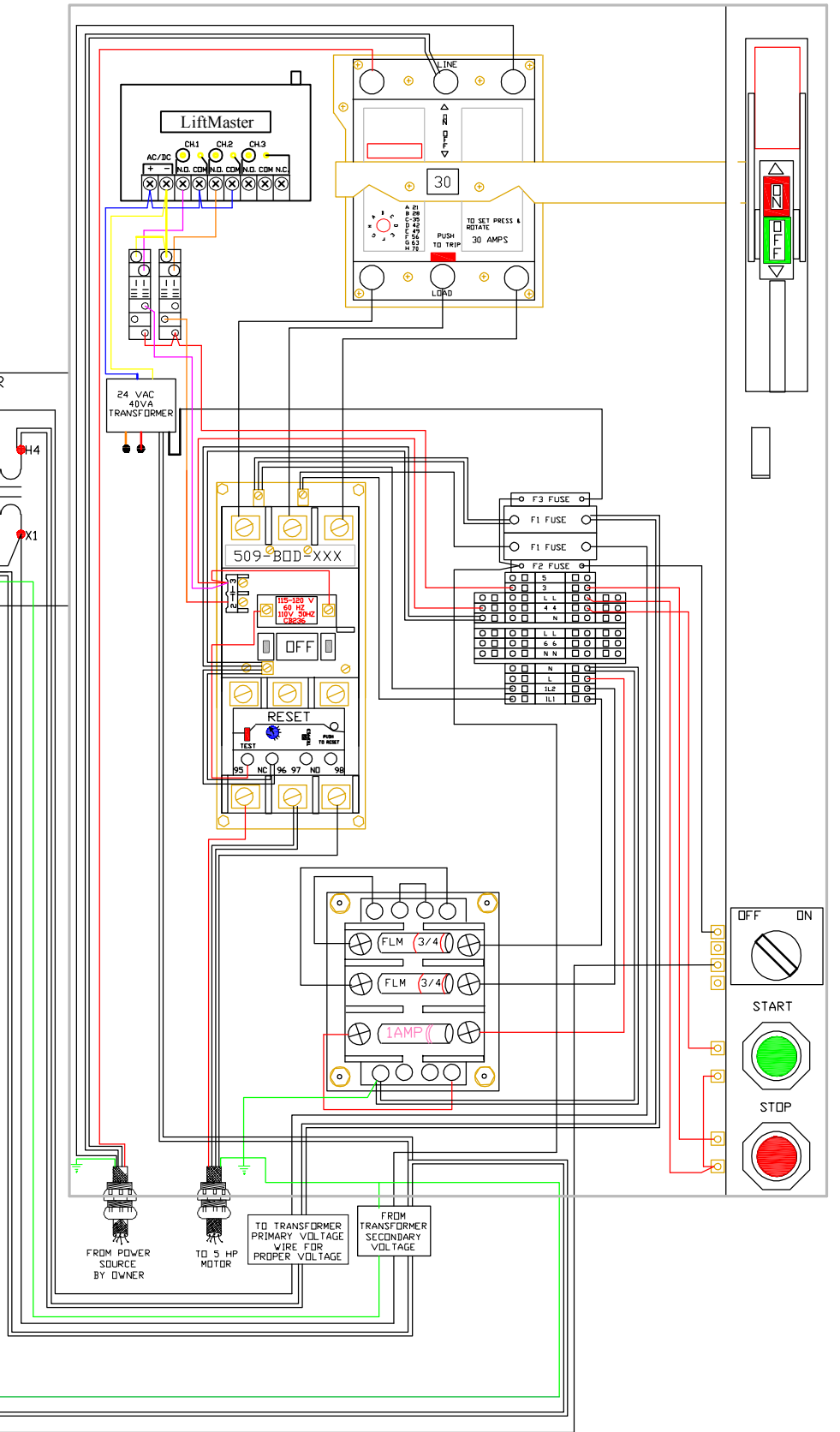
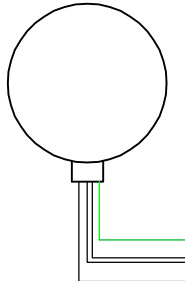
TRANSFORMER
40 VA #PED213
SINGLE FUSE HOLDER
#PED933
F3 FUSE 1A 250V
FUSE #PED625A

RADIO RECEIVER MODEL 850LM
#PED272

RADIO TRANSMITTER 3-BUTTON 813LM
#PED272B

5 PIN RELAY 24 VAC (QTY 2)
#PED605
5 PIN RELAY SOCKET (QTY 2)
#PED605A

110 VOLT AC
OPTIONAL VIBRATOR



LEGEND	
—	WHITE
—	RED
—	BLACK
—	GREEN

REVISIONS		
NO	DATE	DESCRIPTION

IDEAL MANUFACTURING INC. 2011 HARNISH BLVD, BILLINGS MT, 59101 PHONE: (406)656-4380 FAX: (406)656-4383	
Si-LOW 210 A1 ELECTRICAL CONTROL PANEL WITH REMOTE CONTROL	
440 / 460 VOLT 3 PHASE PRIMARY 110 V SECONDARY	
TMM 4/11/2019	

240 VOLT THREE PHASE WITH OPTIONAL REMOTE CONTROL

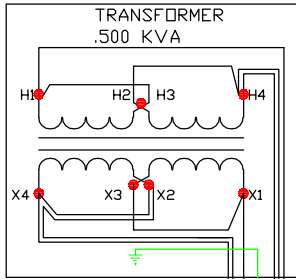
COMBINATION STARTER
513-CJA-A2J-1-6P-42
15 HP 3 PHASE 240 V
NEMA SIZE 2
100 AMP CIRCUIT BREAKER

509-COD-XXX STARTER
592-A2JD OVERLOAD RELAY
1497--B-BASX-3N 80 VA TRANSFORMER
PRIMARY FUSE 1 AMP/KLDR
SECONDARY FUSE .75 AMP/FLM
ENCLOSURE SIZE
10"W X 26 3/8"H X 8 7/32" DEEP

TRANSFORMER
.500 KVA #PED280
DOUBLE FUSE HOLDER
F1 FUSE 3A 600V
#PED931
FUSE #PED932

SINGLE FUSE HOLDER
#PED933
F2 FUSE 6.25A 250V
FUSE #PED934

SWITCH OFF ON
#P00765



OPTIONAL EQUIPMENT
FOR REMOTE START AND STOP
NOTE: WHEN USING THE REMOTE START AND
STOP OPTION ALL STOP COMMANDS
MUST BE WIRED IN SERIES

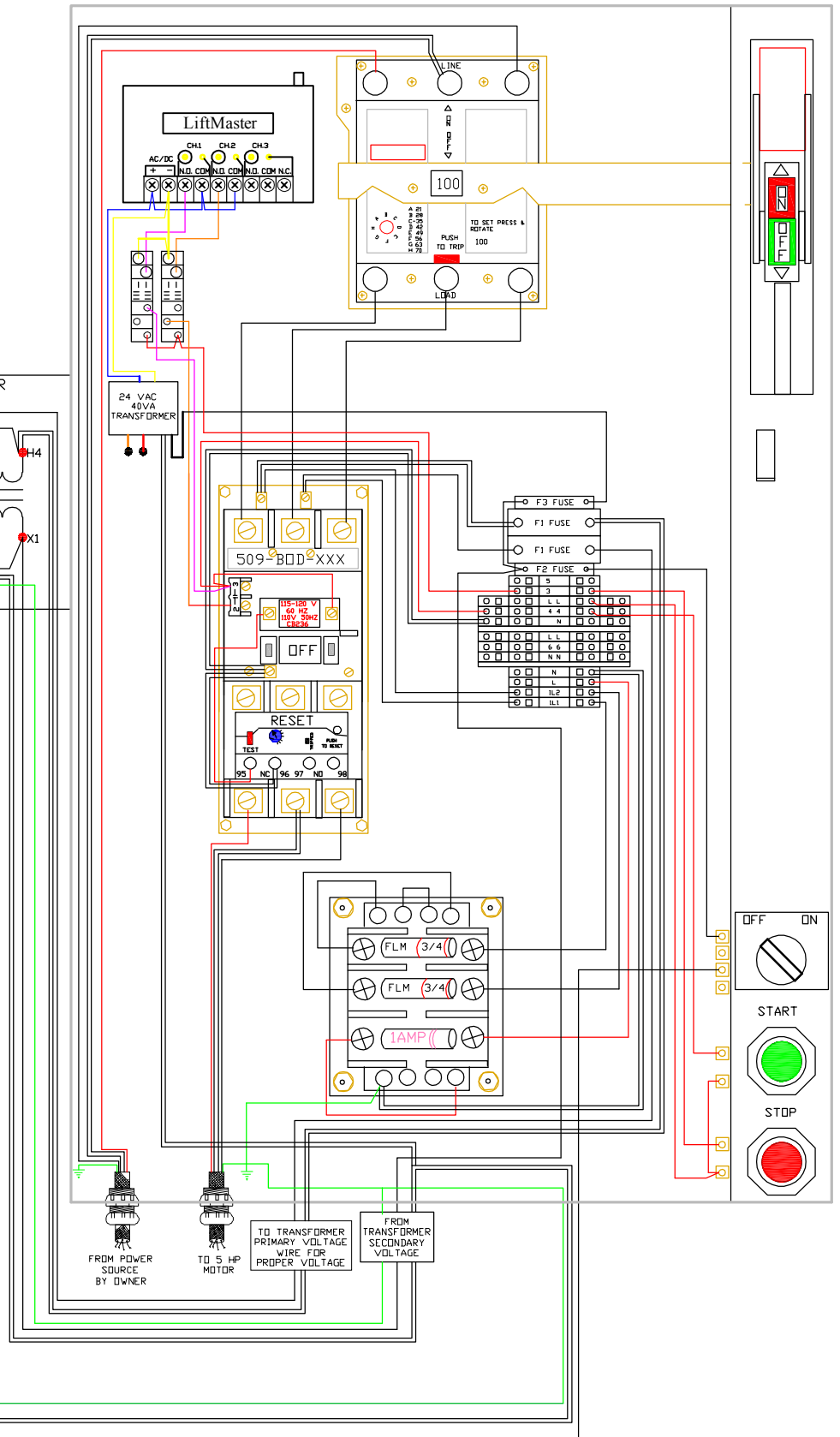
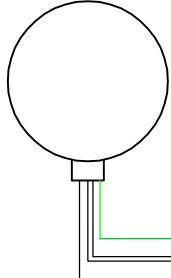
TRANSFORMER
40 VA #PED213
SINGLE FUSE HOLDER
#PED933
F3 FUSE 1A 250V
FUSE #PED625A

RADIO RECEIVER MODEL 850LM
#PED272

RADIO TRANSMITTER 3-BUTTON 813LM
#PED272B

5 PIN RELAY 24 VAC (QTY 2)
#PED605
5 PIN RELAY SOCKET (QTY 2)
#PED605A

110 VOLT AC
OPTIONAL VIBRATOR



LEGEND	
—	WHITE
—	RED
—	BLACK
—	GREEN

REVISIONS		
NO	DATE	DESCRIPTION

IDEAL MANUFACTURING INC.
2011 HARNISH BLVD, BILLINGS MT, 59101
PHONE: (406)556-4360 FAX: (406)556-4363

SI-LOW 210 A1
ELECTRICAL CONTROL PANEL
WITH REMOTE CONTROL

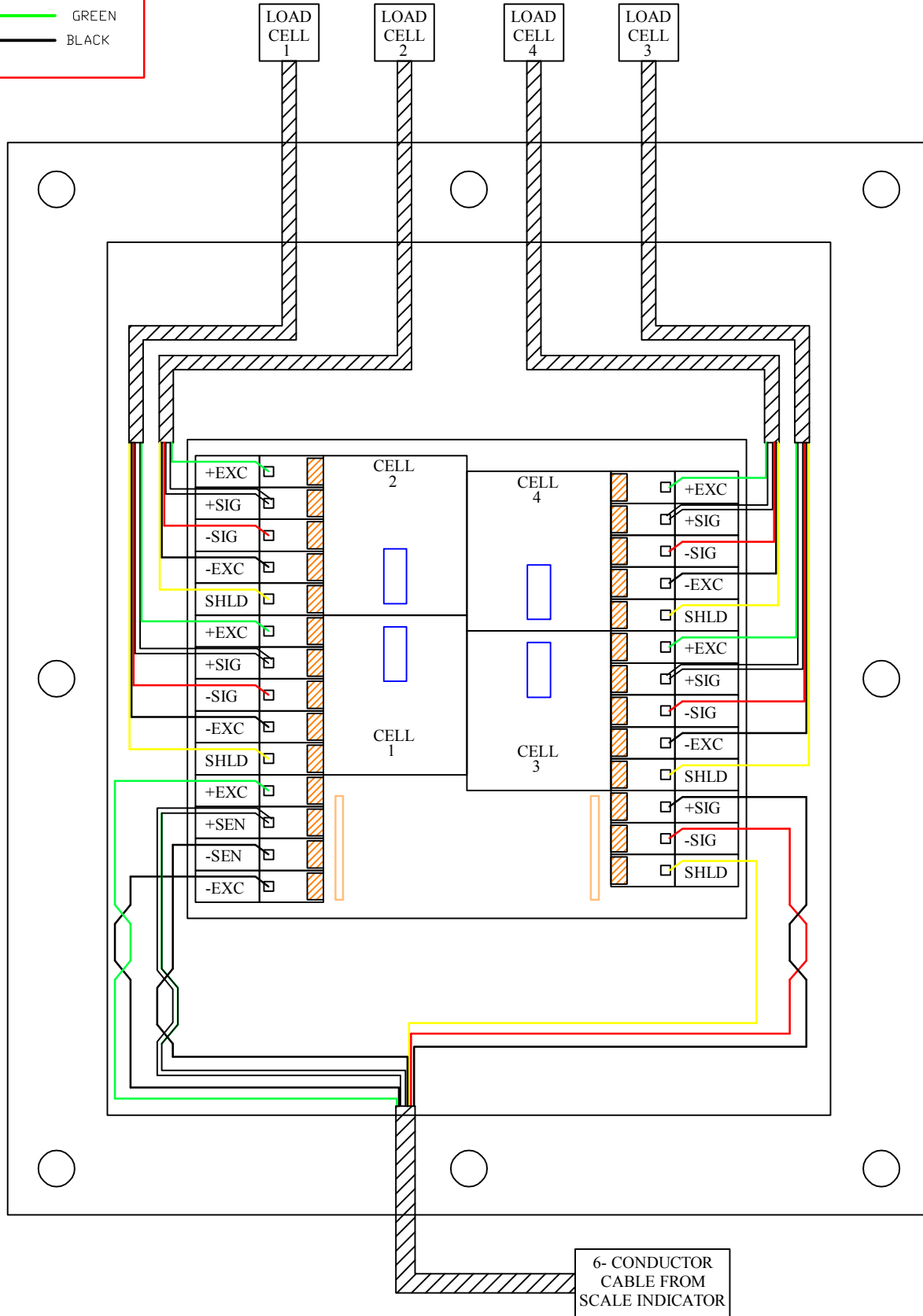
240 VOLT 3 PHASE
PRIMARY 110 V SECONDARY

4/17/2019

WIRE LEGEND

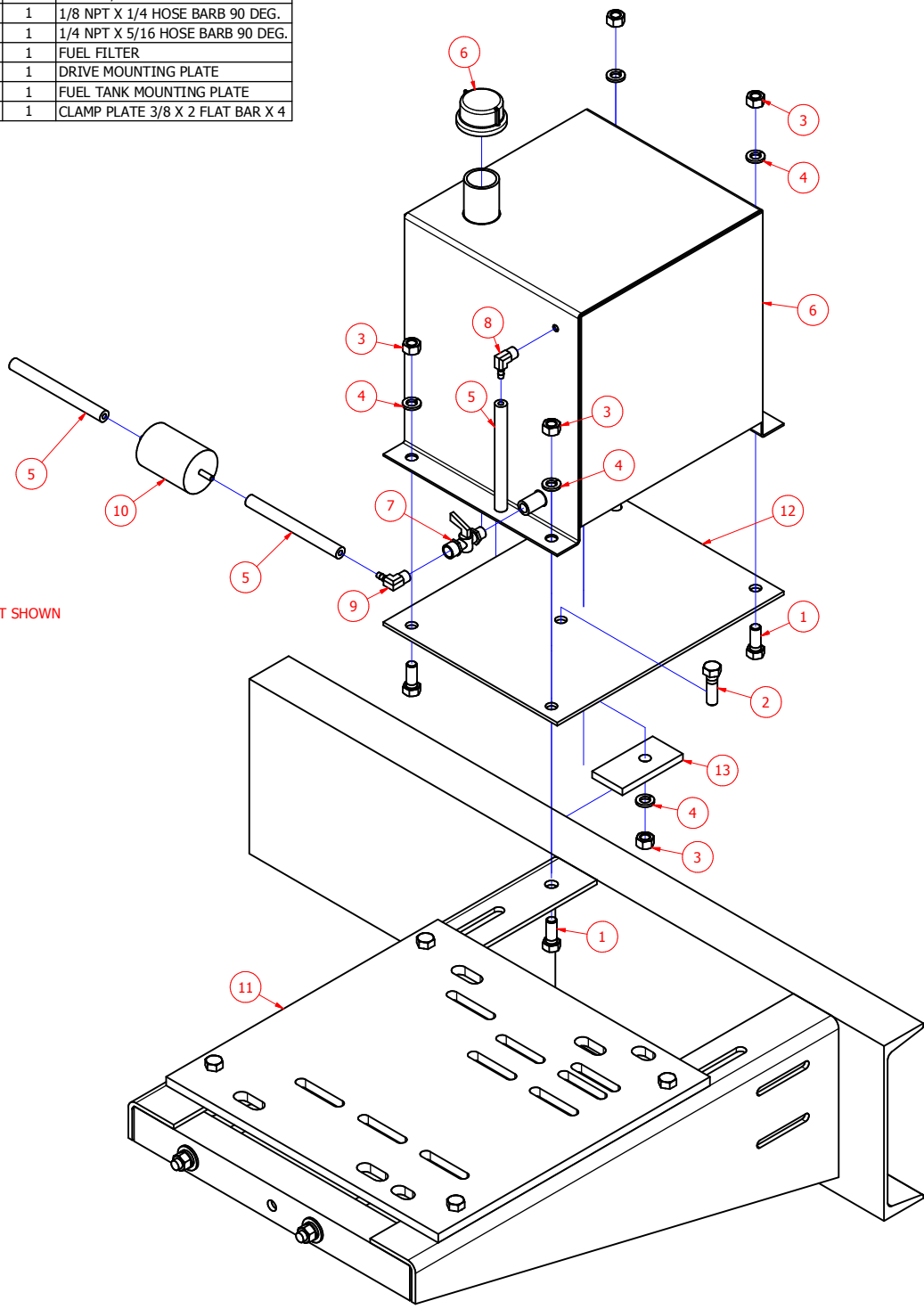
- WHITE
- RED
- YELLOW
- GREEN
- BLACK

SI-LOW 210 A1
FLINTEC LOAD CELLS
TO CARDINAL J BOX
WIRING DIAGRAM



PARTS LIST			
ITEM	PART NUMBER	QTY	DESCRIPTION
1	N/A	4	1/2 - 13 X 1 1/4 HEX BOLT
2	N/A	1	1/2 - 13 X 1 3/4 HEX BOLT
3	N/A	17	1/2 - 13 HEX NUT
4	N/A	13	1/2 LOCK WASHER
5	BKO122	35 in.	1/4 FUEL HOSE
6	BPO113	1	FUEL TANK
7	POO499	1	VALVE 1/4 NPT
8	POO554	1	1/8 NPT X 1/4 HOSE BARB 90 DEG.
9	POO629E	1	1/4 NPT X 5/16 HOSE BARB 90 DEG.
10	POO629F	1	FUEL FILTER
11	SLO310	1	DRIVE MOUNTING PLATE
12	SLO466	1	FUEL TANK MOUNTING PLATE
13	SLO466A	1	CLAMP PLATE 3/8 X 2 FLAT BAR X 4

SI-LOW 210 A1 FUEL TANK



HOSE CLAMPS NOT SHOWN

PROJECTION
 REMOVE ALL BURRS
 UNLESS OTHERWISE SPECIFIED
 DIMENSIONS ARE IN INCHES
 TOLERANCES ARE:
 .XX ± .01
 .XXX ± .005
 FRACTION ± 1/2
 ANGLES ± 1'
 DRILLED HOLE ± 1/4

DRAWN	T Henry	4/29/2019
CHECKED		
QA		
MFG		
MATERIAL		
MASS	180.9 lbmass	

Ideal Mfg., Inc.		2011 Harnish Blvd.		Billings MT 59101
		TITLE		
SI-LOW 210 A				
SIZE	C	DWG NO	SL210 A1 218	REV
SCALE	1 / 4	SHEET 1 OF 1		



205/210
WEIGHT INDICATING INSTRUMENT
TECHNICAL and OPERATION MANUAL

8200-M024-O1 Rev E
04/02

PO BOX 151 • WEBB CITY, MO 64870
PH (417) 673-4631 • FAX (417) 673-5001
<http://www.cardinalscales.com>



Printed in USA

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SERIAL NUMBER _____
DATE OF PURCHASE _____
PURCHASED FROM _____


RETAIN THIS INFORMATION FOR FUTURE USE

PRECAUTIONS


Before using this instrument, read this manual and pay special attention to all "WARNING" symbols:



IMPORTANT



**ELECTRICAL
WARNING**



**STATIC
SENSITIVE**

STATIC ELECTRICITY PRECAUTION



CAUTION! This device contains static sensitive circuit cards and components. Improper handling of these devices or printed circuit cards can result in damage to or destruction of the component or card. Such actual and/or consequential damage IS NOT covered under warranty and is the responsibility of the device owner. Electronic components must be handled only by qualified electronic technicians who follow the guidelines listed below:



ATTENTION! ALWAYS use a properly grounded wrist strap when handling, removing or installing electronic circuit cards or components. Make certain that the wrist strap ground lead is securely attached to an adequate ground. If you are uncertain of the quality of the ground, you should consult a licensed electrician.

ALWAYS handle printed circuit card assemblies by the outermost edges. NEVER touch the components, component leads or connectors.



ALWAYS observe warning labels on static protective bags and packaging and NEVER remove the card or component from the packaging until ready for use.

ALWAYS store and transport electronic printed circuit cards and components in anti-static protective bags or packaging.

FCC COMPLIANCE STATEMENT

WARNING! This equipment generates, uses and can radiate radio frequency and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference in which case the user will be responsible to take whatever measures necessary to correct the interference.

You may find the booklet "How to Identify and Resolve Radio TV Interference Problems" prepared by the Federal Communications Commission helpful. It is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 001-000-00315-4.

All rights reserved. Reproduction or use, without expressed written permission, of editorial or pictorial content, in any manner, is prohibited. No patent liability is assumed with respect to the use of the information contained herein. While every precaution has been taken in the preparation of this manual, the Seller assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from use of the information contained herein. All instructions and diagrams have been checked for accuracy and ease of application; however, success and safety in working with tools depend to a great extent upon the individual accuracy, skill and caution. For this reason the Seller is not able to guarantee the result of any procedure contained herein. Nor can they assume responsibility for any damage to property or injury to persons occasioned from the procedures. Persons engaging the procedures do so entirely at their own risk.

SPECIFICATIONS

Power Requirements:	90 to 264 VAC (50/60 Hz) at 0.4A
Battery Operation:	CAM-350 Type 12 volt 2000 mAh (2.0 Ah)
Enclosure Type, Size:	NEMA 4X/IP66: 9 3/16"W x 7 1/2"H x 3 1/8"D (233mm W x 191mm H x 79mm D) Weight: 8.2lbs - (9.6lb with battery)
Operating Environment:	Temperature: 14 to 104 °F (-10 to +40 °C) Humidity: 90% non-condensing (maximum)
Display:	6-digit, 0.6" high, 7-segment LED
Transducer Excitation:	12 VDC (Jumper selectable) 8 VDC with battery operation (jumper selectable)
Signal Input Range:	1.0 mV min. to 40 mV max. (with dead load boost)
Number of Load Cells:	8 each, 350 OHM minimum resistance
Load Cell Cable Length:	1500 feet maximum. Consult factory for other requirements 30 feet maximum without sense lines
Division Value:	1, 2, or 5 x 10, 1, 0.1, 0.01, 0.001 and 0.0001 commercial 0 to 99, non-commercial
Sensitivity:	NON-COMMERCIAL 0.15 uV/e NTEP 0.3uV/e (Class III/IIIL) CANADA 0.3uV/e (Class III/IIILD) OIML 0.7 uV/e (Class III)
Scale Divisions:	NON-COMMERCIAL 100 to 240,000 NTEP 100 to 10,000 (Class III/IIIL) CANADA 100 to 10,000 (Class III/IIILD) OIML 100 to 10,000 (Class III)
Internal Resolution:	1 part in 16,777,216
Tare Capacity:	Scale Capacity
Sample Rate:	1 to 100 samples per second, selectable
Auto Zero Range:	0.5 or 1 through 9 divisions
Weighing Units:	Tons, Pounds, Pounds-Ounces, Ounces, Metric Tons, Kilograms, Grams
Keypad:	Color coded Membrane type Model 205 - 7 keys Model 210 - 22 keys
Standard I/O:	(1) bi-directional RS232 (20mA) (1) output only RS232 (20mA)
Optional I/O:	14 bit Analog Output (0 to 10v, 4 to 20mA)

SPECIFICATIONS, Cont.

Standard Features:

- Push button tare function
- Gross, tare, net conversion
- Selectable key lockout
- Hi-Resolution mode
- Adjustable filtering
- Gross and Net accumulators
- Dual serial ports
- Remote input lines for Zero, Tare, Gross and Print (1000 feet maximum)
- Programmable print format using Visual Print or nControl (2 Visual Tickets available)
- SMA level 2 compliant serial communications
(For more information see <http://www.scalemanufacturers.org>)
- Field re-programmable via PC interconnection
- Test feature (performs display and internal tests)
- Battery operation
- Auto Shutoff and Sleep modes

Additional Model 210 Standard Features:

- Numeric keypad
- Keypad tare function
- Count feature with accumulator
- Time and Date with selectable 12 or 24 hour operation
- Checkweighing
- Three Preset Weight Comparators

Optional Features:

- Analog Output
- Battery Operation
- Special Filtering
- Column Mounting available

Certifications:

This equipment is certified to comply with the requirements for a Class III/IIIL device by the

- National Conference on Weights and Measurements (Certificate No. 01-011)
- Measurement Canada (Approval No. AM-5397)
- And for a Class III device by OIML R-76 (Certificate No. DK 0199.47).



PRECAUTIONS

Static Electricity



CAUTION! This device contains static sensitive circuit cards and components. Improper handling of these devices or printed circuit cards can result in damage to or destruction of the component or card. Such actual and/or consequential damage IS NOT covered under warranty and is the responsibility of the device owner. Electronic components must be handled only by qualified electronic technicians who follow the guidelines listed below:



ATTENTION! ALWAYS use a properly grounded wrist strap when handling, removing or installing electronic circuit cards or components. Make certain that the wrist strap ground lead is securely attached to an adequate ground. If you are uncertain of the quality of the ground, you should consult a licensed electrician.

ALWAYS handle printed circuit card assemblies by the outermost edges. NEVER touch the components, component leads or connectors.



ALWAYS observe warning labels on static protective bags and packaging and NEVER remove the card or component from the packaging until ready for use.

ALWAYS store and transport electronic printed circuit cards and components in anti-static protective bags or packaging.

Environmental

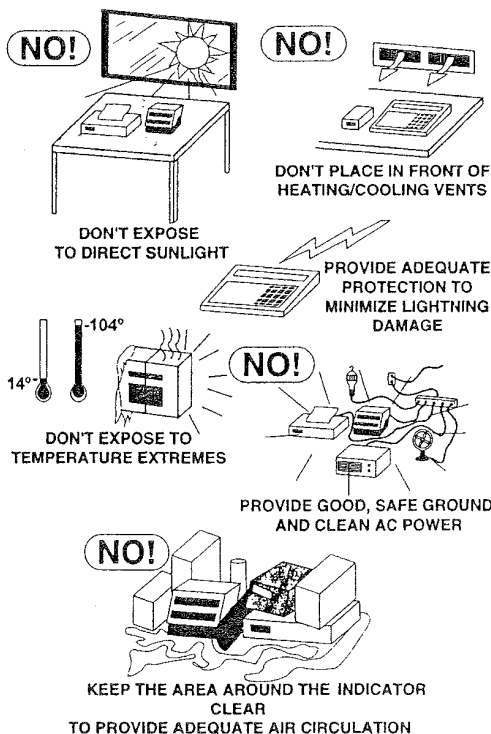
The 205/210 indicators meet or exceeds all certification requirements within a temperature range of 14 to 104 °F (-10 to +40 °C).

In order to keep cooling requirements to a minimum, the indicator should be placed out of direct sunlight and to provide adequate air circulation, keep the area around the indicator clear.

Make certain the instrument is not directly in front of a heating or cooling vent. Such a location will subject the indicator to sudden temperature changes, which may result in unstable weight readings.

Insure that the indicator has good, clean AC power and is properly grounded.

In areas subject to lightning strikes, additional protection to minimize lightning damage, such as surge suppressors, should be installed.



PRECAUTIONS, Cont.

Care and Cleaning

1. **DO NOT** submerge indicator in water, pour or spray water directly on instrument.
2. **DO NOT** use acetone, thinner or other volatile solvents for cleaning.
3. **DO NOT** expose equipment to temperature extremes.
4. **DO NOT** place equipment in front of heating/cooling vents.
5. **DO** clean the indicator with a damp soft cloth and mild non-abrasive detergent.
6. **DO** remove power before cleaning with a damp cloth.

SITE PREPARATION REQUIREMENTS

The Cardinal 205/210 indicators are precision weight-measuring instruments. As with any precision instrument, they require an acceptable environment to operate at peak performance and reliability. This section is provided to assist you in obtaining such an environment.

Electrical Power

The 205/210 indicators have been designed to operate from 90 to 264 VAC at 50/60 Hz. Note that a special order is not required for operation at 230 VAC.



CAUTION! - To avoid electrical hazard and possible damage to the indicator, **DO NOT**, under any circumstance, cut, remove, alter, or in any way bypass the power cord grounding prong.

On models requiring 230 VAC power, **it is the responsibility of the customer** to have a qualified electrician install the proper power cord plug which conforms to national electrical codes and local codes and ordinances.

The power outlet for the indicator should be on a separate circuit from the distribution panel. This circuit should be dedicated to the exclusive use of the indicator. The wiring should conform to national and local electrical codes and ordinances and should be approved by the local inspector to assure compliance.

To prevent electrical noise interference, make certain all other wall outlets for use with air conditioning and heating equipment, lighting or other equipment with heavily inductive loads, such as welders, motors and solenoids are on circuits separate from the indicator. Many of these disturbances originate within the building itself and can seriously affect the operation of the instrument. These sources of disturbances must be identified and steps must be taken to prevent possible adverse effects on the instrument. Examples of available alternatives include isolation transformers, power regulators, uninterruptible power supplies, or simple line filters.



CAUTION! When in parallel runs, locate Load Cell cables a minimum of 24" away from all AC wiring.

INSTALLATION

Before beginning installation of your 205/210 Weight Indicating Instrument, make certain that the instrument has been received in good condition. Carefully remove the instrument from the shipping carton and inspect it for any evidence of damage (such as exterior dents or scratches) that may have taken place during shipment. Keep the carton and packing material for return shipment if it should become necessary. It is the responsibility of the purchaser to file all claims for any damages or loss incurred during transit.

MOUNTING

NOTE! Should your 205/210 indicator come already installed on a scale, the following information describing the installation of the instrument does not apply.

The Model 205/210 Indicator is housed in a NEMA 4X/IP66 stainless steel wall or desk-mount enclosure. The 205/210 gimbal may be mounted on a desktop or other smooth, flat, horizontal surface or may be mounted on a wall. Refer to Figure No. 1 for a layout of wall-mounting bolts.

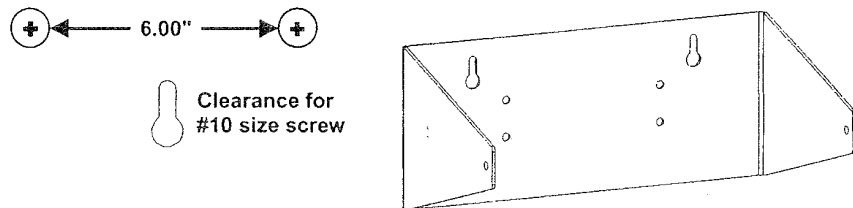



Figure No. 1

If wall mounted, make certain the mounting surface is strong enough to support the instrument. The mounting location should be where the display is easily viewed while being close enough to provide the operator easy access to the keypad. Carefully lay out the mounting hole locations, then drill and install the anchor bolts. Attach the gimbal to the wall and securely tighten the retaining bolts.

LOAD CELL CONNECTION

 **CAUTION!** Disconnect any external load cell power supply before connecting load cells to the instrument. Failure to do so will result in permanent damage to the instrument.

1. Remove the 12 acorn nuts securing the back panel to the main housing, then loosen the bottom-left cable gland connector for the load cell. This gland connector is located on the rear panel of the enclosure. Refer to Figure No. 2 for illustration of the connector layout.
2. Slip the single cable from the load cell or load cell junction box through the gland connector and into the enclosure.
3. Remove 2" of the outer insulation jacket then remove 1/4" of insulation from each of the 4 wires and shield without sense leads or 6 wires and shield with sense leads (refer to figure No. 3).

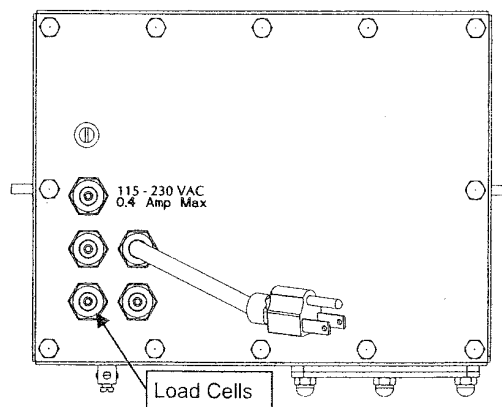


Figure No. 2

INSTALLATION, Cont.

3. Connect each of the wires to terminal block P1 referring to the labels on the circuit board for terminal connections. Refer to Figure No. 6 for terminal block location.

4. To terminate a wire, first press down on the release bar for the terminal, insert the wire into the terminal opening then allow the release bar to return to its original position, locking the wire in place. Repeat the procedure until all of the wires are in place.

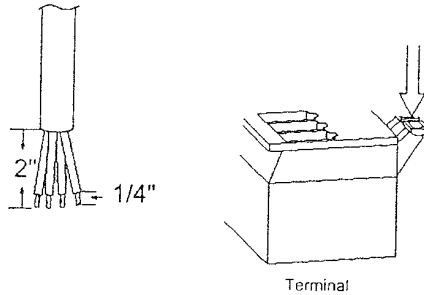


Figure No. 3

5. Route the load cell cable through the two cable clips provided on the upper and left sides of the enclosure interior.

NOTE! If the sense leads are NOT used, you must install plug-in jumpers at J4 and J5 adjacent to the terminal block. These jumpers attach the sense leads to the excitation leads. If sense leads ARE used (as in motor truck scales), these plug-in jumpers should be positioned on one plug-in pin only or removed and stored for later use.

LOAD CELL CONNECTOR P1

PIN NO.	Function	PIN NO.	Function
1	+ EXCITATION	5	- SIGNAL
2	+ SENSE	6	- SENSE
3	+ SIGNAL	7	- EXCITATION

LOAD CELL CONNECTIONS WITH OVER 30 FEET OF CABLE

For installations with over 30 feet of cable between the indicator and the load cells, sense wires should be used. The sense wires must be connected between the +SENS, -SENS terminals on the indicator and the +EXCITATION, -EXCITATION wires of the load cells or the +SENS, -SENS terminals of the load cell trim board or the section seal trim board. For the indicator to use the sense wires, the +SENS jumper J4 and the -SENS jumper J5 must be open (see Figure No. 6).

Load Cell Cable Shield Wire Connection

The load cell cable shield wire should be connected to the threaded stud inside the indicator. This stud is located on the top inside of the indicator near the load cell connector P1. See Figure No.4.

The shield wire should be wrapped around the stud between the 2 flat washers and secured using the hex nut.

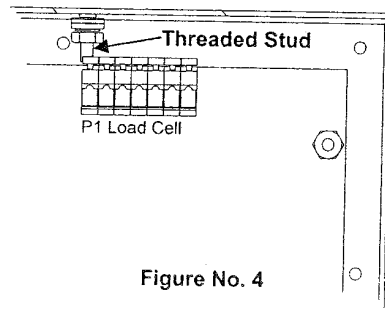


Figure No. 4

SERIAL I/O CABLE INSTALLATION

The 205/210 indicators may be connected to a printer to record weight and associated data or it may be connected to a remote display or even to a computer for transmission of weight data. The weight data may be transmitted on demand (pressing the **PRINT** key or on receipt of a command from the computer). Refer to the Setup, SIO Serial I/O section of this manual.

1. Loosen the cable gland connector(s) for the serial cable. The gland connector(s) for the serial data are located on the rear panel of the enclosure. Refer to Figure No. 2 for an illustration of the gland connector layout.
2. Slip the serial cable through the gland connector and into the enclosure.
3. Remove 2" of the outer insulation jacket then remove 1/4" of insulation from each of the wires (refer to Figure No. 3).

INSTALLATION, Cont.

SERIAL I/O CABLE INSTALLATION, Cont.

4. Connect each of the wires to the Serial Data terminal block (P11) referring to Figure No. 6 for terminal block locations.
5. To terminate, first press down on the release bar for the terminal, insert the wire into the opening then allow the release bar to return to its original position, locking the wire in place. Repeat the procedure until all of the wires are in place.

BI-DIRECTIONAL SERIAL INTERFACE

<u>PIN NO.</u>	<u>Function</u>
1	TXD 1 - RS232
2	RXD 1 - RS232
3	TXD 1 - 20 mA Active
4	GROUND

SERIAL OUTPUT

<u>PIN NO.</u>	<u>Function</u>
5	TXD 2 - RS232
6	TXD 2 - 20 mA Active
7	GROUND

OPTICALLY ISOLATED INPUTS

Included with the I/O are 4 programmable inputs that may be used to remotely (up to 100 feet) initiate various functions within the indicator. These inputs are accessed via a terminal block (P9) on the back of the PC board (see Figure No. 6). The 4 inputs are defined as follows:

<u>PIN NO.</u>	<u>Function</u>
1	Gross
2	Print
3	Zero
4	Tare
5	Common

Remember that the input must be connected to Gnd to initiate the function.

PRESET WEIGHT COMPARATOR

CHECKWEIGHER LOGIC LEVEL OUTPUT

(Optional, Model 210 Only)

If you so choose, you may use the logic level outputs from your Model 210 indicator's preset weight comparators or checkweigher to control peripheral devices used to manage the flow of material or signal when the weight is within preset limits. Note that these outputs are at logic level and cannot drive external devices directly. Solid state relays can be used to accept the logic level output from the 210 and in turn, drive the external device. Maximum output is 5VDC @ 25mA.

To connect the control cable to the preset weight comparator/checkweigher logic level output connector P10, first loosen the gland connector located on the back of the 210 on the right side. Refer to Figure No. 6 for the exact location of this connector. Slip the cable through this connector and into the enclosure. Remove 2 inches of the cable insulating jacket then 1/4 inch of insulation from each of the internal wires (refer to Figure No. 3). Make the proper terminations on terminal block P10. To terminate a wire, first press down on the terminal block release bar, insert the wire into the terminal and remove pressure from the release bar locking the wire in place.

INSTALLATION, Cont.

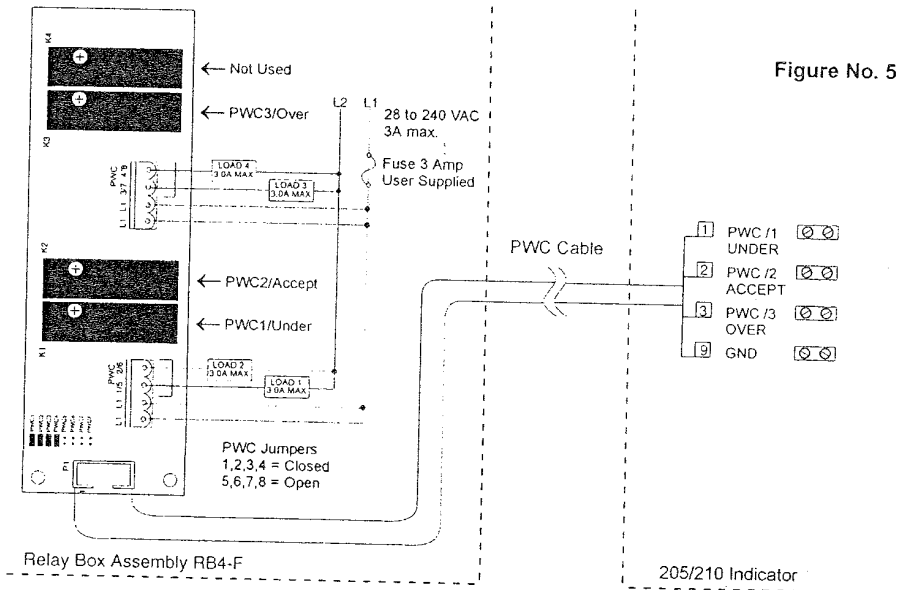
RELAY BOARD - (Optional, Model 210 Only)

The relay board (Cardinal p/n 8539-C062-0A) is mounted in the RB4-F external junction box for use with the 210 Indicator. Connect the devices to be controlled as shown in Figure No. 5.

The relays MUST be configured to be on (closed) or off (open) at weights under the preset weight then switch at the preset weight from on-to-off or off-to-on by setting the under weight condition to on or off during setup and calibration or setup review. Refer to the Setup and Calibration, "d out" (Digital Output) section of this manual for more information.

EXAMPLE: d out= 1,1

PWC1 relay is on (closed) for weights under the preset weight and off (open) for weights equal to or over the preset weight.



NOTE! All relays are the normally-open type that will open when power to indicator is lost.

RE-INSTALLING THE REAR PANEL

After all terminations have been made, remove the excess cable from the instrument enclosure and securely tighten each of the cable gland connectors. Do not over-tighten these connectors but make certain they are snug. **DO NOT USE TOOLS!** Finger tighten only! Insure any unused gland connectors are plugged.

Make certain no cables or wires are exposed between the main housing and rear panel then place the rear panel onto the main housing. Secure with the 12 acorn nuts removed earlier.

NOTE! Follow a diagonal pattern when tightening the acorn nuts.

INSTALLATION, Cont.

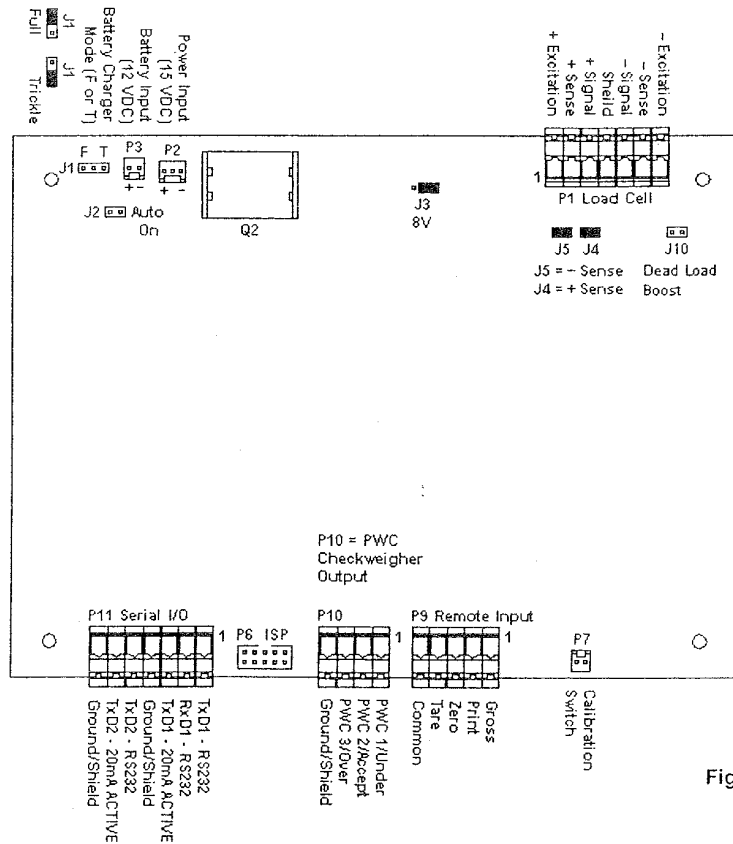


Figure No. 6

MAIN PCB JUMPERS

J1 - BATTERY CHARGE MODE

Place jumper J1 in the Full position when operating the indicator totally from battery power and only recharging the battery pack when it is low. Place jumper J1 in the Trickle position when operating the indicator from commercial power and using the battery pack to supply power only in the event of a power loss.

J2 - AUTO-ON JUMPER

The AUTO-ON jumper J2, when connected, will cause the indicator to power on automatically whenever power is applied to the power input connector. If power is lost momentarily and then reapplied, the indicator will turn on without pressing the ON key.

J3 - 8V EXCITATION JUMPER

The 8V EXCITATION jumper J3, when connected, sets the load cell excitation voltage to 8V for operation with the 12 VDC battery. To operate from the 12 VDC battery, the load cell excitation voltage MUST be set to 8 VDC (J3 closed). Battery operation with the load cell excitation voltage set to 12V will result in an unstable weight display.

J4 AND J5 - SENSE JUMPERS

If the sense leads are NOT used, you must install plug-in jumpers at J4 and J5 adjacent to the terminal block. These jumpers attach the sense leads to the excitation leads. If sense leads ARE used (as in motor truck scales), these plug-in jumpers should be positioned on one plug-in pin only or removed and stored for later use.

J10 - DEAD LOAD BOOST JUMPER

For very low dead loads (less than 10% of the combined load cell capacity) connect the dead load boost jumper J10 on the printed circuit board.

KEYPAD FUNCTIONS - MODEL 205

The Model 205 is equipped with a 7-key keypad. The keypad is used to enter commands and data into the instrument. This section describes each key along with its normal function. It is helpful to refer to the actual instrument while reading this section.



The membrane keypad is not to be operated with pointed objects (pencils, pens, fingernails, etc). Damage to keypad resulting from this practice is NOT covered under warranty.

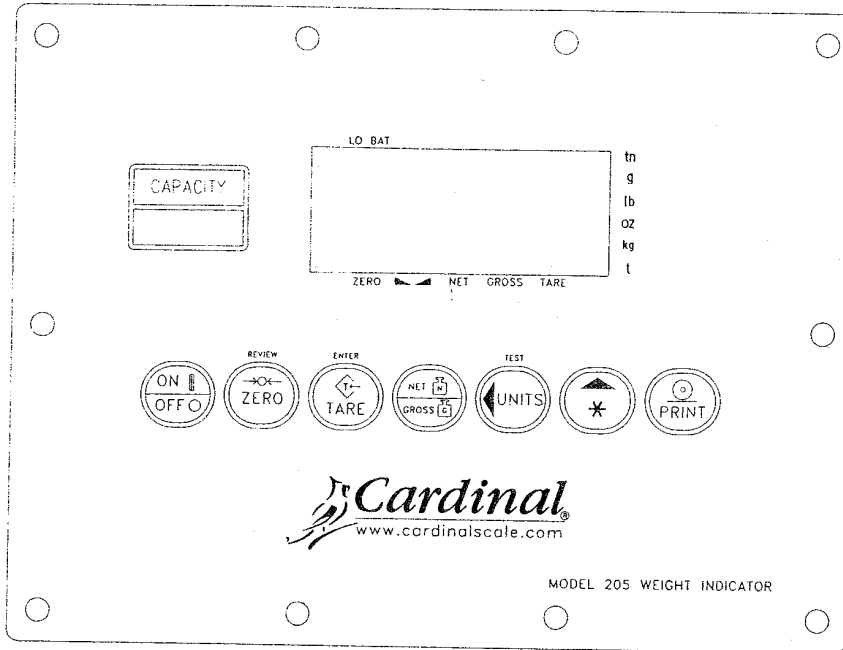


Figure No. 7

ON/OFF KEY

This key performs two functions. Pressing it when the indicator is off will apply power to the instrument. If the indicator is already on, pressing this key will turn the indicator off.

ZERO KEY

Pressing this key will cause an immediate zeroing of the weight display up to the selected limit of 4% or 100% of the scale's capacity. This selection is made during the setup and calibration of the instrument. Note that the indicator will not respond to this command unless the weight display is stable.

TARE KEY

Pressing the TARE key alone will cause the current gross weight to be stored as the new tare weight and cause the weight display to change to the net weight display mode (Net annunciator will turn on).

NET/GROSS KEY

This key is used to toggle between Net and Gross weight modes. The selected mode is indicated by turning on the appropriate annunciator on the display. Note that if no valid tare weight has been entered, pressing this key will cause a momentary "notArE" display error and the indicator will remain in the Gross weight mode.

KEYPAD FUNCTIONS - MODEL 205, Cont.

UNITS/LEFT ARROW KEY

This key performs two functions. In normal operation, this key is used to select the units in which the weight is to be displayed. The available units of measure ("unit1" and "unit2") are selected in setup. The available units include tons, pounds only, pound-ounces, ounces only, tonnes (metric tons), kilograms, and grams. Note that not all combinations are supported. During setup, this key is used to advance the cursor left to the next position when inputting setup parameters.

PRINT KEY

Pressing this key will add the displayed gross or net weight to the associated accumulator and initiate the transmission of weight and other data depending on the Print Tab Settings (see example) via the selected printer output port (see Port= under Print menu) unless the continuous data feature of this port was enabled during setup and calibration. Note that the indicator will not respond to this command unless the weight display is stable. If displaying gross weight, the only weight printed is gross weight. If displaying net weight, the gross, tare, and net weights are printed.

The 205 includes support for visual tickets. Visual tickets are designed by the PC based programs Visual Print or n Control, then downloaded to the indicator. The 205 allows two programmable formats in addition to the standard print tab settings format.

Print formats are selected by using the **ASTERISK** and **PRINT** keys in combination (refer to the next section for details). **NOTE!** When the **PRINT** key is pressed the indicator looks for the selected format. If no visual ticket is found it reverts to the print tab settings.

```
#2
10:19 23/08/2000
100.00 lb G
20.00 lb T
80.00 lb N
0.00 lb GROSS ACCUM
272.00 lb NET ACCUM
```

TICKET EXAMPLE

ASTERISK/UP ARROW KEY

This key is used for several functions. During setup, when a setup parameter (not a parameter value) is displayed, pressing this key will "backup" to the previous prompt. Also during setup, when a parameter value is displayed, pressing this key will "toggle" between the different available values for the setup parameter. In normal operation, this key is used in conjunction with the other keys on the keypad to access additional indicator features. These features and their associated key combinations are as follows:

ASTERISK, ZERO KEY

This combination will enter the Review mode of Setup and Calibration. Refer to Setup Review section of this manual for details.

ASTERISK, TARE KEY

This combination will display the current tare weight for three (3) seconds.

ASTERISK, NET/GROSS KEY

This combination will display the Net accumulator.

ASTERISK, NET/GROSS KEY, PRINT KEY

This combination will print the Net accumulator.

ASTERISK, NET/GROSS KEY, ZERO KEY

This combination will zero (clear) the Net accumulator.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY

This combination will display the Gross accumulator.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY, PRINT KEY

This combination will print the Gross accumulator.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY, ZERO KEY

This combination will zero (clear) the Gross accumulator.

KEYPAD FUNCTIONS - MODEL 205, Cont.

ASTERISK, UNITS KEY

This combination will enter the Test mode. The Test mode is used to conduct a test of all display elements. The test consists of 5 cycles, each lasting about one second:

1. All horizontal segments will turn on (no annunciators).
2. All vertical segments and decimal points will turn on (no annunciators).
3. All annunciators will turn on.
4. All display elements off.
5. The model number (205) and the software version X.X.
6. The calibration numbers (C1 to C4).

ASTERISK, PRINT KEY

This combination is used to *change* the selected print ticket format. Pressing the **ASTERISK** then the **PRINT** key will display a prompt "Prt=". Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, press the **ASTERISK/UP ARROW** key to "toggle" between the different available values, then press the **ENTER** key to save it. Allowable values are:

0 = print tab settings 1 = visual ticket format 1 2 = visual ticket format 2

NOTE! When a print format is selected, it will remain active until changed by the operator.

ANNUNCIATORS – MODEL 205

Annunciators are turned on to indicate that the display is in the mode corresponding to the annunciator label or that the status indicated by the label is active. The annunciators flash on and off to indicate that the 205 is waiting for an input from the keypad for the mode indicated by the flashing annunciator. Refer to Figure No. 7 for location of the annunciators.

ZERO

The ZERO annunciator indicates that the weight is within +/- 1/4 division of the center of zero.

STABLE

The STABLE annunciator is identified with two small triangle shapes and is turned on when the weight display is stable. This means that the change in successive weight samples is less than the motion limits selected during setup and calibration of the instrument.

NET

The NET annunciator is turned on to show that the displayed weight is the net weight (gross weight less tare weight).

GROSS

The GROSS annunciator indicates that the displayed weight is the gross weight.

LO BAT

The LO BAT annunciator is used with the battery operation and will turn ON to indicate that the internal battery requires charging. If continued use further drains the battery, no change in operation will occur until just before the battery voltage drops to a level where operation is affected. At this level, the indicator will automatically turn itself off. Note that when the indicator is charging the battery, the LO BAT annunciator will NOT be on.

T

The T (tons) annunciator is located to the right of the weight display and is turned on to show that the displayed weight units is tons.

g

The g (grams) annunciator is located to the right of the weight display and is used to indicate that the displayed units of weight measurement is grams.

ANNUNCIATORS - MODEL 205, Cont.

lb

The **lb** (pounds) annunciator is located to the left of the weight display and is turned on to indicate that the displayed weight units is pounds.

oz

The **oz** (ounces) annunciator is located to the right of the weight display and is turned on to show that the displayed weight units is ounces.

kg

The **kg** (kilograms) annunciator is located to the left of the weight display and indicates that the displayed units of weight measurement is kilograms.

t

The **t** (tonnes, metric tons) annunciator is located to the right of the weight display and is used to indicate that the displayed units of weight measurement is tonnes (metric tons).

KEYPAD FUNCTIONS - MODEL 210

The Model 210 is equipped with a 22-key keypad. The keypad is used to enter commands and data into the instrument. This section describes each key along with its normal function. It is helpful to refer to the actual instrument while reading this section.



The membrane keypad is not to be operated with pointed objects (pencils, pens, fingernails, etc). Damage to keypad resulting from this practice is NOT covered under warranty.

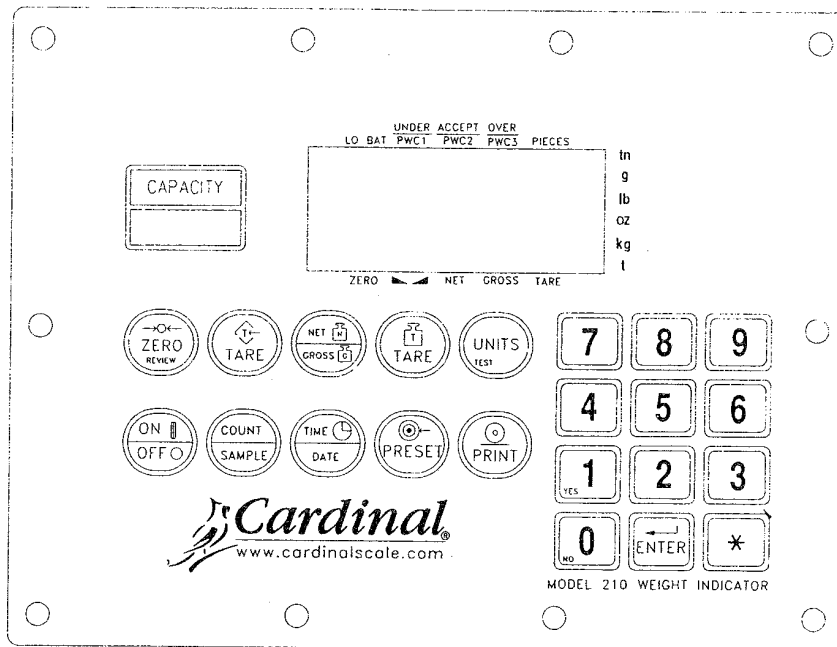


Figure No. 8

ON/OFF KEY

This key performs two functions. Pressing it when the indicator is off will apply power to the instrument. If the indicator is already on, pressing this key will turn the indicator off.

KEYPAD FUNCTIONS - MODEL 210, Cont.

COUNT/SAMPLE KEY

This key performs two functions. The first time it is pressed, the indicator will count (unless piece weight is 0). The second time it is pressed (or if pcwt=0 on the first press) will show the prompt "ADD=5" on the display. Continued pressing of the **COUNT/SAMPLE** key will toggle between the ADD=5, 10, 25, 50, 75 prompts to select a sample size. When desired sample size is displayed, press the **ENTER** key **OR** with "ADD=XX" (5, 10 etc.) displayed, using the numeric keypad, key in any desired sample value, then press the **ENTER** key. Press the **ASTERISK** key to abort the input operation. To exit the count function and display weight, press the **NET/GROSS** key.

TIME/DATE KEY

This key is used to enter the clock mode to program the time, date and consecutive number.

Pressing the **TIME/DATE** key will enter the clock mode with the 210 displaying HoUr=.

12-Hour Format Selected In Setup (td=12)

1. With the display showing HoUr=, press the **ENTER** key.
2. If the time displayed is correct, press the **ENTER** key and proceed to step 4.
3. If the displayed time is incorrect, use the numeric keys to enter the correct time and press the **ENTER** key.
4. The display will change to A=. Press the **ENTER** key.
5. The display will show YES.
 - If the time is before noon (12:00 PM), press the **ENTER** key.
 - If the time is after noon (12:00 PM), press the **0/NO** key, then press the **ENTER** key.
6. The display will show dAtE=. Press the **ENTER** key.
7. If the date displayed is correct, press the **ENTER** key to proceed to the consecutive number prompt, Cn.C .n=.
8. If the date displayed is incorrect, use the numeric keys to enter the correct date and press the **ENTER** key to proceed to the consecutive number prompt. Remember to enter the date in the same format (month-day-year or day-month-year) as selected by the USA setup parameter. Note that with the USA=YES setting, the date format is month-day-year.

24-Hour Format Selected In Setup (td=24)

1. With the display showing HoUr=, press the **ENTER** key.
2. If the time displayed is correct, press the **ENTER** key and proceed to step 4.
3. If the displayed time is incorrect, use the numeric keys to enter the correct time and press the **ENTER** key. Note that with the 24-hour format selected, entering all times after noon (12:00 PM), you must add 12 to the time, i.e. 3 PM would be 1500.
4. The display will show dAtE=. Press the **ENTER** key.
5. If the date displayed is correct, press the **ENTER** key to proceed to the consecutive number prompt, Cn.C .n=.
6. If the date displayed is incorrect, use the numeric keys to enter the correct date and press the **ENTER** key to proceed to the consecutive number prompt. Remember to enter the date in the same format (month-day-year or day-month-year) as selected by the USA setup parameter. Note that with the USA=YES setting, the date format is month-day-year.

Consecutive Number

If the consecutive number displayed is correct, press the **ENTER** key to resume normal operation. If the consecutive number displayed is incorrect, use the numeric keys to enter the correct consecutive number (up to 6 digits) and press the **ENTER** key to resume normal operation.

PRESET KEY

This key is used to enter the weight values for the three preset weight comparators or for the checkweigher feature depending on which feature was selected (setup parameter "d out") during setup and calibration.

KEYPAD FUNCTIONS - MODEL 210, Cont.

Preset Weight Comparator

If the Preset Weight Comparator feature was selected, the PWC1 annunciator will flash and the display will show the currently stored value for the number 1 preset weight comparator. If the value displayed is acceptable, press the **ENTER** key, otherwise, use the numeric keys to enter the new preset value and press the **ENTER** key. The PWC2 annunciator will now flash and the display will show the currently stored value for the number 2 preset weight comparator. As before, if the value displayed is acceptable, press the **ENTER** key, otherwise, use the numeric keys to enter the new value and press the **ENTER** key. The PWC3 annunciator will now flash and the display will show the currently stored value for the number 3 preset weight comparator. Again, if the value displayed is acceptable, press the **ENTER** key, otherwise, use the numeric keys to enter the new value and press the **ENTER** key.

Checkweigher

If the Checkweigher feature was selected and the **PRESET** key pressed, the **ACCEPT** and **UNDER** annunciators will flash and the preset value for the minimum acceptable weight will be displayed. Press the **ENTER** key if the displayed value is correct or use the numeric keys and enter the new value and press the **ENTER** key. The **ACCEPT** and **OVER** annunciators will now flash and the display will show the minimum value of weight over the accepted range. As before, if the value shown is correct, press the **ENTER** key. If the value is incorrect, enter the new value and press the **ENTER** key to save it. Note that this value must be greater than the accept value. Remember that both the preset weight comparators and checkweigher functions operate on the absolute value of the weight ignoring the polarity. After the second preset value is entered, the 210 will return to normal operation.

PRINT KEY

Pressing this key will add the displayed gross or net weight or piece count to the associated accumulator and initiate the transmission of weight and other data selected during setup of the Print menu items via the selected printer output port (see Port= under Print menu) unless the continuous data feature of this port was enabled during setup and calibration.

Note that the indicator will not respond to the Print command unless the weight display is stable. If displaying gross weight, the only weight printed is gross weight. If displaying net weight, the gross, tare, and net weights are printed.

The 210 includes support for visual tickets. Visual tickets are designed by the PC based programs Visual Print or n Control, then downloaded to the indicator. The 210 allows two programmable formats in addition to the standard print tab settings format.

Print formats are selected by using the **ASTERISK** and **PRINT** keys in combination (refer to the next section for details). **NOTE!** When the **PRINT** key is pressed the indicator looks for the selected format. If no visual ticket is found it reverts to the print tab settings.

```
#2
10:19 23/08/2000
100.00 lb G
20.00 lb T
80.00 lb N
      0.00 lb GROSS ACCUM
272.00 lb NET ACCUM
```

TICKET EXAMPLE

ZERO/REVIEW KEY

This key performs two functions. In normal operation, pressing this key will cause an immediate zeroing of the weight display up to the selected limit of 4% or 100% of the scale's capacity. Note that this selection is made during the setup and calibration of the instrument. Pressing this key after the **ASTERISK** key will enter the Review mode of Setup and Calibration. Refer to description of **ASTERISK** key and the Setup Review section of this manual for details.

KEYPAD FUNCTIONS - MODEL 210, Cont.

TARE KEY (with diamond "T" symbol)

This key is a dual function key. Pressing the **TARE** key alone (Pushbutton Tare mode) will cause the current gross weight to be stored as the new tare weight and cause the weight display to change to the net weight display mode (Net annunciator will turn on). Pressing this key after entering a numeric value (Keypad Tare) will cause the value entered to be accepted as the new tare weight.

NOTE: Tare weights equal to or greater than scale capacity cannot be entered. In addition, the keypad tare weight division value must be the same as the scale division value. For example, a unit with .005 lb as the division value will display **-Error** if you attempt to enter 1.003 for the tare weight.

NET/GROSS KEY

This key is used to toggle between Net and Gross weight modes. The selected mode is indicated by turning on the appropriate annunciator on the display. Note that if no valid tare weight has been entered, pressing this key will cause a momentary "notArE" display error and the indicator will remain in the Gross weight mode.

TARE KEY (with weight "T"symbol)

Pressing this key will display the current tare weight for three seconds.

UNITS/TEST KEY

This key performs two functions. In normal operation, this key is used to select the units in which the weight is to be displayed. The available units of measure ("unit1" and "unit2") are enabled or disabled in setup. The available units include tons, pounds only, pound-ounces, ounces only, tonnes (metric tons), kilograms, and grams. Note that not all combinations are supported. Pressing this key after the **ASTERISK** key will enter the Test mode. The Test mode is used to conduct a test of all display elements. Refer to description of **ASTERISK** key for details.

0 THROUGH 9 KEYS

These keys are used to enter numeric data during the setup and calibration as well as during normal operation of the instrument. **NOTE:** The 1 and 0 keys have dual functions. They are used to enter numeric data during setup and calibration as well as during normal operations and are also used to answer yes (1 = YES) or no (0 = NO) to various prompts.

ENTER KEY

The **ENTER** key serves two purposes. First, when reviewing setup parameters, pressing the **ENTER** key will display the current setting of the parameter. Second, the **ENTER** key is used to signal completion of the entry of data and causes the indicator to process the data entered.

ASTERISK KEY

This key is used for several functions. During Setup, when a setup parameter (not a parameter value) is displayed, pressing this key will "backup" to the previous prompt. In normal operation, this key is used in conjunction with the other keys on the keypad to access additional indicator features. These features and their associated key combinations are as follows:

ASTERISK, ZERO/REVIEW KEY

This combination will enter the Review mode of Setup and Calibration. Refer to Setup Review section of this manual for details.

ASTERISK, NET/GROSS KEY

This combination will display the Net accumulator.

ASTERISK, NET/GROSS KEY, PRINT KEY

This combination will print the Net accumulator.

ASTERISK, NET/GROSS KEY, ZERO KEY

This combination will zero (clear) the Net accumulator.

KEYPAD FUNCTIONS - MODEL 210, Cont.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY

This combination will display the Gross accumulator.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY, PRINT KEY

This combination will print the Gross accumulator.

ASTERISK, NET/GROSS KEY, NET/GROSS KEY, ZERO KEY

This combination will zero (clear) the Gross accumulator.

ASTERISK, UNITS KEY

This combination will enter the Test mode. The Test mode is used to conduct a test of all display elements. The test consists of five (5) cycles, each lasting about one (1) second:

1. All horizontal segments will turn on (no annunciators).
2. All vertical segments and decimal points will turn on (no annunciators).
3. All annunciators will turn on.
4. All display elements off.
5. The model number (210) and the software version X.X.
6. The calibration numbers (C1 to C4).

ASTERISK, PRINT KEY

This combination is used to *change* the selected print ticket format. Pressing the **ASTERISK** then the **PRINT** key will display a prompt "Prt=". Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are:

0 = print tab settings 1 = visual ticket format 1 2 = visual ticket format 2

In addition to using the **ASTERISK, PRINT** key combination to change the print ticket format, the operator (just prior to printing the ticket) can change the print ticket format at the end of the weighing operation. This is accomplished by performing the normal weighing operation, then pressing the desired format number (0, 1 or 2), followed by pressing the **PRINT** key.

NOTE! When a print format is selected (by either method), it will remain active until changed by the operator.

ANNUNCIATORS - MODEL 210

Annunciators are turned on to indicate that the display is in the mode corresponding to the annunciator label or that the status indicated by the label is active. The annunciators flash on and off to indicate that the 210 is waiting for an input from the keypad for the mode indicated by the flashing annunciator. Refer to Figure No. 8 for location of the annunciators.

ZERO

The ZERO annunciator is turned on to indicate that the weight is within +/- 1/4 division of the center of zero.

STABLE

The STABLE annunciator is identified with two (2) small triangle shapes and is turned on when the weight display is stable. This means that the change in successive weight samples is less than the motion limits selected during setup and calibration of the instrument.

NET

The NET annunciator is turned on to show that the displayed weight is the net weight (gross weight less tare weight).

GROSS

The GROSS annunciator is turned on to indicate that the displayed weight is the gross weight.

ANNUNCIATORS - MODEL 210

TARE

The TARE annunciator is turned on to show that the displayed weight is the tare weight.

LO BAT

The LO BAT annunciator is used with the battery operation and will turn ON to indicate that the battery has less than one hour useful life before recharging will be required. If continued use furthers drains the battery, no change in operation will occur until just before the battery voltage drops to a level where operation is affected. At this level, the indicator will automatically turn itself off. Refer to the Optional Battery Pack Operation section of this manual for more details.

UNDER/PWC1

The UNDER annunciator is used to signal that the displayed weight is less than the minimum value of acceptable weight used in the Checkweigher feature. Note that this annunciator is active only when the Checkweigher feature is enabled.

The PWC1 annunciator is turned on to indicate that the displayed weight is equal to or greater than the weight value stored as preset number 1. Note that this annunciator is active only when the Preset Weight Comparator feature has been enabled.

ACCEPT/PWC2

The ACCEPT annunciator is used to signal that the displayed weight is within the acceptable weight limits for the Checkweigher feature. That is, it is equal to or greater than the minimum acceptable weight and equal to or less than the maximum acceptable weight. Note that this annunciator is active only when the Checkweigher feature has been enabled.

The PWC2 annunciator is turned on to indicate that the displayed weight is equal to or greater than the weight value stored as preset number 2. Note that this annunciator is active only when the Preset Weight Comparator feature has been enabled.

OVER/PWC3

The OVER annunciator is used to signal that the displayed weight is equal to or greater than the minimum value of over weight used in the Checkweigher feature. Note that this annunciator is active only when the Checkweigher feature has been enabled.

The PWC3 annunciator is turned on to indicate that the displayed weight is equal to or greater than the weight value stored as preset number 3. Note that this annunciator is active only when the Preset Weight Comparator feature has been enabled.

T

The T (tons) annunciator is located to the right of the weight display and is turned on to show that the displayed weight units is tons.

g

The g (grams) annunciator is located to the right of the weight display and is used to indicate that the displayed units of weight measurement is grams.

lb

The lb (pounds) annunciator is located to the left of the weight display and is turned on to show that the displayed weight units is pounds.

oz

The oz (ounces) annunciator is located to the right of the weight display and is turned on to show that the displayed weight units is ounces.

kg

The kg (kilograms) annunciator is located to the left of the weight display and is used to indicate that the displayed units of weight measurement is kilograms.

t

The t (tonnes, metric tons) annunciator is located to the right of the weight display and is used to indicate that the displayed units of weight measurement is tonnes (metric tons).

SETUP AND CALIBRATION

Your 205/210 indicator has been thoroughly tested and calibrated before being shipped to you. If you received the indicator attached to a scale, calibration is not necessary. If the indicator is being connected to a scale for the first time or recalibration is necessary for other reasons, proceed as indicated.

The calibration switch is located on a bracket on the inside of the enclosure rear panel. You may gain access to this switch simply by removing the calibration switch access screw on the rear panel. Refer to Figure No. 9.

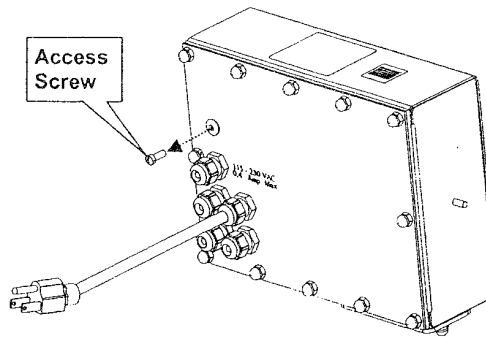


Figure No. 9

MODEL 205

During the setup and calibration process it will be necessary to enter operational parameters via the 205 keypad. Pressing the **TARE/ENTER** key (performs the same function as the **ENTER** key on the 210) will cause the data entered or displayed to be retained and the 205 to advance to the next prompt. The functions of the numeric keys are replaced by using the **UNITS/LEFT ARROW** and the **ASTERISK/UP ARROW** keys. The cursor location is identified by the blinking character and can be advanced to the left to the next position by pressing the **UNITS/LEFT ARROW** key. Pressing the **ASTERISK/UP ARROW** key will change the blinking character to the next value. Continue to press this key to "toggle" between the different available values for the setup parameter. Pressing the **ASTERISK** key when a setup parameter (not a parameter value) is displayed, will "backup" to the previous prompt.

MODEL 210

During the setup and calibration process it is necessary to enter operational parameters via the 210's keypad. Pressing the **ENTER** key without entering a new value will retain the current setting and advance the 210 to the next prompt. To change a setting, enter a new value and press the **ENTER** key. This will save the new value and advance the 210 to the next prompt. Pressing the **ASTERISK** key will "backup" to the previous prompt.



CAUTION: The membrane keypad is not to be operated with pointed objects (pencils, pens, fingernails, etc). Damage to keypad resulting from this practice will NOT be covered under warranty.

Enter Setup Mode

To enter the setup mode, with the indicator ON, insert a small screwdriver or other tool through the calibration switch access hole on the rear panel. Press and release the calibration switch. The menu SetUP will be displayed. Continue to press and release the switch to rotate through the beginning point for entering the setup mode.

SEtUP	Setup Mode (starts at USA prompt)
A-d	Analog to Digital Filtering (starts at dFLt= prompt)
CAL	Calibration (starts at CAL1 prompt)
Sio	Serial Input/Output (starts at BAUD prompt)
Print	Print Tab Settings (starts at PORT prompt)
F SPAn	Fine Span Adjustment
Hi rES	Display high resolution weight mode
LoCoUt	Key lock out function
dAC	Digital to Analog Converter (If DAC board is installed, Calibration of 10 volt or 4 to 20 mA Analog Output)

If you press the **ENTER** key at the SetUP prompt, you may proceed through to the next section (up to and including fSPAn) by pressing the **ENTER** key.

SETUP AND CALIBRATION, Cont.



NOTE! Setup may be interrupted at any time. ALL data previously entered and finalized with the ENTER key will be retained in the non-volatile memory.

Pressing the calibration switch *at any prompt* will return you to the SETUP menu. To exit setup, press the **ASTERISK** key with any of the above menu selections displayed or cycle power at any time (press the **ON/OFF** key twice).

NOTE! With the exception of the SETUP prompt, the prompts displayed for each section are different if you push the calibration switch instead of pressing the **ENTER** key to proceed through the section. *For example*, if you press the calibration switch with the SETUP displayed, the next prompt displayed will be A-d. If you step through the setup prompts by pressing the **ENTER** key, the next prompt displayed will be A-d?. In addition, at a prompt with the ? displayed, you must press the **ENTER** key, the **1/YES** key then the **ENTER** key again to proceed with that section. To skip the section and advance you to the next menu selection, press the **ENTER** key twice.

SETUP

USA (domestic or international)

With SETUP displayed, press the **ENTER** key. The display will change to USA=. Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

USA = 1 (Domestic)

Date = mm/dd/yy
Trl = no
Cap + 4% to OC

USA = 0 (International)

Date = dd/mm/yy
Trl = yes
Cap + 9 grads to OC
PT printed with tare
Lamp test on power up

Lft (Legal For Trade)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

Lft = 1

Interval Settings (Int=) allowed
are: 1, 2, 5, 10, 20, 50

Lft = 0

Interval Setting (Int=) is
selectable from 1 to 99.

NOTE! When both *Lft=1* and *USA=1*, the followings results occur:

Scale must have between 100 and 10,000 divisions
Tra = .5 or 0 to 3
Inhibit serial data during input
Disables **COUNT** key
Date = mm/dd/yy
Trl = no
Cap + 4% to OC

NOTE! When *Lft=1* and *USA=0*, the followings results occur:

Uns = 1
Date = dd/mm/yy
Trl = yes
Cap + 9 grads to OC
PT printed with tare
Lamp test on power up

SETUP AND CALIBRATION, Cont.

Unit1= (Weighing Unit 1)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are:

0 = none	4 = oz (ounces)
1= tn (tons)	5 = kg (kilograms)
2= g (grams)	6 = tonnes (metric tons)
3 = lb (pounds)	7 = lb/oz (pounds/ounces)

Int= (Interval Setting)

Press the **ENTER** key to show the current value.

If LfT = 1 (Legal For Trade = YES), using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 1, 2, 5, 10, 20 or 50.

If LfT=0 (Legal For Trade = NO), using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 1 through 99.

In either case, if the setting displayed is acceptable, press the **ENTER** key again it.

dPP= (Decimal Point Setting)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0, 1, 2 or 3.

0 = XXXXXX	2 = XXXX.XX
1 = XXXXX.X	3 = XXX.XXX

CAP= (Capacity)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 1 through 999,999.

NOTE! Capacity cannot exceed 999,999.

Unit2= (Weighing Unit 2)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are:

0 = none	4 = oz (ounces)
1= tn (tons)	5 = kg (kilograms)
2= g (grams)	6 = tonnes (metric tons)
3 = lb (pounds)	7 = lb/oz (pounds/ounces)



NOTE! The selection for Unit2 can not be the same as Unit1. In addition, dependent upon the selection for Unit1 and the interval and decimal point settings, not all unit combinations are available.

trA= (Zero Tracking Range)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0 (disables Zero Tracking), .5, or 1 through 9.

SETUP AND CALIBRATION, Cont.

trL= (4% Zero Range)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

trL = 1 (Yes)
4% of scale capacity

trL = 0 (No)
Full capacity (no limit)

PUO= (Power-Up Zero Feature)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

PUO = 1 (Yes)
Automatic Re-Zero on Power-Up

PUO = 0 (No)
No Re-Zero on Power-Up

td= (12 or 24 Time Format) - Model 210 Only

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to select the format (12 or 24 hour) of the Model 210 clock operation, then press the **ENTER** key to save it. Note that in the 24 hour format, 12 is added to all times after noon, i.e. 3 PM would be 1500.

td = 12
12 hour clock (3PM displays 3:00)

td = 24
24 hour clock (3PM displays 15:00)

d oUt= X,Y (Digital Output) - Model 210 Only

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to select the X,Y values for the digital output, then press the **ENTER** key to save it.

d out= X, Y

where: X = State below cutoff (0 = LOW, 1 = High)
Y = Preset Number or Checkweigher Mode

- 0 = Digital Output is disabled
- 1 = Low State before cutoff with 1 active Preset
- 2 = Low State before cutoff with 2 active Presets
- 3 = Low State before cutoff with 3 active Presets
- 11 = High state before cutoff with 1 active Preset
- 12 = High state before cutoff with 2 active Presets
- 13 = High state before cutoff with 3 active Presets
- 4 = Low State before cutoff on Checkweigher Mode
- 14 = High state before cutoff on Checkweigher Mode

P-bAL= (Preset Print-On-Balance)

With only one Preset selected (d OUt= 1 or 11), an additional prompt P-bAL= (automatic Print on Balance) will be displayed. If selected (P-bAL=YES), when the weight equals (or is above) the preset value and all motion stops, the weight will be printed (if a printer is attached). Note, that the weight must go below 50% of the preset value before another print operation can be performed.

If the setting displayed is acceptable, press the **ENTER** key to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

P-bAL = 1 (Yes)
Automatic Print on Balance
Enabled

P-bAL = 0 (No)
Automatic Print on Balance
Disabled

SETUP AND CALIBRATION, Cont.

P-bAL= (Checkweigher Print-On-Accept)

With Checkweigher selected (dOUT= 4 or 14), an additional prompt P bAL, Print on Balance, (automatic print on accept) will be displayed. If selected (P-bAL=YES), when the scale weight is stable and in the accept range of the checkweigher, the weight will be printed (if a printer is attached).

If the setting displayed is acceptable, press the **ENTER** key to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

P-bAL = 1 (Yes)

Automatic Print on Accept Enabled

P-bAL = 0 (No)

Automatic Print on Accept Disabled

SLEEP= (Sleep Mode Feature)

The Sleep Mode feature conserves battery power when the indicator remains unused for a selected period of time. With the feature enabled, the load cell excitation will be reduced and the display will be blank.

Press the **ENTER** key to show the current status of this feature. If a number other than 0 is shown, this feature is selected and the number shown corresponds to the number of minutes of a stable zero weight reading before the indicator enters the sleep mode. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter a new value (0 to 10) then press the **ENTER** key to store the new setting. Note that entry of a 0 disables this feature.

A oFF= (Auto Shutoff)

The Automatic Shutoff feature will automatically turn the indicator off (when it is not in use) after a predetermined period of inactivity to prolong battery life. To turn the instrument back on you must press the **ON / OFF** key.

Press the **ENTER** key to show the current status for this feature. A number other than 0 indicates that the auto shutoff feature is enabled and the displayed number corresponds to the number of minutes of stable weight displayed before the indicator is turned off automatically. Note that a 0 indicates the feature has been turned off. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter a new value (0 to 10) then press the **ENTER** key to store the new setting.

CLtAr= (Clear Tare)

The Clear Tare feature allows the indicator to clear the Stored Tare weight when the Net weight goes below zero (a negative net weight after display of a positive net weight). With this feature enabled, the operator must re-set the tare after completion of a transaction when the load (container plus item) is removed from the scale.

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

CLtAr = 1 (Yes)

Automatically clears Stored Tare
when Net weight goes below zero

CLtAr = 0 (No)

Stored Tare is not cleared when
Net weight goes below zero

The following is a typical example of the Clear Tare feature in use.

1. Place container on scale, then press **TARE** key (with diamond "T" symbol on 210).
2. Load container with item to be weighed and perform normal weighing operation.
3. Remove load (item *AND* container) from scale.
4. Scale weight returns to below zero (the weight of the container) and is then reset to zero.
5. Operator is required to repeat step 1 before next weighing operation.

SETUP AND CALIBRATION, Cont.

A - d (A - d?) - Analog to Digital Filtering

dFLt= (Digital Filtering)

With A - d (A - d?) displayed, press the **ENTER** key. The display will change to dFLt=. Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0, 1, 2 or 3. Note, that if you select 3 (Custom Filtering) two additional prompts will be displayed.

dFLt=	
0	Disabled – NO Filtering
1	MINIMAL FILTERING (sample rate = 2)
2	MODERATE FILTERING (sample rate = 1)
3	CUSTOM FILTERING

NOTE! The prompts, F= (Filter Level) and b= (Break Range) will only be displayed if you selected 3 (Custom Filtering) for the dFLt= (Digital Filtering) prompt.

F= (Filter Level)

Press the **ENTER** key to show the current setting for the filter level. The filter level is a number from 1 to 99 that corresponds to the level of filtering with 99 being the greatest filtering and 1 the least. To accept the value displayed, press the **ENTER** key, otherwise, use the numeric keys to enter a new value then press the **ENTER** key to save it.

b= (Break Range)

Press the **ENTER** key to show the current setting for the break range. The break range is a number from 1 to 255 that corresponds to the number of division change to break out of the filtering. Press the **ENTER** key to keep the displayed value or use the numeric keys to enter a new value and press the **ENTER** key to save the new setting. Note that entry of a 0 disables this feature.

Sr= (Sample Rate)

Press the **ENTER** key to show the current setting for the sample rate. The value displayed is the sample rate in samples per second. Press the **ENTER** key to save the displayed value or use the numeric keys to enter a new value (1 to 100) and press the **ENTER** key to save it.

UnS= (Motion Range)

Press the **ENTER** key to view the current setting for the range of motion detection. If the displayed value is acceptable, press the **ENTER** key to save it. Otherwise, use the numeric keys to enter the new range (the number of divisions of change permitted before indicating unstable), then press the **ENTER** key to save the new setting. Allowable range values are: 0 through 99 divisions.

SC= (Stable Count)

Press the **ENTER** key to view the current setting for the number of consecutive stable weight readings before indicating stable weight. This helps filter weight readings for stability for use with Auto Print on Balance, or and anything trying to capture stable weight. If the displayed value is acceptable, press the **ENTER** key to save it. Otherwise, use the numeric keys to enter a new value and press the **ENTER** key to save the new setting. Allowable values for the stable count are: 3 through 255.

SETUP AND CALIBRATION, Cont.

FILTER SETTING RECOMMENDATIONS

Non Critical Sample Rate

If the sample rate is not critical, as in static weighing, set dFLt= to "0" (no filtering), dFLt= "1" (F=6, b=12, Sr= 2/Sec), or dFLt= "2" (F=6, b=8, Sr= 1/Sec).

Critical Sample Rate

If the sample rate is critical, as in a filling operation, use the Custom Filtering (set dFLt= to "3").

1. Sr= SAMPLE RATE (1 to 50 samples/second) determination:

Set the sample rate as close as possible to produce a display graduation change for every graduation of material added to the scale.

$$\frac{\text{Material Flow Rate (lbs/second)}}{\text{Resolution}} = Sr$$

EXAMPLE: $\frac{100\text{lbs/sec}}{10\text{lbs}} = 10\text{s/s} = Sr$

2. b= BREAK RANGE (1 to 255 graduations) determination:

Turn the filtering off by setting the dFLt= setting to "0". Operate the system as it will be normally used and, by observation, determine the number of grads of instability that needs to be filtered out. Set the break range (b=) to that value.

$$\frac{\text{Weight Change}}{\text{Graduation Value}} = b$$

EXAMPLE: 20,000 x 10lb capacity scale with 800lb variation in the weight display.

$$\frac{800}{10} = b = 80$$

3. F= FILTER SETTING (1 to 99) determination: Set to desired results.
4. If stability is unacceptable with any setting of F=, reduce the sample rate and/or increase the break range, b= setting for increased filtering.

SETUP AND CALIBRATION, Cont.

CAL (CAL?) - Calibration

With CAL (CAL?) displayed, press the **ENTER** key. The display will change to show the current setting NO. To skip calibration and proceed to the Sio menu, press the **ENTER** key again. To begin calibration, press the numeric key **1/YES** then the **ENTER** key. After pressing the **ENTER** key the display will change to CAL1=.

NOTE! If the indicator was calibrated previously and the four (4) calibration "C" numbers were recorded, you may enter the values for C1 through C4 instead of using test weights. By entering the previously recorded "C" numbers, you can return to that calibration setting without having to use test weights. Refer to the Calibration "C" Number section of this manual for instructions on viewing the "C" numbers.

1. With "CAL1=" displayed, press the "diamond T" **TARE** key (**UNITS** key on the 205).
2. At the "C1=" prompt, press the **ENTER** to show the current value of the C1 number.
3. If the "C" number displayed is acceptable, press the **ENTER** key again to save it.
4. Otherwise, use the numeric keys to enter a new "C" number, then press the **ENTER** key to save it.
5. Repeat steps 2 through 4 for C2, C3 and C4.



NOTE! If any components have been changed that affect calibration and/or your scale is used in a commercial application and must be "Legal for Trade" you can not use "C" numbers to re-calibrate.

If you wish to use test weights (or are required to) for calibration, press the **ENTER** key at the "CAL1=" prompt.

CAL1= - (First Calibration Weight, 0 to Scale Capacity)

This is the first of two calibration weights: This weight could be ZERO (NO LOAD) or the TEST WEIGHTS (TEST LOAD). Press the **ENTER** key. The display will show 0.0.

If the first calibration weight is to be ZERO or NO LOAD, press the **ENTER** key.

If the first calibration weight is to be the TEST WEIGHTS or TEST LOAD, use the numeric keys to input the value of the calibrated test weights. Place these weights on the scale platform, then press the **ENTER** key.

Starting at the left and proceeding right, a series of dashes will appear on the display. The dashes will stay on the display momentarily, then starting at the left and proceeding right disappear, after which the display will show: CAL2=.

CAL2= - (Second Calibration Weight, 0 to Scale Capacity)

This is the second of two calibration weights. Press the **ENTER** key. The display will show 0.0.

If this second calibration weight is to be zero, make certain the scale platform is empty then press the **ENTER** key again.

If this second calibration weight is to be the test load, use the numeric keys and enter the total weight of the calibrated test weights. Place the weights on the scale platform and press the **ENTER** key.

Starting at the left and proceeding right, a series of dashes will appear on the display. The dashes will stay on the display momentarily, then starting at the left and proceeding right disappear, after which the display will show: Sio?.

Sio (Sio?) - Serial Input/Output

With Sio (Sio?) displayed, press the **ENTER** key. The display will change to show the current setting "no". To skip configuring the Sio (serial input/output) and proceed to the Print? menu, press the **ENTER** key again. To configure the Sio, press the numeric key **1/YES** then the **ENTER** key. After pressing the **ENTER** key, the display will change to bAud=.

SETUP AND CALIBRATION, Cont.

baud= (Serial Port Baud Rate)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter a new baud rate for the serial ports, then press the **ENTER** key to save it. Allowable values are:

12 = 1200 Baud	24 = 2400 Baud	48 = 4800 Baud
96 = 9600 Baud	19 = 19.2k Baud	38 = 38.4k Baud
76 = 76.8k Baud		

Prty= (Serial Port Parity)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0, 1, or 2.

0 = NONE (No Parity)	1 = Odd Parity	2 = Even Parity
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bitS= (Serial Port Data Bits)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 7 or 8.

StoP= (Serial Port Stop Bits)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 1 or 2.

Cont1= (Continuous Output Serial Port 1)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

Cont1= 1 (Yes) Continuous Output	Cont1= 0 (No) No Continuous Output
--	--

If you selected Cont1= 1 (Yes Continuous Output), an additional prompt, "tyPE=" will be displayed.

If you selected Cont1= 0 (No Continuous Output) proceed to the Weight On Demand section.

tyPE= (Continuous Output Format)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0, 1, 2 or 3.

0 = SMA	1 = SB-400	2 = SB-200	3 = Rice Lake IQ355
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If SMA is selected, the data will be transmitted in the following format:

<lf><s><r><n><m><f><xxxxxx.xxx><uuu><cr>

Where:

lf =	Line Feed	
s =	Flags	Z = center of Zero, O = Overcap, E = zero Error, e = weight not currently being displayed
r =	Range	1, 2, 3, ...
n =	Mode	G = Gross, T = Tare, N = Net
m =	Motion	M = Motion, " "(blank) = no motion
f =	Custom	Custom flag
xxxxxx.xxx =	Weight	Six digits with decimal point
uuu =	Units	ton, lb, l/o, oz, t, kg, g
cr =	Carriage Return	(hex 0D)

SETUP AND CALIBRATION, Cont.

If SB-400 or Computer is selected, the data will be transmitted in the following format:

`<s><xxxxxx><d><uu><m><cc><cr>`

Where:

s =	Sign	"-" = negative, " " (<i>blank</i>) = positive
xxxxxx.xxx =	Weight	Six digits
d =	Decimal point	Added to string if enabled in setup
uu =	Units	tn, lb, l/o, oz, t, kg, g
m =	Mode	G = Gross, N = Net
cc =	Weight Status	OC = overcap CZ = center of zero MO = motion ee = weight not currently being displayed
cr =	Carriage Return	(hex 0D)

The SB-80, SB-300 (*multiple displays not supported*) and WinVRS use the SB-400 format.

If SB-200 is selected, the data will be transmitted in the following format:

`<cr><s><xxxxxx><d><c><uu><m> ETX`

Where:

cr =	Carriage Return	(hex 0D)
s =	Sign	"-" = negative, " " (<i>blank</i>) = positive
xxxxxx.xxx =	Weight	(with leading zeros)
d =	Decimal point	Embedded into weight (after weight dpp=0)
c =	status	m = motion o = overcap e = weight not currently being displayed
uu =	Units	tn, lb, l/o, oz, t, kg, g
m =	Mode	G = Gross, N = Net
ETX =	End of TeXt	(hex 03) MUST terminate ALL serial commands

If Rice Lake IQ355 is selected, the data will be transmitted in the following format:

`<stx><polarity><wwwwwww><units><g/n><status><crlf>`

Where:

stx =	Start of TeXt	(hex 02)
polarity =	Sign	"-" = negative, " " (<i>blank</i>) = positive
wwwwwww =	Weight	Seven digits
units =	Units	" " (<i>blank</i>) = none, L = lb, K = kg, T = tons, G = grams, O = ounces
g/n	Mode	G = Gross, N = Net
status	status	" " (<i>blank</i>) = valid I = invalid M = motion O = overcap
CRLF =	Carriage Return with Line Feed	(hex 0D) with (hex 0A)

SETUP AND CALIBRATION, Cont.

Weight On Demand

If continuous output has not been selected for Serial Port 1 (Cont1=NO), the 205/210 indicator will respond to a weight request (ENQ).

The host device (computer) sends:

ENQ - (hex 05)

The 205/210 will respond:

<s><xxxxxx><d><uu><m><cc><cr>

Where:

s =	Sign	"-" = negative, " " (<i>blank</i>) = positive
xxxxxx.xxx =	Weight	Six digits
d =	Decimal point	Added to string if enabled in setup
uu =	Units	tn, lb, l/o, oz, t, kg, g
m =	Mode	G = Gross, N = Net
cc =	Weight Status	OC = overcap CZ = center of zero MO = motion ee = weight not currently being displayed
cr =	Carriage Return	(hex 0D)

NOTE! The Weight On Demand function is not available for Serial Port 2.

Cont2= (Continuous Output Serial Port 2)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, 0/NO or 1/YES, enter the new setting, then press the **ENTER** key to save it.

Cont2= 1 (Yes)

Continuous Output

Cont2= 0 (No)

No Continuous Output

If you selected Cont2= Yes (Continuous Output) an additional prompt, "tyPE=" will be displayed.

tyPE= (Continuous Output Format)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 0, 1, 2 or 3.

0 = SMA

1 = SB-400

2 = SB-200

3 = Rice Lake IQ355

NOTE! See Continuous Output Serial Port 1, tyPE= for description of output formats.

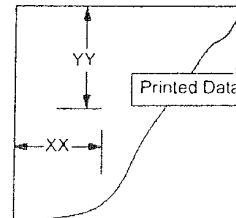
Print (Print?) - Print Tab Settings

With Print (Print?) displayed, press the **ENTER** key. The display will change to show the current setting "no". To skip configuring the Print Tab Settings and proceed to the FSPAN? menu, press the **ENTER** key again. To configure the Print Tab Settings, press the numeric key 1/YES then the **ENTER** key. After pressing the **ENTER** key the display will change to Port=.

The general format for the input is A = YY.XX where A is the character identifying the data printed, YY is the number of lines down and XX is the number of spaces to the right.



NOTE! Enter 00 in either location, YY or XX, to disable the data from printing.



SETUP AND CALIBRATION, Cont.

Port= (Select Port for Printer)

Press the **ENTER** key to show the current value. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the new setting, then press the **ENTER** key to save it. Allowable values are: 1 or 2.



NOTE! Although either port can be used for the printer port, it is recommended to use the bi-directional port 1 with a bi-directional cable.

HoUr= (Time Print Location)

Press the **ENTER** key to show the current setting for the location of the time printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

dAtE= (Date Print Location)

Press the **ENTER** key to show the current setting for the location of the date printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

CnC n= (Consecutive Number Print Location)

Press the **ENTER** key to show the current setting for the location of the consecutive number printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

GroSS= (Gross Weight Print Location)

Press the **ENTER** key to show the current setting for the location of the Gross weight printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

tArE= (Tare Weight Print Location)

Press the **ENTER** key to show the current setting for the location of the Tare weight printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

nEt= (Net Weight Print Location)

Press the **ENTER** key to show the current setting for the location of the Net weight printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

G ACC= (Gross Weight Accumulator Print Location)

Press the **ENTER** key to show the current setting for the location of the Gross weight accumulator printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

n ACC= (Net Weight Accumulator Print Location)

Press the **ENTER** key to show the current setting for the location of the Net weight accumulator printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

CoUnt= (Count "number of pieces on the scale" Print Location) - Model 210 Only

Press the **ENTER** key to show the current setting for the location of the Count (number of pieces on the scale) printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

EACH= (Piece Weight Print Location) - Model 210 Only

Press the **ENTER** key to show the current setting for the location of the Piece weight printing. If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, use the numeric keys to enter the new location then press **ENTER** to save it.

SETUP AND CALIBRATION, Cont.

CrLF= (Carriage Return Line Feed) - Data Format Termination

Data transmitted from the serial I/O port can be terminated with a single carriage return and either no line feed or a single line feed command. Press the **ENTER** key to view the current setting. A "YES" on the display means the data will be terminated with a carriage return AND a line feed while a "no" on the display means the data will be terminated with a single carriage return only.

If the setting displayed is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys, **0/NO** or **1/YES**, enter the new setting, then press the **ENTER** key to save it.

EoP= (End-Of-Print Line Feeds)

At the end of a data transmission to a printer, the indicator can transmit a pre-selected number of line feed commands to space the paper in the printer to the desired position for withdrawal or for the next print.

Press the **ENTER** key to view the current setting. If the displayed value is acceptable, press the **ENTER** key to save it. Otherwise, use the numeric keys to enter the new the number of End-Of-Print linefeeds, then press the **ENTER** key to save the new setting. Allowable values are: 0 through 99.



NOTE! The FSPAN and Hi rES modes require a load of 10% of Capacity be on the scale before adjustments can be made.

F SPAn (FSPAN?) - Fine Span Adjustment

With the *F SPAN?* prompt displayed after pressing the **ENTER** key at the last Print prompt:

With FSPAN? displayed, press the **ENTER** key. The display will change to show the current setting "no". To skip the Fine Span Adjustment and return to the **SETUP** menu, press the **ENTER** key again. To perform the Fine Span Adjustment, place a calibrated test weight on the scale and press the numeric key **1/YES** then the **ENTER** key.

After pressing the **ENTER** key, the display will change to show the amount of the test weight and the annunciators will alternately flash off and on i.e. (all ON, weighing unit off, then all OFF, weighing unit ON). Press the **1/YES** to increase the span OR press the **0/NO** key to decrease the span. Press the **ASTERISK** key to return to the previous prompt or press the **ENTER** key to exit FSPAN? and return to the **SetUP** menu.

With the *F SPAN* prompt displayed after pressing the Calibration switch:

With F SPAN displayed, place a calibrated test weight on the scale and press the **ENTER** key. After pressing the **ENTER** key, the display will change to show the amount of the test weight and the annunciators will alternately flash off and on (all ON, weighing unit off, then all OFF, weighing unit ON). Press the **1/YES** to increase the span OR press the **0/NO** key to decrease the span. Press the **ASTERISK** key to return to the previous prompt or press the **ENTER** key to exit F SPAN and return to the **SETUP** menu.

Hi rES - Display High Resolution Weight

With Hi rES on the display, pressing the **ENTER** key will show the active weight in "high resolution" mode (in 1/10 interval). Press the **PRINT** key to print the weight (followed by the text **TEST**) via the selected printer output port enabled during setup and calibration.

LoCoUt - Key Lock Out Function

With LoCoUt on the display, pressing *any* key will display "LoCd" (locked) or "UnLoCd" (unlocked) for the current key state. Pressing a locked key during normal operation will result in a 1/2 second display "LoCd" and the key will be ignored. To exit the LoCoUt function, press the calibration switch or cycle power (press the **ON/OFF** key twice).



NOTE! The menu selections Hi rES and LoCoUt can only be selected using the calibration switch.

SETUP REVIEW

The 205/210 indicators allow several operational parameters to be reviewed and changed without breaking the calibration seal. These operational parameters are:

Power Up Zero Reset Enable/Disable
Time Format
Digital Output Control Enable/Disable
Sleep Mode Feature Enable/Disable
Auto Shutoff Feature Enable/Disable

Serial Input / Output Configuration
Baud Rate
Parity
Number of Data Bits
Number of Stop Bits
Continuous Output Port 1
Continuous Output Format
Continuous Output Port 2
Continuous Output Format

Print Tab Settings
Printer Port Selection
Time
Date
Consecutive Number
Gross Weight
Tare Weight
Net Weight
Gross Weight Accumulator
Net Weight Accumulator
Count (*Model 210 Only*)
Piece Weight (*Model 210 Only*)

To enable the Setup Review feature, with the indicator ON:

1. Press the **ASTERISK** key. The indicator will respond by showing the FunCt= (Function) prompt and alternately flashing off and on (all ON, weighing unit off, then all OFF, weighing unit ON) the annunciators.
2. Press the **ZERO/REVIEW** key. The display will change to the prompt for the selection of power-up zeroing (PUO=).
3. Using the same procedure as described in the Setup and Calibration section of this manual, make the required changes.
4. Press the **ASTERISK** key to return to the previous prompt.
5. To exit Setup Review, press the **ENTER** key to step the remaining prompts OR at anytime, cycle the power (press the **ON/OFF** key twice).

CALIBRATION "C" NUMBERS

The "C" numbers are displayed only during the Test mode operation by pressing the **ASTERISK** key then the **UNITS/TEST** key. The "C" numbers are shown at the end of the test operation and each number is displayed for approximately 4 seconds, allowing you to record them. Each number may be up to three (3) digits in length. By recording these numbers you will be able to return the indicator to its present calibration settings without using test weights simply by entering the "C" numbers. Refer to the Setup and Calibration, "CAL" section of this manual for instructions on using the "C" numbers.



If any components have been changed that affect calibration and/or your scale is used in a commercial application and must be "Legal for Trade" you can not use "C" numbers to re-calibrate.

ACCUMULATORS

To *view* the NET accumulator:

1. Press the **ASTERISK** key then the **NET/GROSS** key.
2. Press the **ASTERISK** key to return to normal operation.

To *print* the NET accumulator:

1. Press the **ASTERISK** key, the **NET/GROSS** key, then the **PRINT** key
2. The indicator will return to normal operation when printing has been completed.

To *clear (zero)* the NET accumulator:

1. Press the **ASTERISK** key, the **NET/GROSS** key, then the **ZERO** key
2. Press the **ASTERISK** key to return to normal operation.

To *view* the Gross accumulator:

1. Press the **ASTERISK** key then the **NET/GROSS** key twice.
2. Press the **ASTERISK** key to return to normal operation.

To *print* the Gross accumulator:

1. Press the **ASTERISK** key, the **NET/GROSS** key twice, then the **PRINT** key
2. The indicator will return to normal operation when printing has been completed.

To *clear (zero)* the Gross accumulator:

1. Press the **ASTERISK** key, the **NET/GROSS** key twice, then the **ZERO** key
2. Press the **ASTERISK** key to return to normal operation.

MODEL 210 Only

To *view* the Count accumulator:

1. Press the **ASTERISK** key then the **COUNT/SAMPLE** key.
2. Press the **ASTERISK** key to return to normal operation.

To *print* the Count accumulator:

1. Press the **ASTERISK** key, the **COUNT/SAMPLE** key, then the **PRINT** key
2. The indicator will return to normal operation when printing has been completed.

To *clear (zero)* the Count accumulator:

1. Press the **ASTERISK** key, the **COUNT/SAMPLE** key, then the **ZERO** key
2. Press the **ASTERISK** key to return to normal operation.

BEFORE YOU CALL FOR SERVICE

The 205/210 indicators have been designed to provide you with years of trouble-free operation. However, should you experience a problem, please refer to the troubleshooting guide below before you call for service. The following describes several types of symptoms along with suggested remedies.

PROBLEM	POSSIBLE SOLUTIONS
Display does not turn on	<p>AC operation: Is the AC power cord fully inserted into the wall receptacle? Check wall receptacle for proper AC power. Try another electrical appliance in the same receptacle, does it work? Check the circuit breaker. Has there been power failure?</p> <p>Battery operation: Check if battery is installed and correctly. Is battery discharged - replace or recharge.</p>
Incorrect weight displayed	<p>Has the instrument been calibrated? Insure that the scale platform isn't touching an adjacent object. Check the load cell connector wiring. If using four (4) wire load cells, insure the sense lead jumpers (J4 & J5) are installed. Have proper operation procedures been followed?</p>
Indicator will not display weight	<p>Refer to Error Codes section and make certain that the "oCAP" message is not displayed. If so, and scale is not loaded, perform the calibration sequence.</p>
The printer prints but does not use the Print Tab Settings or prints a test ticket	<p>The print tab setting or visual ticket format must be selected prior to beginning the weighing operation or just prior to printing the ticket.</p> <p>To select the ticket format prior to beginning the weighing operation:</p> <ol style="list-style-type: none">1. Press the ASTERISK key then the PRINT key. The display will change to the "Prt=".2. Press the ENTER key to show the current value.3. If the value displayed is acceptable, press the ENTER key again to save it.4. If the displayed value is incorrect (or another ticket format is desired), use the numeric keys to enter the new value, then press the ENTER key to save it. <p>To select the ticket format just prior to printing the ticket:</p> <ol style="list-style-type: none">1. Press the desired format number.2. Pressing the PRINT key. <p>Allowable values for ticket formats are:</p> <ul style="list-style-type: none">0 = print tab settings1 = visual ticket format 12 = visual ticket format 2

NOTE! When a print format is selected (by either method), it will remain active until changed by the operator.

ERROR CODES

The 205/210 indicators are equipped with software that indicates when an error in the operation takes place. The following lists the error codes displayed by the 205/210 along with their meaning. Should you encounter an error code, please refer to this list for the cause.

CALbtn (Calibration Button)

CALbtn will be displayed (until the condition changes), on power-up if the calibration switch is pressed in by the operator, the calibration access screw is the wrong length and is depressing the switch, the switch is disconnected from the PC board, or the switch is defective.

CORRECTIVE ACTION: Release the switch. Insure correct screw (#10 x 1/2 Stainless Steel fillister head) was installed for the calibration access screw. Referring to Figure No. 6, make sure calibration switch cable is plugged into P7 on the PC board. Replace calibration switch assembly. Consult your scale service provider.

ConFiG (Configuration)

E²PROM checksum failure. Indicates improper stored calibration data, calibration is necessary.

CORRECTIVE ACTION: Recalibrate with calibrated test weight.

Error

An invalid keypad entry was attempted:

- A. **PRINT** key pressed with a negative weight.
- B. **TARE** key pressed to enter a push button tare value of a negative value.
- C. **ENTER** key pressed to enter a tare weight value that exceeds the scale capacity.
- D. **ENTER** key pressed to enter a tare weight value that is inconsistent with the scale division value (i.e. attempt to enter a tare of 123 with scale divisions of 5).
- E. **ZERO** key pressed when the gross weight is outside the scale zero weight range.
- F. **lb/kg** key pressed to change to kilograms when the kilogram tare weight value exceeds 4 digits in length.

CORRECTIVE ACTION: Determine which of the reasons for the error display is applicable and take the appropriate corrective action.

ErrAh (Analog Error High)

1. The load cell input is above the range of the indicator.

CORRECTIVE ACTION: Check for improper load cell wiring, excessive load, and for output of 1 to 40mV.

2. Load cell or circuit failure.

CORRECTIVE ACTION: Consult your scale service provider.

ErrAL (Analog Error Low)

1. The load cell input is below the range of the indicator.

CORRECTIVE ACTION: Check for improper load cell wiring and for output of 1 to 40mV.

2. Load cell or circuit failure.

CORRECTIVE ACTION: Consult your scale service provider.

Err1

A program checksum mismatch has been detected.

CORRECTIVE ACTION: Consult your scale service provider.

Err3

Internal RAM failure.

CORRECTIVE ACTION: Consult your scale service provider.

HuH?

UNITS key pressed in an attempt to perform a "unit" conversion that is not allowed.

CORRECTIVE ACTION: Determine the reason for the error display and take the appropriate corrective action.

ERROR CODES, Cont.

notArE

NET key pressed with no stored tare weight value.

CORRECTIVE ACTION: Determine the reason for the error display and take the appropriate corrective action.

OCAP (Over Capacity)

The load on the scale exceeds the scale capacity plus nine (9) divisions.

CORRECTIVE ACTION: Remove the over capacity load from the scale platform. May indicate miscalibration.

-oF- (Overflow)

The indicator is attempting to display a positive number greater than six (6) digits in length or a negative number of more than five (5) digits.

CORRECTIVE ACTION: Return to Gross Weight mode and review Tare value. May indicate miscalibration.

toobG

UNITS key pressed in an attempt to perform a "unit" conversion where the interval would have been greater than 50.

CORRECTIVE ACTION: Determine the reason for the error display and take the appropriate corrective action.

UnStb (Unstable)

Motion is present when trying to power up, print, zero or perform a push button tare function.

CORRECTIVE ACTION: Wait for a stable weight display (STABLE annunciator on) before performing any of these operations.

CALIBRATION SEAL INSTALLATION

If your 205/210 Weight Indicating Instrument is used in a commercial application it must be tested and sealed by your local weights and measurements official. The 205/210 is designed to accept a lead and wire security seal to prevent unauthorized access to the calibration adjustments. Refer to Figure No. 10 for details on the installation of the seal.

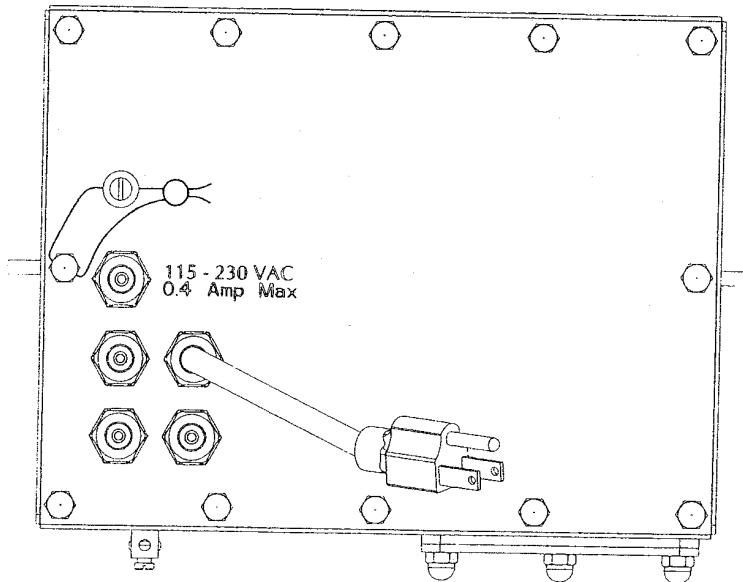


Figure No. 10

OPTIONAL BATTERY OPERATION

The 205/210 indicators can operate from a readily available Sealed Lead-Acid Camcorder type battery (*not included*). If you wish to operate the indicator from a battery, you must first obtain and install a CAM-350 Type, 12 volt, 2000 mAh (2.0 Ah) battery before operation can begin. The battery is contained inside the instrument and is easy to install. Access is via a removable panel on the bottom of the indicator (See Figure No. 11). The battery can be purchased from the Cardinal Scale Parts Department (p/n 6800-0018) or ordered from the following companies online:

- www.discountcell.com
- www.ebatts.com
- www.mobilizenow.com
- www.planetbattery.com

The battery life of the indicator varies significantly with the way the indicator is used (e.g. the longer more display segments are on, the faster the battery will discharge). The battery used in the 205/210 indicator will power it continuously, with four 350 ohm load cells, for from 5.5 hours (with maximum display segments on) to 9 hours (with minimum display segments on). This time can be extended if the Sleep and Auto-Shutoff features are employed.

LOAD CELLS	BATTERY LIFE (in Hours)
1	7 to 13
2	6.5 to 11.5
3	6 to 10
4	5.5 to 9
6	5 to 7.5
8	4.5 to 6.5



NOTE! The 205/210 indicators are shipped with the load cell excitation voltage set to 12V (J3 *open*). To operate from a 12 VDC battery, the load cell excitation voltage **MUST** be set to 8V (J3 *closed*). Battery operation with the load cell excitation voltage set to 12V will result in an unstable weight display. Refer to Figure No. 6 for location of J3.

Battery Installation

1. Remove the AC power to the indicator.
2. Referring to Figure No. 11, remove the three acorn nuts securing the Battery Access Cover to the bottom of the indicator, then remove the cover exposing the battery access opening.
3. Insure the (-) negative polarity markings of the battery are positioned facing up (towards the front of the indicator) and the alignment notch in the battery is to the left.
4. Slide the battery into the opening, compressing the battery ejector spring, until you feel resistance and the battery is almost flush with the bottom of the indicator.
5. Replace the Battery Access Cover and install the three acorn nuts removed earlier, securing the battery in place.

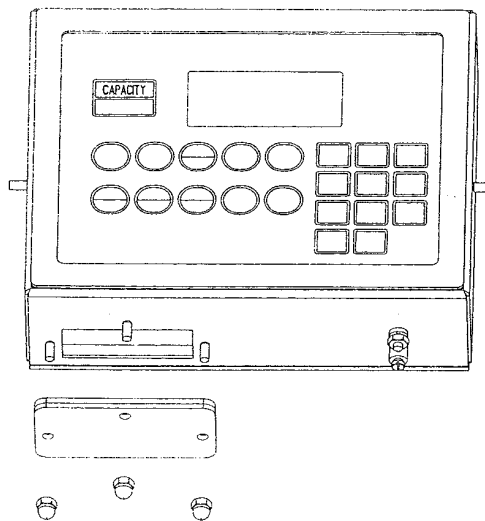


Figure No. 11

Battery Removal

1. Remove the AC power to the indicator.
2. Referring to Figure No. 11, remove the three acorn nuts securing the Battery Access Cover to the bottom of the indicator.
3. Remove the cover, exposing the battery access opening.
4. An internal spring will push the battery partially out of the opening. Grasp the end of the battery and slide it out of the opening.
5. Replace the Battery Access Cover and install the three acorn nuts remove earlier.

OPTIONAL BATTERY OPERATION, Cont.

Discharging the Battery

The battery is discharging when the indicator is operated without the AC power cord plugged into a wall outlet. The LO BAT annunciator on the indicator keypad serves to indicate the state of the battery. When the indicator is operating by battery power, and the battery has sufficient charge to power the indicator, the LO BAT annunciator is off. If the battery becomes discharged while the indicator is in use, the LO BAT annunciator will turn ON to indicate the battery needs to be charged. When this occurs, the battery will have sufficient charge to power the indicator for a short time (less than 1 hour of operation) before recharging is required.

If continued use further drains the battery to a level where the battery is unable to adequately power the indicator, the indicator will turn off automatically to prevent damaging the battery.

NOTE! If the battery has become severely discharged, the indicator may not respond at all when turned on. This is a safety feature to prevent the indicator from being powered up when the battery voltage is excessively low. Plug the indicator into the AC wall outlet to charge the battery.



Due to the nature of batteries, shutting the indicator OFF will cause the battery to recover slightly. If the indicator is operated after turning itself off, it may run for a few minutes before the LO BAT annunciator turns ON again. If the battery is too discharged to power the indicator, it will automatically turn itself off when the **ON/OFF** key is pressed.

Charging the Battery

The battery can be recharged with the indicator's built-in charger. Note that the battery can be left connected to the charger indefinitely, without risk of damage.

Cyclic Operation

When operating the indicator totally from battery power and only recharging when the batteries are low, place the Battery Charge Mode jumper(J1) in the FULL position. For the location of the Battery Charge Mode jumper(J1), refer to Figure No. 6.

Back-Up Operation

When operating the indicator from commercial power and using the battery to supply power only in the event of a power loss, place the Battery Charge Mode jumper(J1) in the TRICKLE position. For the location of the Battery Charge Mode jumper(J1), refer to Figure No. 6.

When the battery installed in a indicator needs to be charged, simply plug the AC power cord into a wall outlet and charging will begin. Note that operating the indicator during charging only minimally affects the charge time of the battery. The indicator can operate at a 100% duty cycle and will only prolong the charge time by less than 20%. Note too that charge time is dependent on the depth of the discharge and will vary from one application to the next, but will typically not exceed 10 hours even with the indicator turned on.



NOTE! While the 12 VDC battery is charging, the LO BAT annunciator will remain ON until the battery is charged to approximately 10 volts. Upon reaching that level, the LO BAT annunciator will turn off. This DOES NOT mean the battery is fully charged, only that the battery has reached a charge sufficient to turn off the LO BAT annunciator. At the level of charge where the LO BAT annunciator turns OFF, without further charging, the indicator will only operate for a few minutes before turning ON the LO BAT annunciator again, indicating additional charging is required.

OPTIONAL BATTERY OPERATION, Cont.

Optimum Battery Performance

The life of the battery depends greatly on the duty cycle of the indicator, depth of discharge and operating temperature. The battery will normally provide 10 hours of continuous operation within an operating range of 14 to 104 °F (-10 to +40 °C). Several steps can be taken to optimize the performance and life of the battery.

1. Enable the Auto Shut-Off feature. This feature will cause the indicator to shut itself off after the period of inactivity selected in setup, thus preserving the battery. (Refer to the Setup and Calibration section for an explanation of the Auto Shut-Off feature).
2. If possible, plug the AC power cord into a wall outlet after each work shift to allow the battery to recharge. This will minimize the depth of discharge and greatly increase the number of cycles the battery can undergo.
3. If conditions permit, avoid charging and discharging the battery in extreme cold. Due to the chemistry of batteries, low temperatures decrease the capacity of the battery significantly causing a greater depth of discharge at colder temperatures than at room temperature. The battery will function without problems at temperatures as low as 14 °F (-10 °C) but will not last as many cycles as it would at room temperature.
4. Avoid storing the battery after discharging. If the battery is to be left for several days or more, make certain that it is charged before storage. The optimum environment for batteries is to charge while stored. The type of charger used in the indicator will not damage the batteries in any way even if the battery is left charging indefinitely.

APPENDIX A – ANALOG OUTPUT OPTION (DAC) BOARD

This appendix describes the installation, setup and calibration of the optional Analog Output Option DAC (Digital to Analog Converter) board. This option consists of both a 0 to 10 volt and 4 to 20 mA analog output.

The Analog Output Option (DAC) board (Cardinal p/n 8200-C210-0A) is a 14-bit (16,383 states) analog representation of the displayed weight. The maximum load resistance for the current output is 500 ohms. The minimum load resistance for the voltage output is 2K ohms. Connections are made via a terminal block on the back of the option board. Refer to Figure No. 12 for the connector pin layout.

The 205/210 indicators feature complete "ranging" for DAC output. Users may select a weight range to be used for a selectable voltage range. This covers all current indicators/users and expands the capabilities for new applications. The 205/210 indicators also have auto-detect for option board installation. When the DAC board is found, additional prompts will be added to Setup. The main menu adds "dAC" (dAC?) after "LoCoUt". In addition, the calibration sequence includes the steps necessary to calibrate the analog output.

INSTALLATION

Mounting the DAC Board

NOTE! Should your indicator come with the DAC board already installed, the following information describing the mounting of the board does not apply. Proceed to the Cable Installation section.

1. Make sure the power to the indicator is OFF. Unplug the AC adapter and/or remove the battery.
2. Remove the 12 acorn nuts securing the back panel to the main housing.
3. Lift the back panel from the main housing, taking care not to stretch the cable and wires between the panel and main housing.
4. Locate the threaded mounting stud (below J2) and connector P5 on the main board.
5. To install the DAC board, carefully align the DAC board P1 (pins on trace side of DAC board) with connector P5 on the main board.
6. Align the hole in the DAC board with the threaded mounting stud (below J2) on the main board.
7. Apply even downward pressure to the end of the DAC board with P1.
8. Using the lock washer and hex nut supplied with the DAC board, secure the DAC board to the main board.

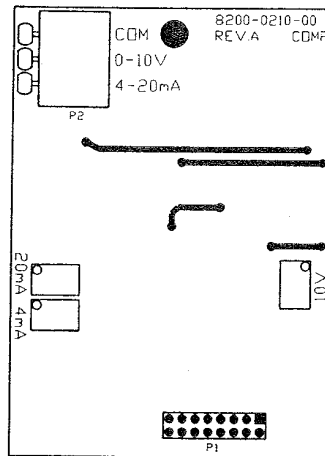


Figure No. 12 - DAC (Rear View)

Cable Installation

1. Loosen a cable gland connector for the Analog Output cable. The gland connector(s) are located on the rear panel of the enclosure.
2. Slip a two wire cable through the gland connector and into the enclosure.
3. Remove 2" of the outer insulation jacket then remove 1/4" of insulation from each of the wires.
4. Connect each of the wires to the terminal block (P2).
5. To terminate, first press down on the release bar for the terminal, insert the wire into the opening then allow the release bar to return to its original position, locking the wire in place. Repeat the procedure until all of the wires are in place.

P2 TERMINAL BLOCK

<u>PIN NO.</u>	<u>Function</u>
COM	Common
0-10V	0 to 10 volt output (2K Ω Min. Load)
4-20 mA	4 to 20 mA current output (500 Ω Max. Load)

CALIBRATION of the ANALOG OUTPUT

The analog output has been calibrated at the factory and should require no other adjustment. If, for some reason, it is found necessary or desirable to readjust this output, the procedure listed below may be used. In order to calibrate the analog output, it is first necessary to enter the Calibration mode by gaining access to the calibration switch. Refer to the Setup and Calibration section of this manual for additional information.

The following questions in the "dAC" section apply only if the board is installed.

dAC (dAC?) – Digital to Analog Converter

With dAC? displayed, press the **ENTER** key. The display will change to show Lo=.

Lo=

Press the **ENTER** key to show the stored value. This is the value, in weight, which outputs zero volts (or 4 mA) from the "dAC". All weight below this target will output zero volts (or 4 mA). If the setting is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the desired weight value, then press the **ENTER** key to save it. The **NET/GROSS** key will change the weight sign. For example, to input -1000 as the weight value, press 1 0 0 0 **NET**. Allowable values are: -99999 to 999999.

Hi=

Press the **ENTER** key to show the stored value. This is the value, in weight, which outputs the maximum selected voltage and current (see oUt=). All weights above this value will output maximum volts from the "dAC". If the setting is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the desired weight value, then press the **ENTER** key to save it. This weight must be a positive value, up to capacity of scale, and above the Lo= value. Allowable values are: 1 to 999999.

oUt=

Press the **ENTER** key to show the stored value. This is the maximum output value in volts (00.01 to 10.00). All weight values equal to or greater than "Hi=" will output this value. Note, that if the scale goes OCAP (over capacity), this value is used also. If the setting is acceptable, press the **ENTER** key again to save it. Otherwise, using the numeric keys enter the desired, then press the **ENTER** key to save it. Allowable values are: 00.01 to 10.00.

NOTE! If the 4 to 20 mA current output is to be used, set "oUt=" to: $10 \times \frac{(\text{max current} - 4)}{16}$

$$\text{Current} = \frac{\text{"oUt="}}{10} \times 16 + 4 \text{ (mA)} \quad (\text{Can not be greater than 20 mA})$$

Adj Hi

This sets the "dAC" output to "oUt=" level for adjusting the level. Adjustment potentiometers "pots" (10V and 20 mA) on the option board are used.

- Adjust the 10V pot for the maximum voltage output entered for "oUt=".
- If the 4 to 20 mA current output is to be used, adjust the 20mA pot for the calculated maximum current.

Press the **ENTER** key to proceed to "Adj Lo", or the **ASTERISK** key to return to the previous prompt.

Adj Lo

This sets the "dAC" output to zero for adjusting the level. Adjustment "pots" (10V and 4 mA) on the option board are used.

- There is no adjustment for zero volts out.
- If the 4 to 20 mA current output is to be used, adjust the 4mA pot for the low (4 mA) current output.

Press the **ASTERISK** key to return to "Adj Hi", or the **ENTER** key to return to the SEtUP prompt



NOTE! Cycling between "Adj Hi" and "Adj Lo" is necessary when adjusting the current out. This must be repeated until no adjustment is necessary.

CALIBRATION of the ANALOG OUTPUT, Cont.

RE-INSTALLING THE REAR PANEL

After all terminations have been made, remove the excess cable from the instrument enclosure and securely tighten each of the cable gland connectors. Do not over-tighten these connectors but make certain they are snug. **DO NOT USE TOOLS!** Finger tighten only! Insure any unused gland connectors are plugged.

Make certain no cables or wires are exposed between the main housing and rear panel then place the rear panel onto the main housing. Secure with the 12 acorn nuts removed earlier.

NOTE! Follow a diagonal pattern when tightening the acorn nuts.

EUROPEAN DECLARATION OF CONFORMITY

Manufacturer: Cardinal Scale Manufacturing Company
PO Box 151
203 East Daugherty
Webb City, Missouri 64870 USA

Telephone No. 417 673 4631
Fax No. 417 673 5001

Product: Non-automatic Weight Indicating Instrument
Model Numbers 200, 205, 210 and 220
Serial Number EXXXYY-ZZZ
where XXX = day of year
YY = last two digits of year
ZZZ = sequential number

The undersigned hereby declares, on behalf of Cardinal Scale Manufacturing Company of Webb City, Missouri, that the above-referenced product, to which this declaration relates, is in conformity with the provisions of:

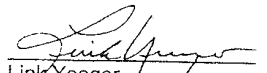
European Standard EN 45501: 1992 and equivalent International
Recommendation OIML R76, edition 1992
EU Type Approval Certificate Number DK 0199.47
Report No. DANAK-195612

Council Directive 73/23/EEC (19 February, 1993) Low Voltage Directive
as amended by Council Directive 93/68/EEC (22 July, 1993)

Council Directive 90/384/EEC (20 June, 1990) on the Harmonization
Of the Laws of Member States relating to non-automatic weighing
Systems as amended by:
Council Directive 93/68/EEC (22 July, 1993)
Report No. DANAK-195728

European Standard EN50082: 1995 for radiated emissions and
European Standard EN50082-2: 1995 Class B for EMC immunity.

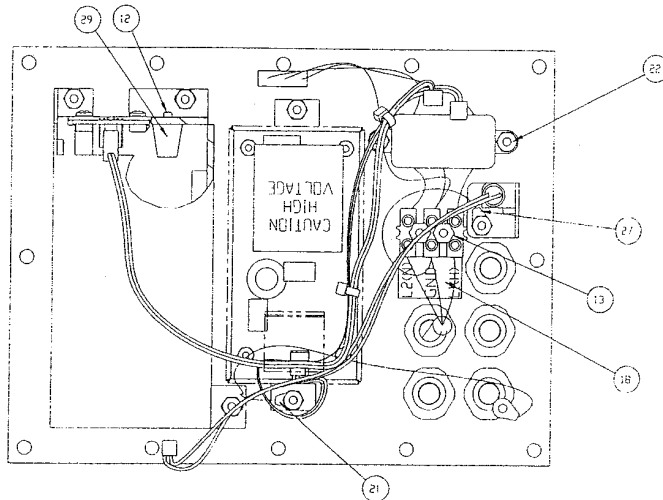
The Technical Construction File required by this Directive is maintained at the corporate headquarters of Cardinal Scale Manufacturing Company, 203 East Daugherty, Webb City, Missouri.


Link Yeager
Director, Quality Assurance

PART IDENTIFICATION

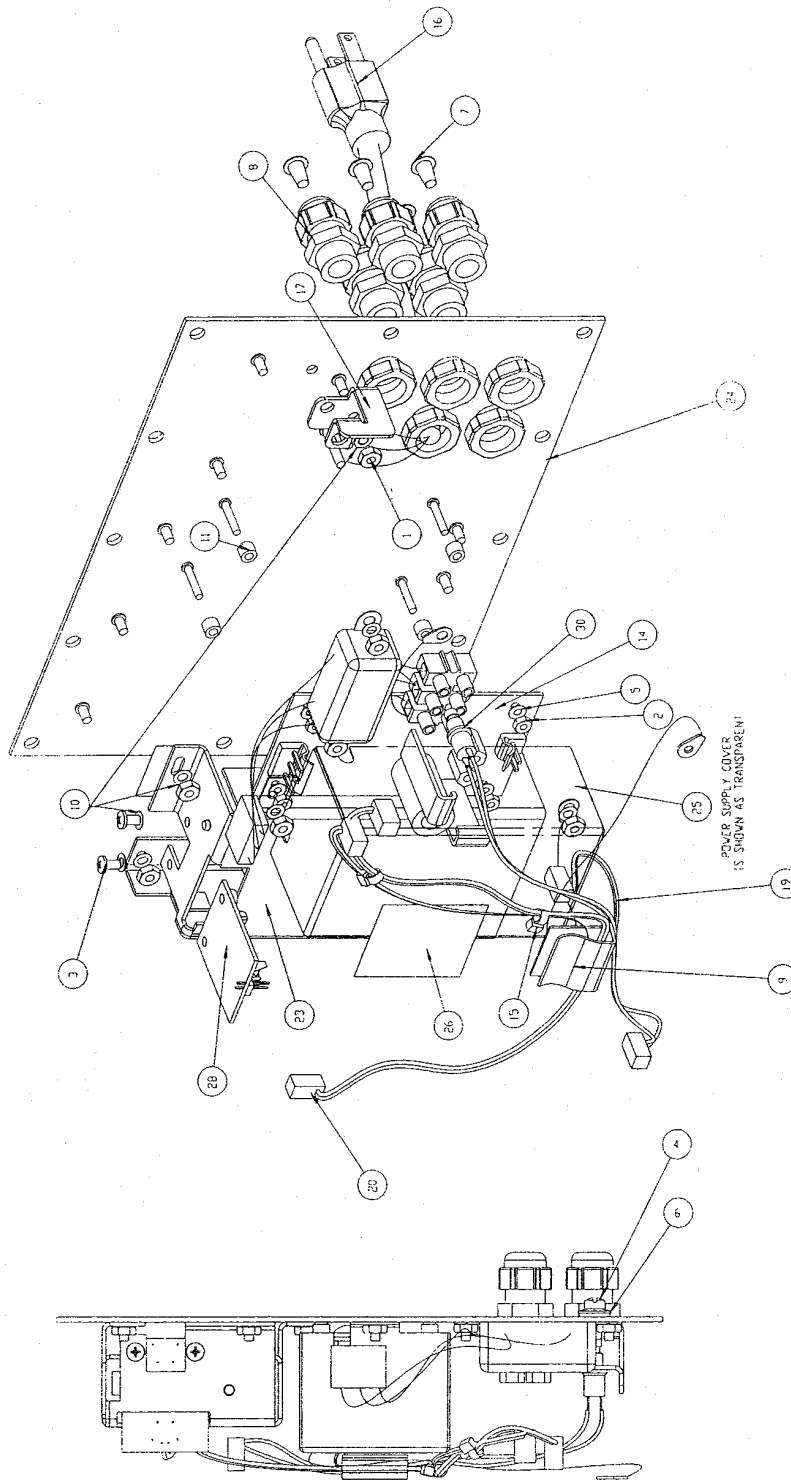
(Rear Enclosure Sub Assembly)

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	8	6013-0039	HEX NUT #6-32
2	4	6013-0245	HEX NUT #4-40
3	2	6021-0654	SCW PAN HEAD #6-32 x .250 PDMS
4	1	6021-1108	SCW FILLISTER MACHINE-SCW #10-32 x .375 S.S.
5	4	6024-0108	WASHER LOCK INT. TOOTH #4 S.S.
6	1	6024-1081	WASHER FLAT #10 NEOPRENE BACKING S.S.
7	4	6540-1104	PLUG, HOLE 0.173-.240 RED POLYETH
8	5	6610-2248	GLAND CONNECTOR
9	1	6610-5007	CABLE CLIP
10	10	6680-0004	WASHER LOCK INT. TOOTH #6 Z/P
11	4	6680-0138	SPACER #6 x .187 NYLON
12	1	6680-0200	POP RIVET
13	2	6680-0203	SPACER (PCB) #6-32 x .500
14	1	6800-1033	POWER SUPPLY BOARD
15	2	6980-0014	WIRE TIE 4" BLACK
16	1	6980-1030	POWER CORD 18/3 SVT CEE 6.3 FT
17	1	8200-B019-08	BRACKET: CALIBRATION SWITCH
18	1	8200-B104-08	LABEL: 205/210 TERM. BLOCK
19	1	8200-B204-0A	CABLE: 205/210 POWER SUPPLY OUTPUT
20	1	8200-B205-0A	CABLE: 205/210 BATTERY CABLE
21	1	8200-B212-0A	CABLE: GND
22	1	8200-B215-0A	CABLE: AC POWER W/FILTER 205/210 DWI
23	1	8200-C012-08	BRACKET, BATTERY HOLDER
24	1	8200-C016-0A	WELDMENT: ENCLOSURE REAR
25	1	8200-C018-08	POWER SUPPLY COVER
26	1	8510-C346-0I	LABEL - HIGH VOLTAGE
27	1	8512-B350-0A	WIRE: 18GA, GRN, 5.0, #8RT/TINNED
28	1	8526-B222-0A	BATTERY POWER BOARD
29	1	8526-B232-08	SPRING, BATTERY COVER
30	1	8539-B254-0A	ASSEMBLY: CABLE, CALIBRATION SWITCH



PART IDENTIFICATION

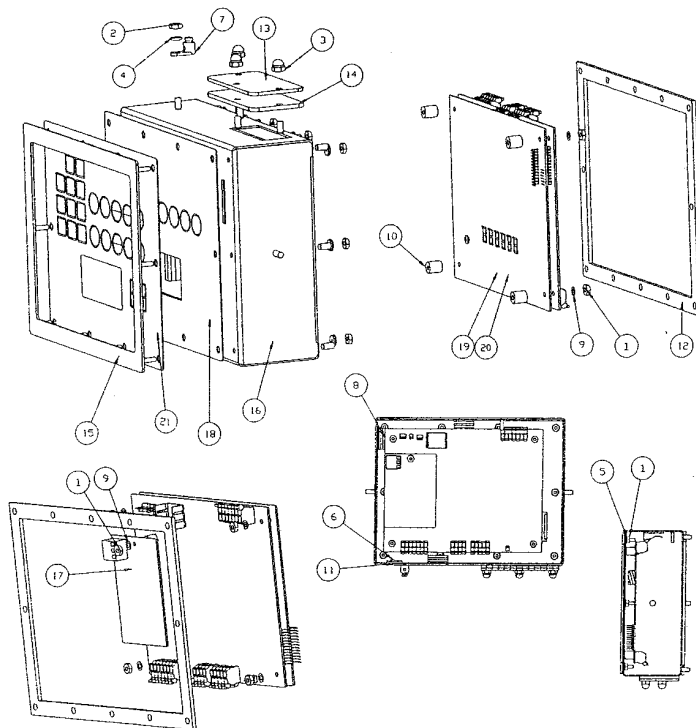
(Rear Enclosure Sub Assembly)



PART IDENTIFICATION

(Front Enclosure Sub Assembly)

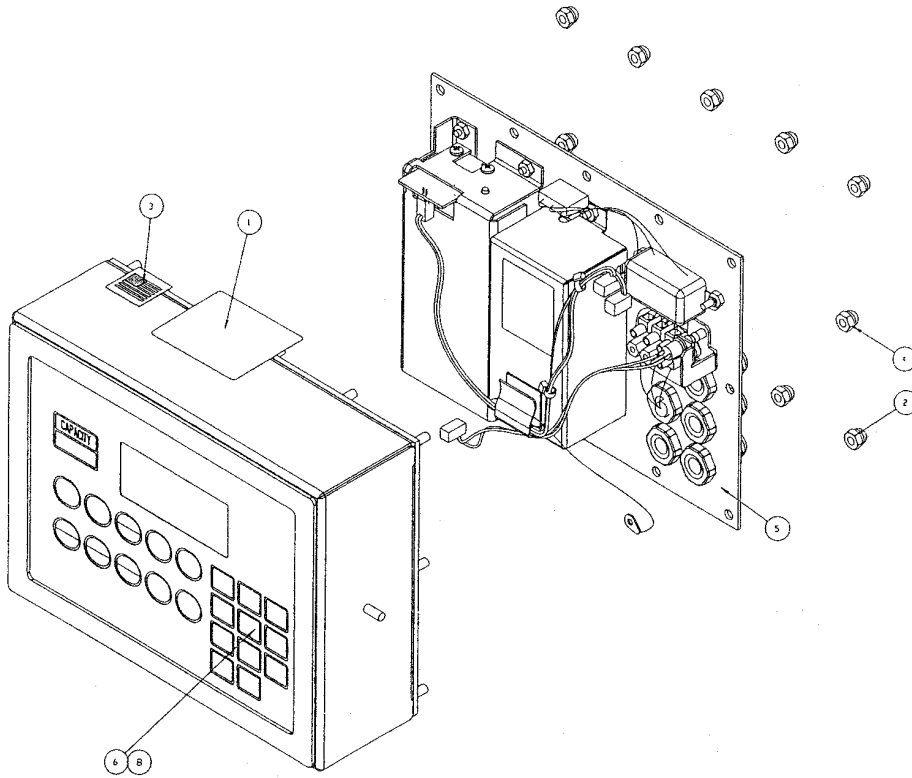
ITEM NO.	QTY.	QTY.	PART NUMBER	DESCRIPTION
	205	210		
1	14	14	6013-0039	NUT HEX #6-32
2	1	1	6013-0297	NUT 10-32 HEX
3	3	3	6013-0433	NUT HEX #10-32 ACORN S.S.
4	1	1	6021-0623	SCW PAN HEAD #6-32 x .750 PDMS
5	10	10	6024-1078	WASHER FLAT #6 NEOPRENE BACKING S.S.
6	1	1	6560-0064	DESSICCANT 1 x 1 BAG
7	1	1	6610-5002	GROUND LUG
8	3	3	6610-5007	CABLE CLIP
9	4	4	6680-0004	WASHER LOCK INT. TOOTH #6 Z/P
10	4	4	6680-1049	SPACER (PCB) #6 x .438
11	1	1	6710-1017	TAPE DBL SIDED 1.0 WIDE 45 MIL THK.
12	1	1	8200-B014-08	GASKET FOR 210 ENCLOSURE
13	1	1	8200-B020-08	COVER, BATTERY
14	1	1	8200-B021-08	GASKET: BATTERY DOOR
15	1	1	8200-C015-0A	WELDMENT: BEZEL FOR 210
16	1	1	8200-C017-0A	WELDMENT: ENCLOSURE, FRONT
17			8200-C201-0A	DAC PCB (OPTIONAL)
18	1		8200-D100-08	KEYPAD: 205 DWI
19	1		8200-D201-0A	PC BD, ASSY. 205 MAIN
20		1	8200-D201-1A	PC BD, ASSY. 210 MAIN
21		1	8200-D202-08	KEYPAD: 210 DWI



PART IDENTIFICATION

(Final Assembly)

ITEM NO.	QTY.	QTY.	PART NUMBER	DESCRIPTION
	205	210		
1	1	1	593GR986	SERIAL TAG ASSEMBLY
2	11	11	6013-0433	NUT HEX #10-32 ACORN S.S.
3	1	1	6650-0087	LABEL: MADE IN THE USA
4	1	1	8200-B026-08	NUT HEX #10-32 ACORN S.S. DRILLED
5	1	1	8200-D207-0A	SUB ASSEMBLY: REAR ENCLOSURE
6		1	8200-D208-0A	SUB ASSEMBLY: FRONT
8	1		8200-D208-1A	SUB ASSEMBLY: FRONT 205

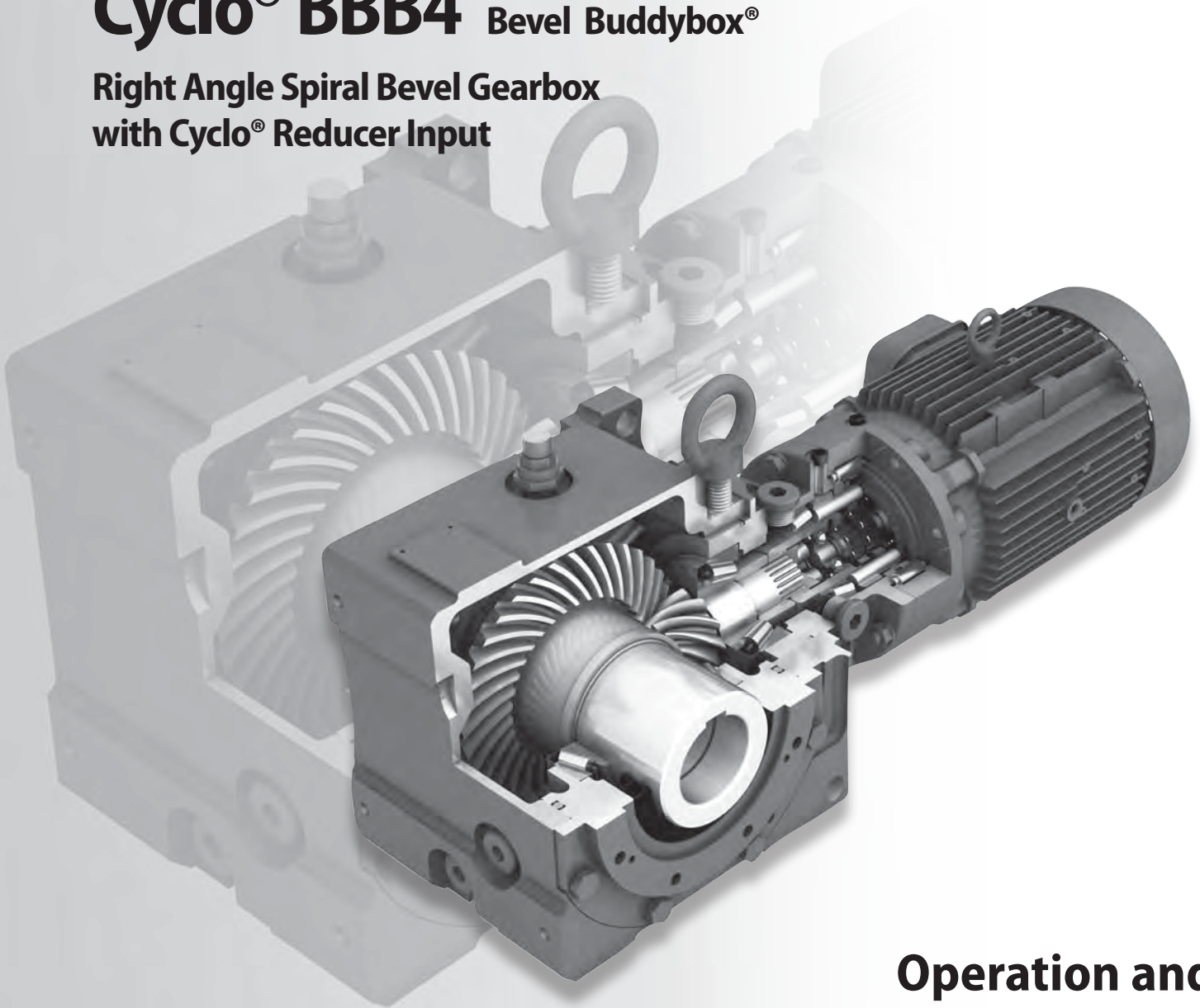




Sumitomo Drive Technologies
Always on the Move

Cyclo[®] BBB4 Bevel Buddybox[®]

Right Angle Spiral Bevel Gearbox
with Cyclo[®] Reducer Input



Operation and Maintenance Manual

Manual 13.604.60.002

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Important Notes

Safety Symbols

These safety symbols appear throughout this manual to indicate important warnings:



DANGER: Incorrect handling of the unit and/or failure to follow the instructions may cause physical damage, serious personal injury, and/or death.



CAUTION: Incorrect handling of the unit and/or failure to follow the instructions may cause physical damage and/or personal injury.

Safety Precautions

Review and adhere to the instructions in this manual to ensure:

- trouble-free Cyclo® BBB4 operation
- your rights to make a warranty claim.

Read this manual and all accompanying documents thoroughly before use. Understand the machine, information on safety, and all precautions for correct operation. Sumitomo recommends making this manual easily accessible for reference at the machine location.



- **Only properly trained personnel** should transport, install, align, wire, inspect, operate, and maintain the unit.
- When the unit is to be used in a system for transport of human beings, a secondary safety device should be installed to guard against accidents that may result in injury, death, or damage to the system.
- When the unit is to be used for an elevator, install a safety device on the elevator side to prevent it from falling; otherwise, serious injury, death, or damage to the elevator may result.



CAUTION:

- Operate the unit only within its design and performance specifications; otherwise, injury or damage to the system may occur.
- Keep hands and all foreign objects from the internal moving parts of the unit; otherwise, injury or damage to the system may occur.
- Take damaged units off-line immediately and do not resume operation until properly repaired.
- Modifications or alterations of any kind to the unit will void the warranty and all subsequent claims.
- Do not remove the rating plate.

Disposal

Please refer to local, state, and federal regulations governing disposal of:

Steel Scrap:

- Housing (Ductile and Gray Cast Iron)
- Gears
- Shafts
- Bearings

Lubricants:

- Gear Oil
- Grease

Inspection Upon Delivery



- In order to avoid injury, **ensure that the unit is in a stable position** before unpacking.
- **Verify that the unit received matches your order.** Using the incorrect product may cause equipment damage or personal injury.
- **Do not** remove the nameplate from the unit.

Upon delivery, inspect the unit for damage that may have occurred during shipment. Notify the shipping company immediately if you find any damage. **Do not** install or operate a damaged unit.

Upon receipt of the reducer/gearmotor, verify that:

- the model number on the unit nameplate matches the purchase order
- the unit was not damaged during shipping
- all bolts and nuts are fully tightened.

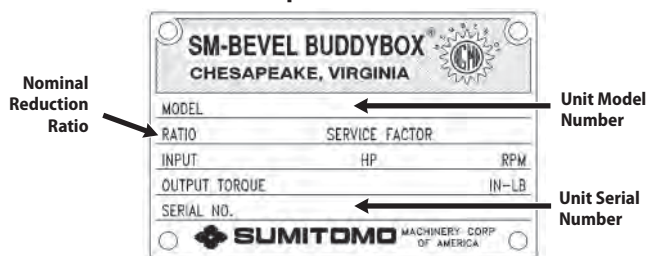
Please consult your Sumitomo agent, distributor, or sales office if you find any defects or if you have any questions.

Nameplate Inspection

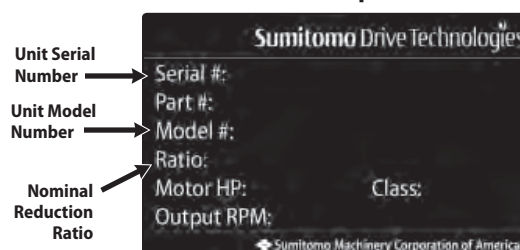
When contacting Sumitomo about this product, please be prepared to provide the following information from the reducer/gearmotor nameplate:

- **reducer or gearmotor model number (nomenclature)**
- **reduction ratio**
- **serial number.**

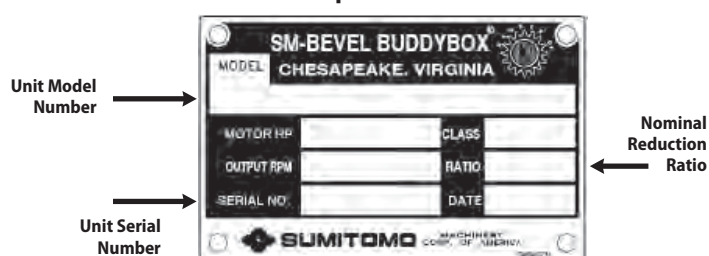
Metal Nameplate



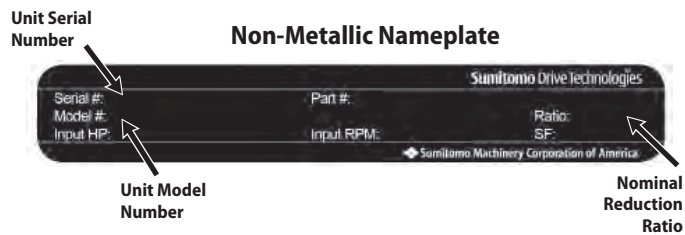
Non-Metallic Nameplate



Metal Nameplate



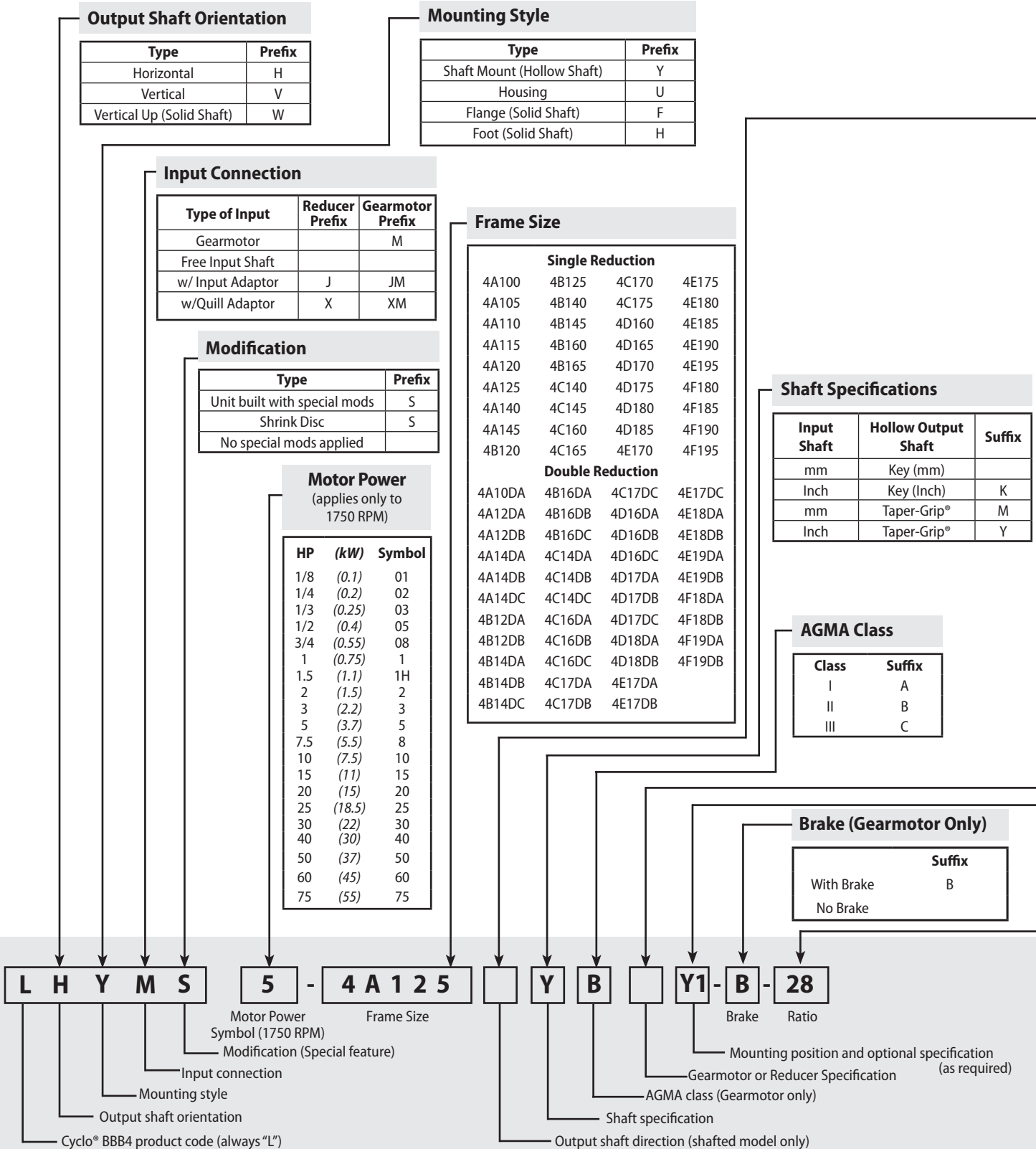
Non-Metallic Nameplate



Nomenclature

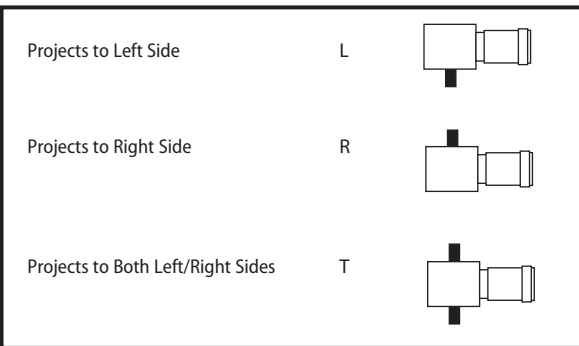
Nomenclature

Our nomenclature details specific information about our products. Verify that the nomenclature of the unit delivered matches your order.



Nomenclature, continued

Output Shaft Direction (shafted model only)



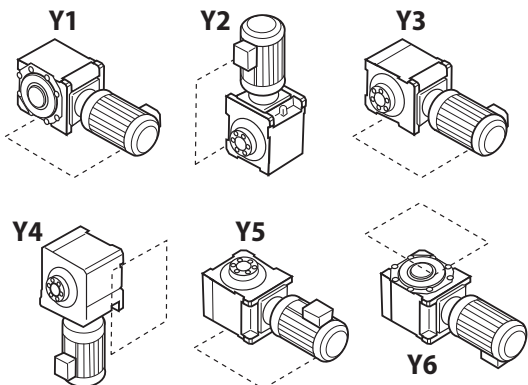
Gearmotor Specification

Specification	Suffix
Three-Phase Motor	
Single-Phase Motor	SG
AF Motor (Adj. Frequency)	AV
Servo Motor	SV
DC Motor	DV
Torque Limiter	TL

Reducer Specification

Type	Suffix
Standard	
Baseplate	BP
Shovel Base	SB
DC Motor	DV

Mounting Positions



Nomenclature Example: LHYMS-5-4A125-YB1-B-28

- | | |
|--------------------------------|-------------------------------------|
| L - Cyclo® Bevel Buddybox | 4A125 - Frame Size |
| H - Horizontal | Y - Inch Shaft Specification |
| Y - Shaft Mount (Hollow Shaft) | B - AGMA Class |
| M - Gearmotor | Y1 - Mounting Position |
| S - Special Modifications | B - Brake (gearmotor only) |
| 5 - 5 HP (3.7kW), 1750 RPM | 28 - Ratio |

Nominal and Exact Ratio

BBB with Planetary Input				BBB with Cyclo Input			
Nominal Ratio		Frame Size	Exact Ratio	Single Reduction			
Input	Overall			Nominal Ratio		Frame Size	Exact Ratio
				Input	Overall		
3	11	4A10	10.50	All	6	21	21.0
		4A12			7	22	22.4
		4A14	10.89		8	25	24.5
		4B14			11	28	28.0
		4B16	10.85		13	35	35.2
		4C16			15	39	38.5
	4D16	17			46	45.5	
	4E17	21			53	52.5	
	4E18	10.50	25		60	59.5	
	4F18		29		67	67.2	
	4E19	10.82	35		74	73.5	
	4F19		41		80	80.0	
4	13	4A10	12.99	45	88	87.5	
		4A12	12.80	55	102	101.5	
		4A14	12.95	65	112	112.0	
		4B14		75	123	122.5	
		4B16	12.80	85	151	150.5	
		4C16		95	179	178.5	
	4D16	105		207	206.5		
	4D17	115		249	248.5		
	4E17	13.09	125	305	304.5		
	4E18		135	417	416.5		
	4E18	13.01	145	417	416.5		
	4F18		155	417	416.5		
5	14	4A10	14.21	All	104	364	364.0
		4A12	14.00		121	424	423.5
		4A14	14.16		143	501	500.5
		4B14			165	578	577.5
		4B16	14.00		195	683	682.5
		4C16			231	809	808.5
	4D16	273			956	955.5	
	4D17	319			1117	1116.5	
	4E17	14.32	377		1320	1319.5	
	4E18		473		1656	1655.5	
	4E18	14.23	559		1957	1956.5	
	4F18		649		2272	2271.5	
4E19	16.26	731	2559	2558.5			
4F19		841	2944	2943.5			
4E19	16.17	1003	3511	3510.5			
4F19		1247	4365	4364.5			
5	16	4A10	15.36	All	1479	5177	5176.5
		4A12	15.65		1849	6472	6471.5
		4A14	16.00		2065	7228	7227.5
		4B14			2537	8880	8879.5
		4B16	16.26		3045	10658	10657.5
		4C16			3481	12184	12183.5
	4D16	4437			15530	15529.5	
	4D17	5133			17966	17965.5	
	4E17	16.17	6177		21620	21619.5	
	4E18		7569		26492	26491.5	
	4E18	15.63	841		2944	2943.5	
	4F18		1003		3511	3510.5	
4E19	15.47	1247	4365	4364.5			
4F19		1479	5177	5176.5			
5	18	4A10	16.80	All	1849	6472	6471.5
		4A12	17.12		2065	7228	7227.5
		4A14	17.50		2537	8880	8879.5
		4B14			3045	10658	10657.5
		4B16	17.78		3481	12184	12183.5
		4C16			4437	15530	15529.5
	4D16	5133			17966	17965.5	
	4D17	6177			21620	21619.5	
	4E17	17.68	7569		26492	26491.5	
	4E18		17.10		841	2944	2943.5
	4E18	16.92			1003	3511	3510.5
	4F18		1247		4365	4364.5	
4E19	16.92	1479	5177	5176.5			
4F19		1849	6472	6471.5			

Storing and Transporting

Storage Location

- Store the unit in a clean, dry area.
- **Do not** store outdoors or in an area with high humidity, dust, sudden temperature changes, or corrosive gases.

Generally, the Cyclo® BBB4 gearbox is to be stored indoors, in an ordinary factory or a warehouse. The unit should be sealed, wrapped in plastic and additionally packed with desiccant. Desiccant should be replaced periodically to keep the inside of the box dry. Use of color changing desiccant will aid in identifying when desiccant should be changed.

Storage Period

- **Do not** store the unit for longer than 3 months without following long-term storage procedures recommended by Sumitomo.
- Consult Sumitomo when storing the unit for more than 3 months. Rust proofing procedures are required.
- Consult Sumitomo when exporting the unit. Rust proofing procedures may be required.

If the Cyclo® BBB4 gearbox will be inactive for a long period of time, long-term storage preparation is required to prevent rust or other degradation to the gearbox.

LONG-TERM STORAGE SPECIFIED WITH ORDER:

If long-term storage is specified at the time of order entry, Shell VSI Circulating Oil #32 or NP-20 [JIS] equivalent rust preventative is already sprayed into the Cyclo® BBB4 reducer and the air vent is replaced with a sealing plug before shipping the reducer from Sumitomo factory. External machined surfaces are coated with a suitable NP-19 [JIS] petroleum base corrosion preventative such as Black Bear Par-Al-Ketone, Houghton Rust Veto 342, Daphne Ever Coat No.1 or equivalent.

Consult Sumitomo for Long Term Storage procedures:

- Storage without factory preparations
- Ongoing maintenance during storage period

unit of rust preventative and ensure that non-metal parts, i.e., oil seals, o-rings, air breather, have not deteriorated. Non-metal parts may deteriorate easily from exposure to ambient conditions (i.e., extreme temperatures, UV rays). Replace deteriorated parts with new before unit start-up.

After starting the unit, verify that there is no abnormal noise, vibration, and/or temperature rise. Immediately stop the unit and call your local distributor, Original Equipment Manufacturer or Sumitomo directly if you observe any abnormality.

Transporting



- **Do not** stand directly under a unit suspended by a lifting mechanism. Injury or death may occur if the unit is dropped.
- **Before lifting the unit**, determine its weight (refer to catalog, packing list, etc.) and ensure that the moving equipment will support the unit's weight.
- **Never hoist or move a unit that exceeds the moving equipment's rated capacity** or else personal injury and/or equipment damage may occur.
- **Do not** allow the unit to drop or fall while moving. **Always use the eye bolts** attached to the gear housing (and on motor if supplied) when moving the unit. After securing the unit to the machine, remove the moving hooks/straps from the eyebolts.

Operation After Storage

Before operating the unit after an extended storage period, flush

Installation Precautions



- Do not use the reducer/gearmotor for specifications other than those shown on the nameplate or in the manufacturing specification documents. Personal injury and/or equipment damage may occur.
- Do not place combustible material on or around the unit; fire may occur.
- Do not place any objects around the unit that will prohibit proper ventilation. Inadequate ventilation may lead to high unit temperature and/or fire.
- Do not step on or hang from the unit. Excessive weight may cause component breakage leading to personal injury and/or equipment damage.
- Do not touch the shaft, keyway, or motor fan with bare hands; injury may occur.
- For applications in which lubricant leaks could adversely affect operations (i.e., package handling, food processing), place an oil pan below the unit to protect against contamination that may occur if oil seals become damaged or worn.
- Do not remove the eye-bolt from the motor. Should the eye-bolt need to be removed for any reason, install a replacement bolt in the tapped hole to prevent water from entering the motor.

Installation Location

Ambient Temperature Range:	14° - 104°F (-10° - 40°C)
Ambient Humidity:	85% or less
Ambient Conditions:	14°F minimum
Altitude:	3,280 feet (1,000 m) or less
Atmosphere:	The location should not contain corrosive gas, explosive gas, or steam. The location should be free of dust and well ventilated.
Location:	Indoor – free of dust and water

Consult Sumitomo when the unit will operate in conditions other than those specified above. Special unit modifications may be required.

Units manufactured according to customer specified application requirements (i.e. outdoor modifications, high-temperature modifications) are designed to operate within the specified environment.

Install the unit so inspection and/or maintenance procedures may be easily performed. Install all units that are not shaft mounted on a sufficiently rigid base.

Torque arm clearance with machine structure is required to allow for machine shaft run out. Refer to the Torque Arm Installation section in this manual for additional information.

Installation Angle

Mount the unit in the specified position for which it was ordered. Confirm the mounting position from the gearbox nameplate.

Consult your local distributor, Original Equipment Manufacturer or Sumitomo directly if the mounting angle is to be **other than horizontal or vertical**.

Severe Loading Conditions

For applications with severe vibration and/or frequent starts and stops, Sumitomo recommends the use of high-strength mounting bolts of Grade 8.8 (or greater).

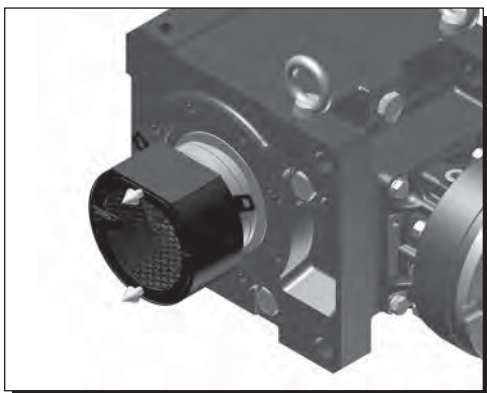
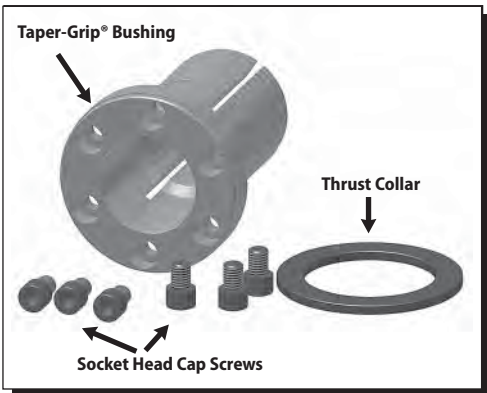
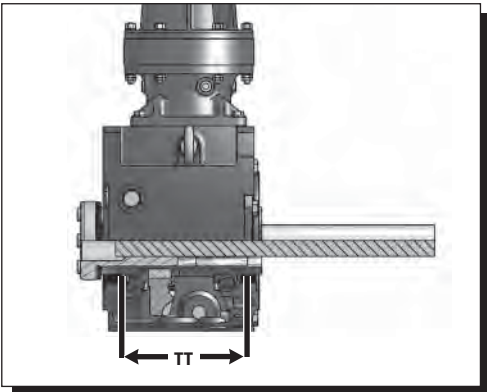
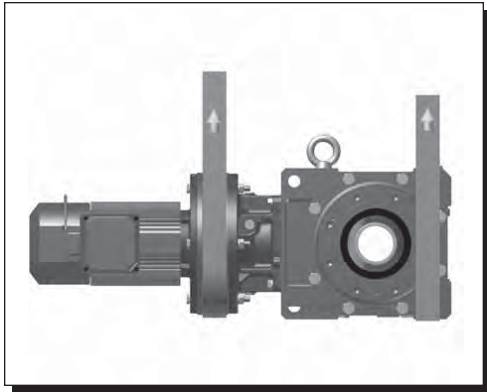
Installation onto the Driven Machine



- Before coupling the reducer/gearmotor to the machine, verify the appropriate/desired rotation of the machine. Differences in the rotational direction may cause personal injury and/or equipment damage.
- Before operating the unit, ensure that all safety guards around the rotating components are in-place and secure. Failure to do so may result in personal injury.
- When joining the reducer or gearmotor to the load, ensure that the center alignment, belt tension, and/or parallelism of the coupling device are within the coupling manufacturer's established recommendations. For applications with a belt, ensure that the belt is properly tensioned to the manufacturer's specification, and the bolts securing the pulley and couplings are sufficiently tightened. Failure to follow these precautions may result in personal injury and/or equipment damage.

Installation onto Driven Shaft

Taper-Grip® Bushing



Taper-Grip® Bushing Introduction

The keyless Taper-Grip® bushing system provides a simple and reliable shaft attachment for Sumitomo speed reducers and gearmotors. This system allows bi-directional shaft rotation operation with a powerful, slip-free grip. To assure peak performance of your equipment, please read, understand and follow these installation instructions.



Prior to installation of the Cyclo® BBB4 onto the driven shaft, ensure that the shaft length meets or exceeds the minimum shaft engagement value "TT" detailed in Table 1.



Do not operate unit until the torque arm has been attached to the unit and fixed to a rigid structure. The torque arm prevents counter-rotation during unit operation. Refer to torque arm installation section in this manual for instructions.



CAUTION: The Cyclo® BBB4 must be externally supported prior to insertion of driven shaft into bushing. External support **MUST** be maintained until all bushing socket head cap screws have been tightened to the appropriate operational torque.

Components of Taper-Grip® Bushing

As shown in the figure on the left, the Taper-Grip® bushing includes the **bushing**, **thrust collar**, and **socket head cap screws**.

Table 1. Driven Shaft Tolerance ^[1] and Minimum Shaft Engagement

Shaft Diameter (in)	Tolerance (in)
1-3/16 – 1-15/16	+0 / -0.0015
2 – 3-1/8	+0 / -0.0018
3-3/16 – 4-11/16	+0 / -0.0021
4-3/4 – 6-1/2	+0 / -0.0025

Shaft Diameter (mm)	Tolerance (µm)
(30 - 50)	(+0 / -39)
(50 - 80)	(+0 / -46)
(80 - 120)	(+0 / -54)
(120 - 180)	(+0 / -63)

Cyclo® BBB4 Size	TT (in)	TT (mm)
4A	7.79	(198)
4B	9.33	(237)
4C	10.16	(258)
4D	11.82	(300)
4E	13.94	(354)
4F	16.22	(412)

Note: [1] Based on ISO/JIS/DIN h8

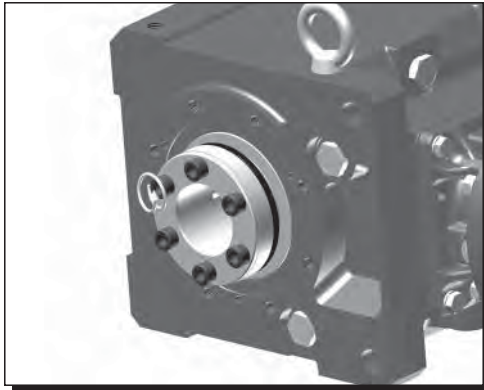
Taper-Grip® Bushing Installation onto Driven Shaft

1

Remove **bushing cover** if unit was supplied with one.

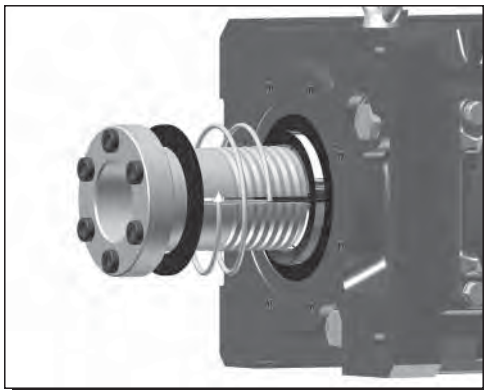
Installation onto Driven Shaft, continued

Taper-Grip® Bushing



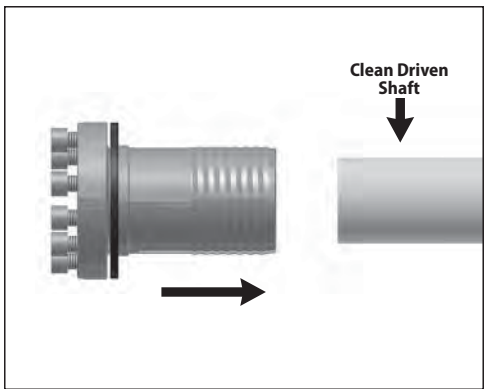
2

Loosen **socket head cap screws**.



3

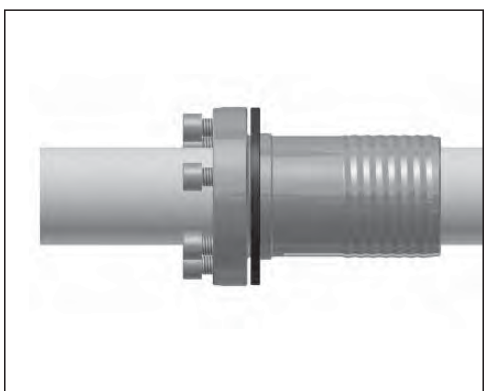
Remove (unscrew) Taper-Grip® bushing from the unit.



4

Clean all **grease, oil** and/or **anti-seize paste** from the driven shaft. Failure to do so could result in damage to shaft.

Slide Taper-Grip® bushing onto driven shaft.



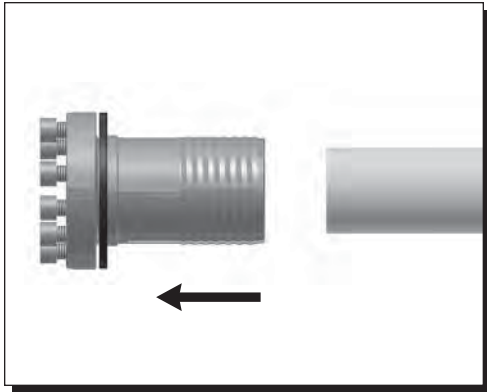
5

Inspect and test Taper-Grip® bushing on shaft.

- Check shaft for **burrs, corrosion, or warp**. Repair or replace shaft as necessary.
- Slide bushing back and forth along shaft, checking for surface irregularities and fit.
- Verify bushing is sized correctly for the shaft diameter.

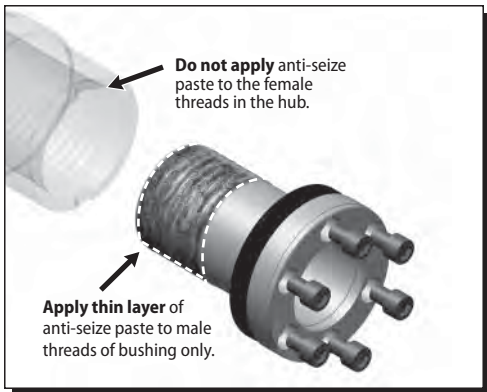
Installation onto Driven Shaft, continued

Taper-Grip® Bushing



6

Remove Taper-Grip® bushing from driven shaft.



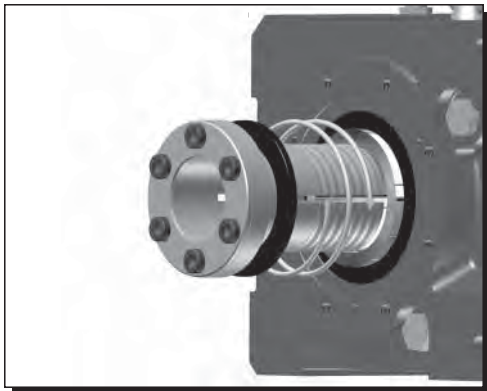
7

Apply a thin layer of anti-seize paste to the male threads of the Taper-Grip® bushing only.



Ensure that the anti-seize paste does not enter the Taper-Grip® bushing bore.

Do not apply anti-seize paste to the female threads in the hub.



8

Screw Taper-Grip® bushing into Cyclo® BBB4 leaving **approximately 1 mm gap between the bushing flange and thrust collar.**



Do not apply grease, oil, or anti-seize paste to the driven shaft or the bushing bore before placing the unit onto driven shaft. Use of these friction-minimizing products will adversely affect the ability of the unit to transmit torque.



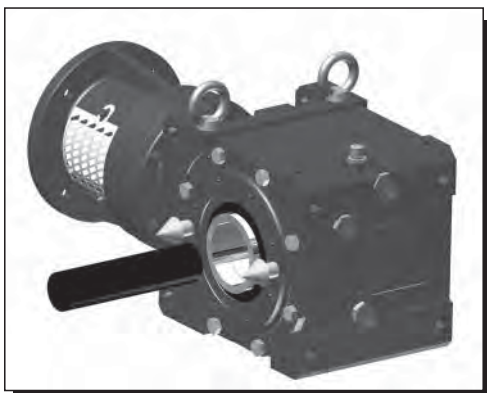
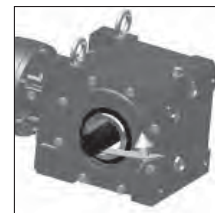
CAUTION: The Cyclo® BBB4 must be externally supported prior to insertion of driven shaft into bushing. External support **MUST** be maintained until all bushing socket head cap screws have been tightened to the appropriate operational torque.

9

Mount or slide the **Cyclo® BBB4** onto the driven shaft to the desired location.

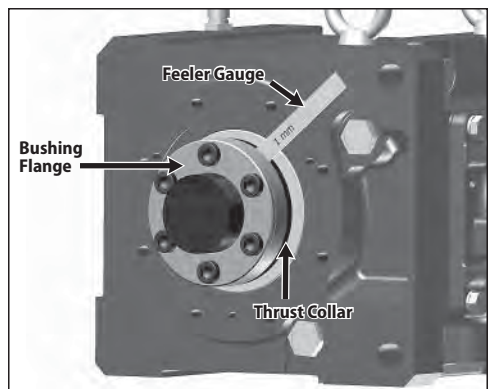


Do not rock or pry the unit.



Installation onto Driven Shaft, *continued*

Taper-Grip® Bushing

**10**

Screw Bolts into Taper-Grip® bushing.

- Lightly oil threads of each bolt before inserting.
- Finger tighten each bolt to secure in place.
- Be sure to **maintain the 1 mm** (approximate) **gap** between the **thrust collar** and the **bushing flange**.

11

Tighten bushing bolts to the correct torque value.

- Following a star pattern, use a torque wrench to **gradually tighten each socket head cap screw in 20% increments**.
- Refer to **Table 2, Taper-Grip® Bushing Bolt Tightening Torques**, for the correct operational screw torques.

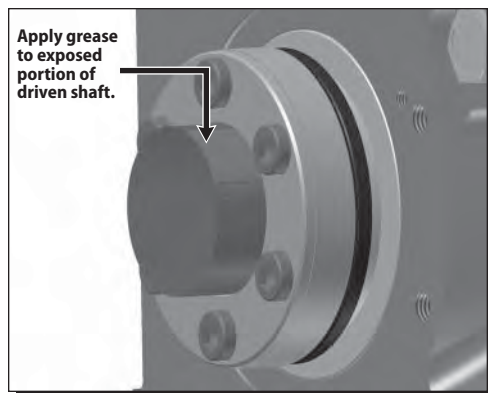
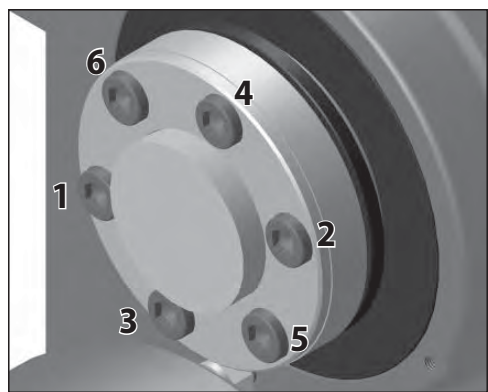
Table 2. Taper-Grip® Bushing Bolt Tightening Torques

Cyclo® BBB4 Size	Screw Qty x Size	Screw Torque	
		lb-ft	(N·m)
4A	6 x M12	56	(75)
4B	6 x M12	104	(140)
4C	6 x M16	185	(250)
4D	6 x M16	223	(300)
4E	8 x M16	223	(300)
4F	10 x M16	223	(300)

12

In order to prevent corrosion, apply grease to the exposed portion of the driven shaft.

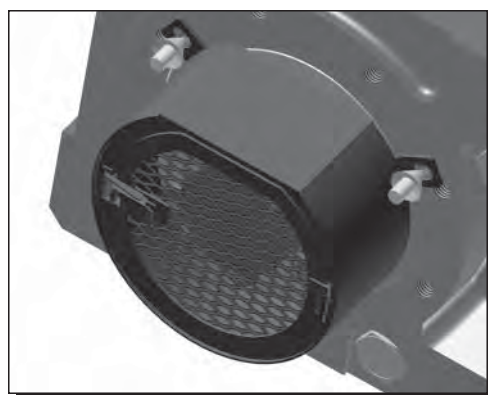
- **After installing and tightening** the bushing bolts with a torque wrench, **apply grease or an anti-corrosion product** to the exposed portion of the shaft.

**13**

For units that include a bushing safety cover, reinstall the guard over the Taper-Grip® bushing.



Do not operate unit until the torque arm has been attached to the unit and fixed to a rigid structure. The torque arm prevents counter-rotation during unit operation. Refer to torque arm Installation section in this manual for instructions.



Installation onto Driven Shaft, continued

Keyed Hollow Bore

Keyed Hollow Bore Installation



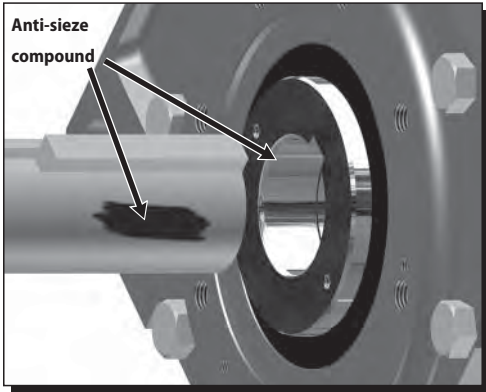
Do not operate unit until the torque arm has been attached to the unit and fixed to a rigid structure. The torque arm prevents counter-rotation during unit operation. Refer to torque arm Installation section in this manual for instructions.



CAUTION: The Cyclo® BBB4 must be externally supported prior to insertion of driven shaft into hollow bore.

Bore and Shaft Tolerance Specifications

- Unless otherwise specified, the tolerance of the Hollow Shaft Bore conforms to JIS H8.
- If application involves high shock loading and/or large radial loads, a shaft tolerance of JIS js6 or JIS k6 is recommended.



Keyed Hollow Bore Installation onto Driven Shaft

1

Apply anti seize compound to the driven shaft surface and inside the reducer keyed hollow bore.

2

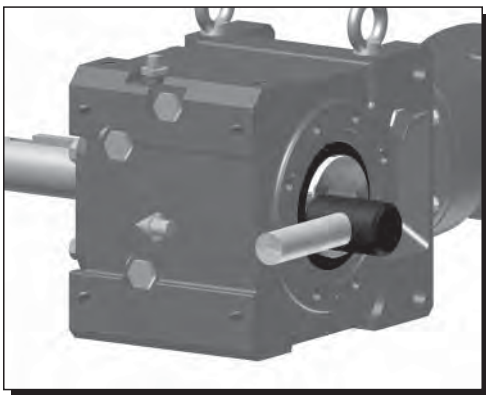
Align the driven shaft with the reducer/gearmotor bore and carefully slide unit onto the driven shaft to the desired location.



If the fit is tight, strike on the keyed hollow bore with a wooden or hard rubber mallet to assist in the assembly.

If using a mallet during installation, strike **only** against the unit's steel keyed hollow bore. Do not strike the reducer housing or oil seal as damage to the bearings, housing and/or seals may occur.

Note: If the fit is tight, use a jig such as the one shown in Table 3 to ease assembly. **Sumitomo does not supply a mounting jig. This information is provided for reference only.**

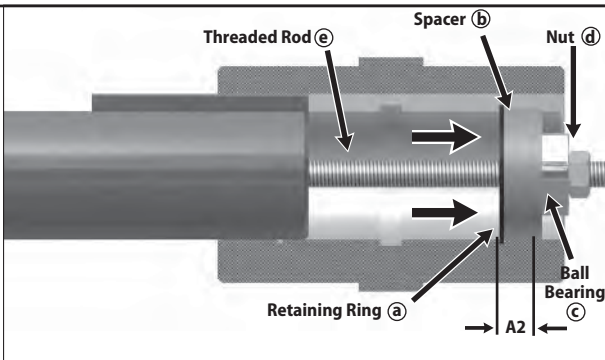
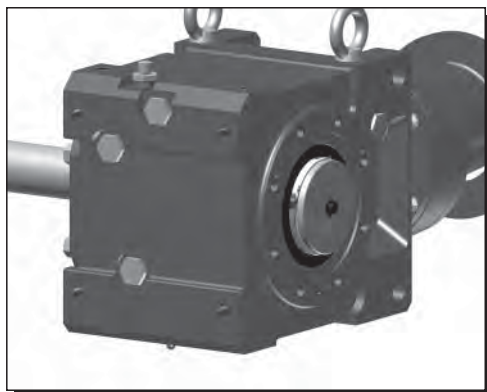


Installation onto Driven Shaft, continued

Keyed Hollow Bore, Shrink Disc Type Hollow Bore

Table 3. Jig Dimensions (mm)

Size	a	b	c	d	e
	CC (ISO/JIS)	A2	Bearing	Nut	Threaded Rod
4A	55	25	51104	M16	M16 x 250
4B	65	25	51105	M20	M20 x 300
4C	75	25	51105	M20	M20 x 300
4D	85	35	51107	M24	M24 x 400
4E	100	35	51107	M24	M24 x 400
4F	120	46	51109	M30	M30 x 450

3

Once driven shaft has been completely inserted into the unit's keyed hollow bore, secure the shaft in place using a keeper plate as shown to the left, or some other means of securing the unit to the driven shaft.



Do not operate unit until the torque arm has been attached. Refer to the Torque Arm Installation section in this manual for instructions.

Shrink Disc Type Mounting Introduction

The **keyless Shrink Disc** provides a reliable commodity shaft attachment for Sumitomo speed reducers and gearmotors. This system allows bi-directional shaft rotation operation with a powerful, slip-free grip.

To assure peak performance of your equipment, please read, understand and follow these installation instructions.



Do not operate unit until the torque arm has been attached to the unit and fixed to a rigid structure. The torque arm prevents counter-rotation during unit operation. Refer to torque arm Installation section in this manual for instructions.



CAUTION: The Cyclo® BBB4 must be externally supported prior to insertion of driven shaft into hollow bore. External support **MUST** be maintained until all shrink disc socket head cap screws have been tightened to the appropriate operational torque.


Bore and Shaft Tolerance Specifications

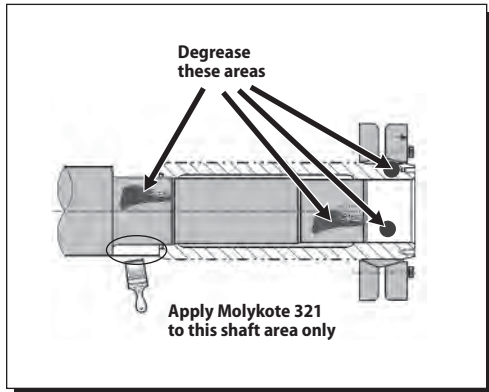
- Refer to the certified outline drawing or Cyclo® BBB4 Catalog for recommended machine shaft dimensions.
- Unless otherwise specified, the tolerance of the Shrink Disc Bore conforms to JIS H8.
- If application involves high shock loading and/or large radial loads, a shaft tolerance of JIS js6 or JIS k6 is recommended.

Installation onto Driven Shaft, continued

Shrink Disc Type Hollow Bore

Shrink Disc Type Hollow Bore Installation onto Shaft

 Before placing unit onto driven shaft, **do not apply grease, oil, or anti-seize paste to the entire driven shaft or to the bore of the shrink disc.** Use of these friction-minimizing products will adversely affect the ability of the unit to transmit torque. Never tighten locking screws before shaft installation. Inner ring may become permanently contracted even at low tightening torques.



1

Clean and degrease contact surfaces; reducer shaft and bore, and the machine driven shaft.

Apply Molykote 321 or an equivalent dry film lubricant to the driven shaft shoulder opposite from the shrink disc.



Do Not apply any friction minimizing compound to the driven shaft at or near the shrink disc.

2

Align the driven shaft with the bore of reducer/gearmotor bore and carefully slide unit onto the driven shaft to the desired location.

- If the fit is tight, strike on the reducer hollow bore with a mallet to assist in the assembly.



If using a mallet during installation, strike **only** against the unit's steel hollow bore. **Do not** strike the reducer housing or oil seal, as damage to the bearings, housing, and/or seals may occur.

If the fit is tight, use a jig such as the one shown in the Keyed Hollow Bore Installation section to ease assembly. **Sumitomo does not supply a mounting jig. This information is provided for reference only.**

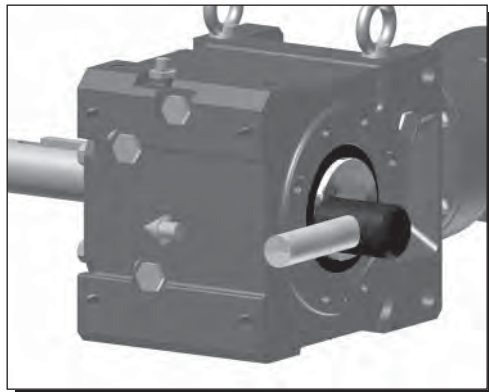
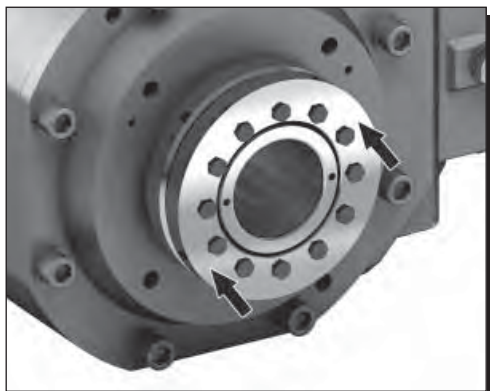


Table 4. Shrink Disc Bolt Tightening Torques

Size	Model (Typical)	Bolt	Bolt Torque	
			lb•ft	(N•m)
4A	TAS-3071-55x68	10 x M6x25 ISO/JIS grade 10.9	9	(12)
4B	TAS-3071-65x80	7 x M8x30 ISO/JIS grade 12.9	26	(34)
4C	TAS-3071-75x100	12 x M8x35 ISO/JIS grade 12.9	26	(34)
4D	TAS-3071-85x110	9 x M10x40 ISO/JIS grade 12.9	51	(68)
4E	TAS-3071-100x140	10 x M12x45 ISO/JIS grade 12.9	87	(118)
4F	TAS-3071-120x165	8 x M16x55 ISO/JIS grade 12.9	214	(290)

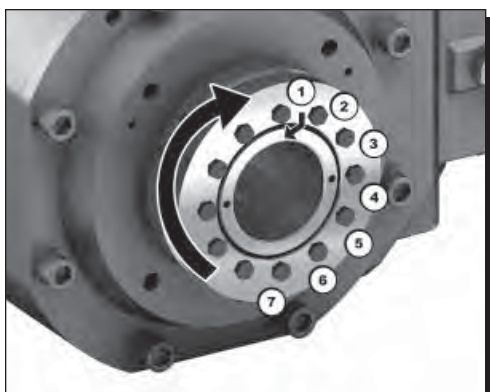
Installation onto Driven Shaft, continued

Shrink Disc Type Hollow Bore



3

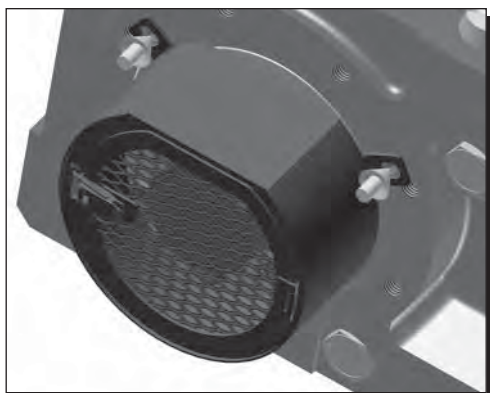
- Set the (untightened) shrink disc on the reducer shaft.



4

Tighten Bolts to the correct torque value.

- For 3-piece design shrink disc, make sure that both plates are parallel when tightening bolts.
- After confirming that the shrink disc is set correctly, tighten the bolts uniformly, in a clockwise pattern while keeping both plates parallel (**not** diagonally or 'star' pattern).
- It is recommended to tighten respective bolts by 30 degrees each time – until the specified torque is reached.



5

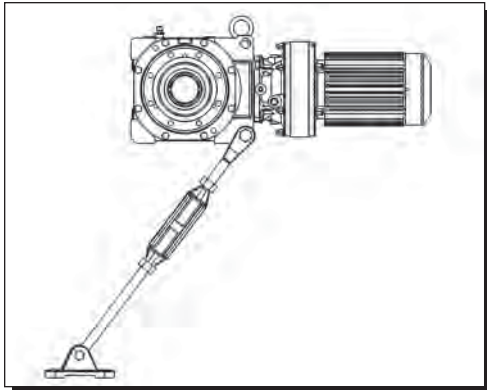
For units with a safety cover, install the guard over the **shrink disc**.



Do not operate unit until the torque arm has been attached. Refer to the Torque Arm Installation section in this manual for instructions.

Torque Arm Installation

Torque Arm Introduction, Turnbuckle Type Torque Arm



Torque Arm Introduction

A **torque arm** is a device used to prevent counter-rotation of the shaft mounted reducer/gearmotor during operation.



The torque arm **must** be mounted in **tension** when torque arm mounting point is greater than 6 inches (150mm) from machine mounting point or, tie-rod or turn buckle type torque arm is used.

Turnbuckle Type Torque Arm Parts

Figure 1. Turnbuckle Rod Type Torque Arm Parts

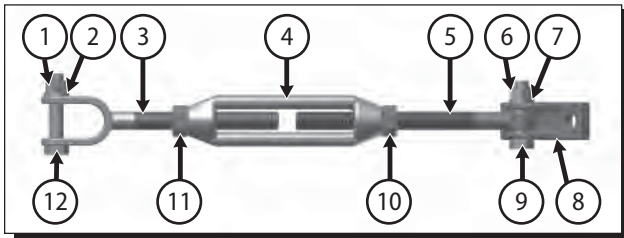
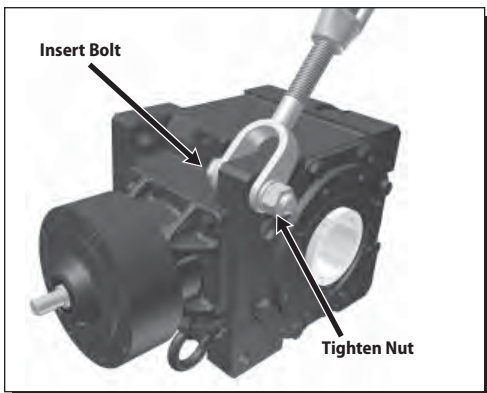


Table 5. Turnbuckle Type Torque Arm Parts

Item Number	Description	Item Number	Description
1	Hex Nut	7	Locke Washer
2	Lock Washer	8	Fulcrum Mounting Bracket
3	Threaded Extension Rod	9	Hex Bolt
4	Turnbuckle	10	Locking Nut (if supplied)
5	Threaded Arm	11	Locking Nut (if supplied)
6	Hex Bolt	12	Hex Bolt



1

Attach the torque arm threaded extension rod to the bevel housing, as shown in Figure 1, at the housing corner eyelet, using the appropriate nut, bolt and lockwasher.

- Insert the bolt through the brackets, torque arm sleeve (if supplied) and reducer housing eyelet.
- Place the lockwasher on the bolt and secure with nut.

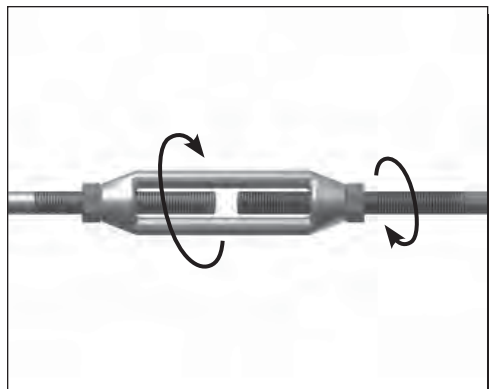
Table 6. Bolt Tightening Torques

Unit Size	Bolt Size ^[1]	ft·lb _f	(N·m)
A	M16 x 75	152 – 167	(206 – 227)
B	M20 x 100	290 – 319	(392 – 431)
C	M24 x 105	507 – 558	(686 – 755)
D	M24 x 125	507 – 558	(686 – 755)
E	M24 x 125	507 – 558	(686 – 755)
F	Consult Factory		

Note: [1] Bolt Class equal to ISO/JIS Class 8.8

Torque Arm Installation, continued

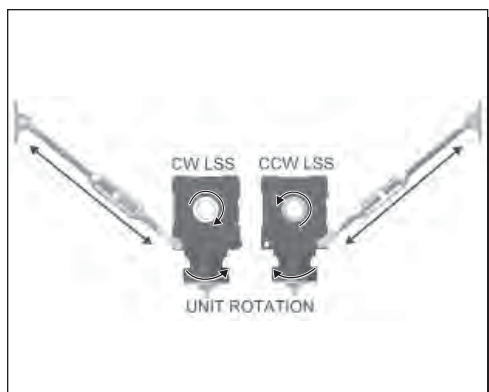
Turnbuckle Type Torque Arm



2

Install the turnbuckle onto the threaded extension rod (gearbox side) and then threaded arm (foundation side) to the turnbuckle

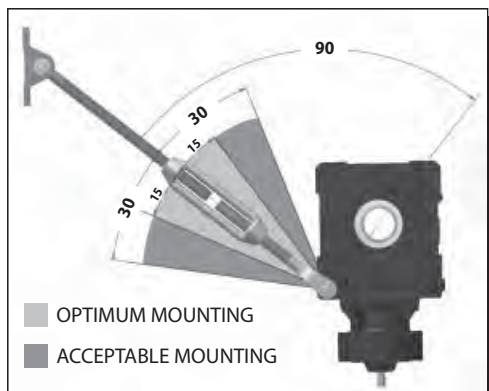
If the assembly was supplied with hex nuts to secure the turnbuckle, install the nuts loosely, ensuring the left hand nut is used on the threaded arm, prior to installing the turnbuckle and threaded arm



3

Position the torque arm so it will be in tension during unit operation and mount the fulcrum mounting bracket to suitable structure or foundation. Consider installing two torque arms for reversing applications to allow torque arm to be in tension for each direction of rotation.

Mounting hardware for fulcrum mounting bracket are NOT supplied by Sumitomo.



4

Position the torque arm as close as possible to 90° relative to the unit output bore / driven equipment shaft.

Sumitomo does not recommend combining torque arm assemblies to achieve a greater overall length.

Table 7. Bolt Tightening Torques

Unit Size	Bolt Size ^[1]	ft·lb _f	(N·m)
A	M16 x 65	152 – 167	(206 – 227)
B	M16 x 80	152 – 167	(206 – 227)
C	M16 x 80	152 – 167	(206 – 227)
D	M16 x 80	152 – 167	(206 – 227)
E	M16 x 80	152 – 167	(206 – 227)
F	Consult Factory		

Note: [1] Bolt Class equal to ISO/JIS Class 8.8

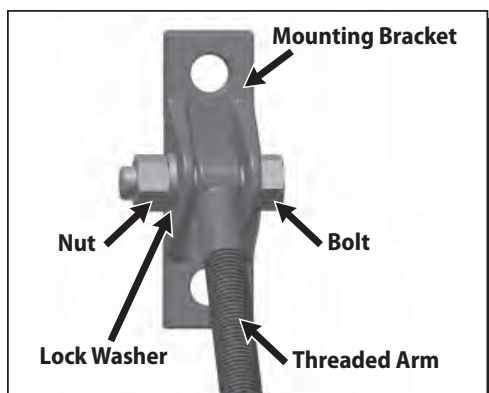
5

Assemble the threaded arm to the fulcrum mounting bracket, as shown.

Some adjustment of the turnbuckle may be required to lengthen or shorten the overall length.

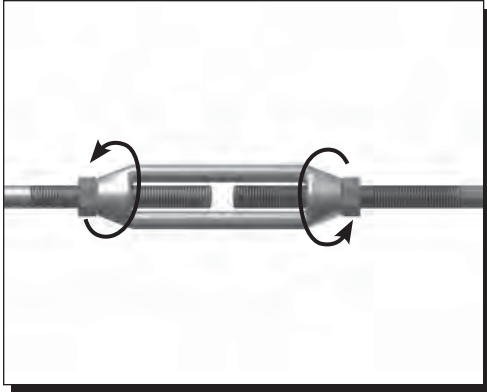
Secure it with the appropriate nut, bolt and lockwasher.

- Insert the bolt through the brackets and threaded arm eyelet.
- Place the lockwasher on the bolt and secure with nut.



Torque Arm Installation, continued

Turnbuckle Type Torque Arm, Tie Rod Type Torque Arm



6

If turnbuckle hex nuts were supplied, secure the turnbuckle position by adjusting the previously installed turnbuckle nuts.

Table 8. Nut Tightening Torques

Unit Size	Nut Size ⁽¹⁾	ft·lb _f	(N·m)
A	M20	290 – 319	(392 – 431)
B	M24	507 – 558	(686 – 755)
C	M24	507 – 558	(686 – 755)
D	M24	507 – 558	(686 – 755)
E	M24	507 – 558	(686 – 755)
F	Consult Factory		

Tie Rod Type Torque Arm Parts

Figure 1. Tie Rod Type Torque Arm Parts

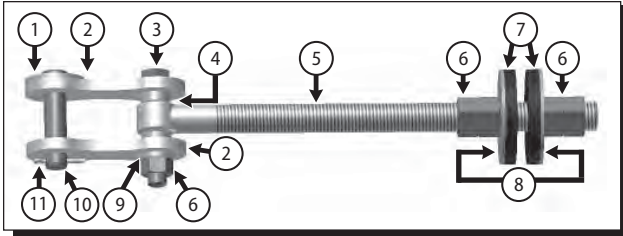
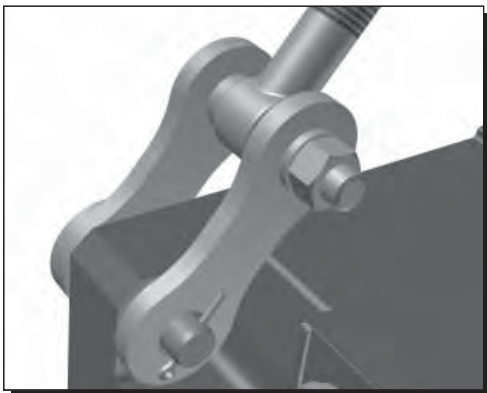


Table 9. Tie Rod Type Torque Arm Parts

Item Number	Description	Item Number	Description
1	Flat Washer	7	Rubber Bushings
2	(2) Mounting Brckts or (1) Clevis	8	Washers
3	Hex Bolt	9	Lock Washer
4	Spacer	10	Clevis Pin
5	Threaded Arm	11	Cotter Pin
6	Hex Nut		



1

Assemble the torque arm mounting brackets or wishbone clevis to the threaded arm, as shown in Figure 1 and attach the torque arm assembly to the bevel housing, at the housing corner eyelet, using the pin and cotter pin.

Tighten mounting bolts according to the values listed in this table:

- Insert the clevis pin through the brackets and housing eyelet.
- Insert the cotter pin into clevis pin and secure assembly.

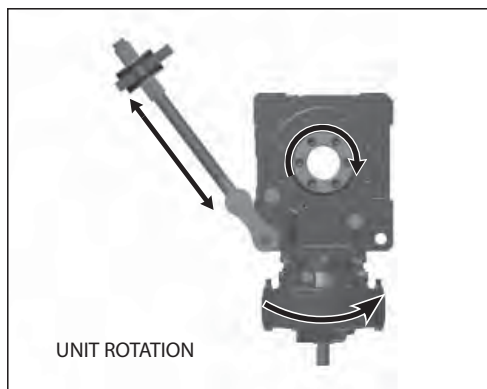
Table 10. Bolt Tightening Torques

BBB4 Size	Bracket Bolt Size ⁽¹⁾	Torque	
		lb-ft	(N·m)
4A	2 x M16	152 – 167	(206 – 227)
4B	2 x M20	290 – 319	(392 – 431)
4C	2 x M24	507 – 558	(686 – 755)
4D	2 x M24	507 – 558	(686 – 755)
4E	2 x M24	507 – 558	(686 – 755)
4F	Consult Factory		

Note: [1] Bolt Class equal to ISO/JIS Class 8.8

Torque Arm Installation, continued

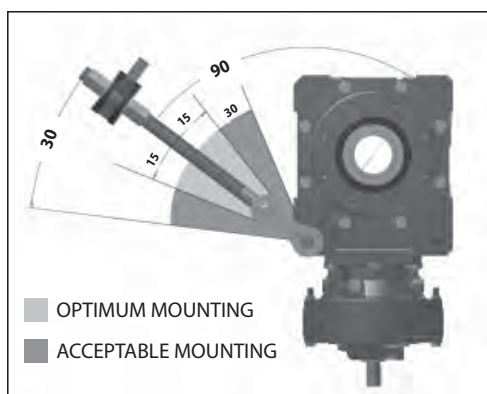
Tie Rod Type Torque Arm



2

Position the torque arm so it will be in tension during unit operation.

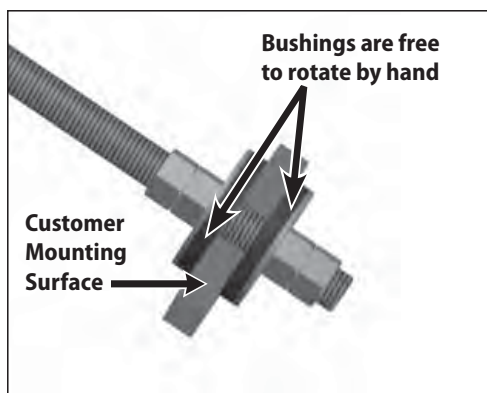
Consider installing two torque arms for reversing applications to allow torque arm to be in tension for each direction of rotation.



3

Position the torque arm as close as possible to 90° relative to the unit output bore / driven equipment shaft.

Sumitomo does not recommend combining torque arm assemblies to achieve a greater overall length.



4

After inserting the torque rod into the mounting surface, carefully tighten nuts on either side of torque rod.



Do **not** over tighten nuts. Tighten to point where rubber bushings can still be hand rotated when the unit is turned off.

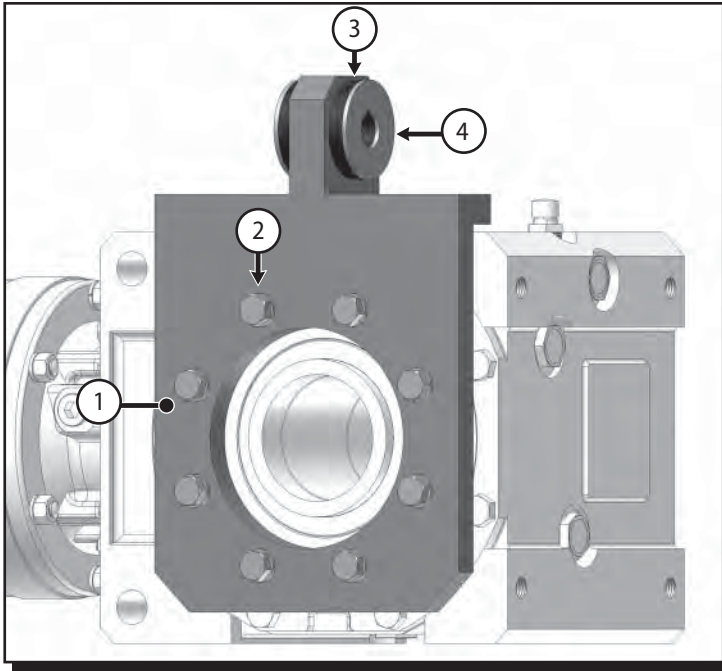


Before starting unit, verify the following:

- The torque arm will be in tension when the unit is in operation.
- The torque arm is aligned with the reducer housing.
- The torque arm is perpendicular to the axis of the output / driven shaft.
- The threaded arm is not touching the reducer housing.

Torque Arm Installation, continued

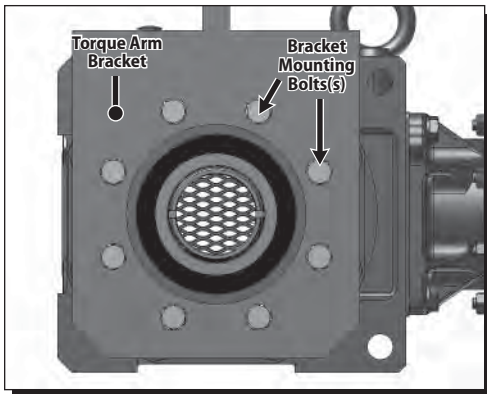
Flange Mount (Banjo) Type Torque Arm



Sumitomo Supplied Components of Flange Mount (Banjo) Type Torque Arm

Table 11. Flange Mount (Banjo) Type Torque Arm Components

Item Number	Description
1	Torque Arm Bracket
2	Bracket Hardware
3	Rubber Bushing (qty 3)
4	Washer (qty 2)



Flange Mount (Banjo) Type Torque Arm Installation Procedure

1

Attach the Flange Mount (Banjo) Torque Arm Bracket to the Cyclo® BBB4 using mounting hardware.

Table 12. Flange Mount (Banjo) Torque Arm Bolt Tightening

Torques Unit Size	Bracket Bolt Size ⁽¹⁾	Torque	
		lb·ft	(N·m)
4A	8 x M10	34 – 38	(46 – 51)
4B	8 x M12	59 – 65	(80 – 88)
4C	8 x M16	152 – 167	(206 – 227)
4D,4E	8 x M20	290 – 319	(392 – 431)
4F	8 x M24	507 – 558	(686 – 755)

Note: [1] Bolt class equal to ISO/JIS Class 8.8

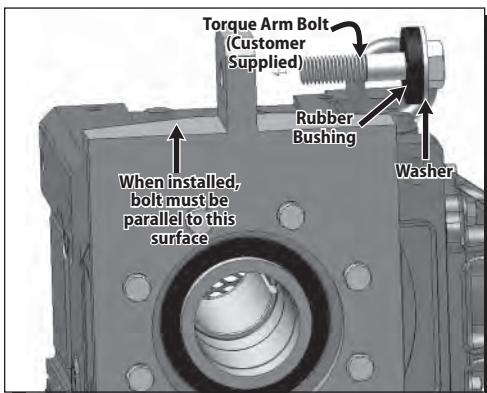
2

Place washer and rubber bushing on bolt.

Insert torque arm bolt (supplied by customer) through mounting tab on Banjo torque arm.

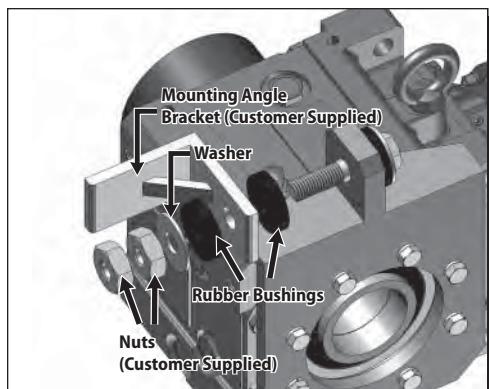


Make sure bolt is parallel to Flange Mount (Banjo) Type Torque Arm surface when fully installed.



Torque Arm Installation, continued

Flange Mount (Banjo) Type Torque Arm



3

Follow these steps to attach the customer supplied mounting bracket.

- Place rubber bushing and mounting angle bracket on bolt.
- Verify that the mounting angle bracket hole is the correct diameter (see Table 12 in Step 1).
- Place remaining bushing, washer and two nuts on the bolt.

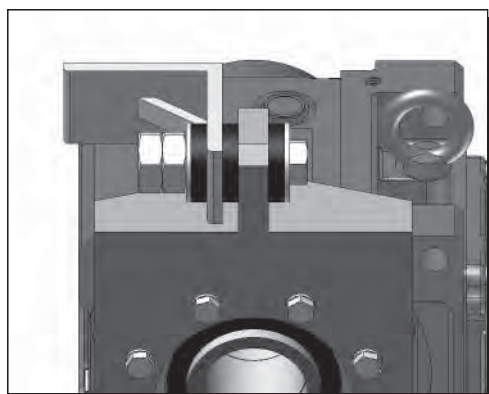


Do not over-tighten nuts. Tighten to point where rubber bushings can still be hand rotated.

Table 13. Flange Mount (Banjo) Torque Arm Bolt Dimensions

Unit Size	Bracket Tab Bore	Typical Bolt Size ⁽¹⁾
4A	Ø18mm	M16
4B	Ø18mm	M16
4C	Ø22mm	M20
4D	Ø26mm	M24
4E	Ø33mm	M30
4F	Ø39mm	M36

Note: [1] Bolt class should be greater or equal to ISO/JIS Class 8.8. Application with multiple start/stops and/or shock loading should use ISO/JIS 10.9 at a minimum.



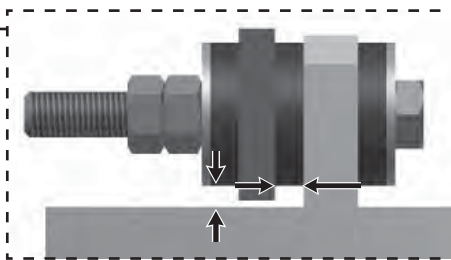
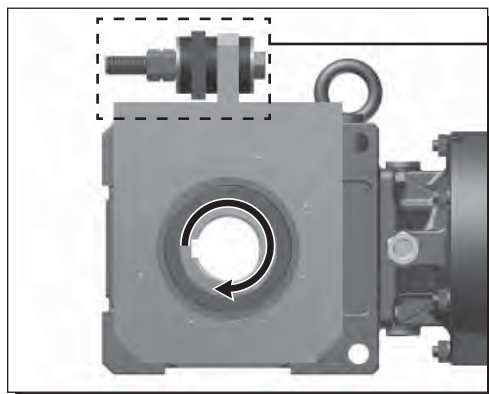
4

Confirm that the rubber bushings can still be rotated by hand. This indicates the bushing has not been over tightened.



Compressed bushings will not allow the bushings to properly absorb the loads of the shaft mounted gearbox. This can lead to premature failure.

Mounting Angle Bracket must be secured to the machine structure.



During full rotation of driven shaft, there must be no metal-to-metal contact between mounting angle bracket and torque arm.

5

Confirm the mounting angle bracket does not interfere with the torque arm.

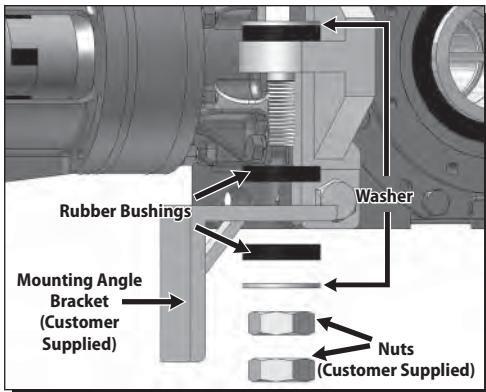
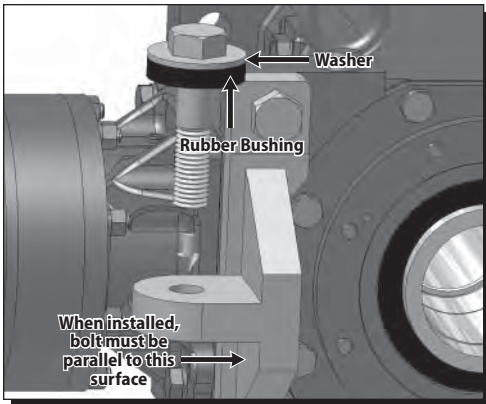
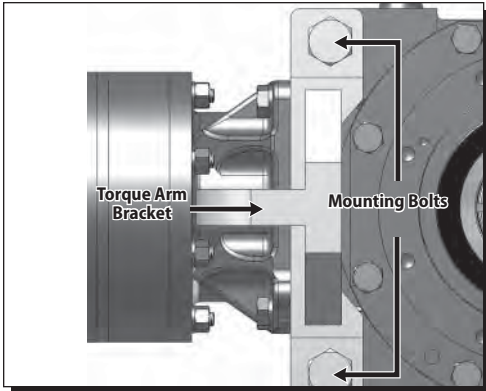
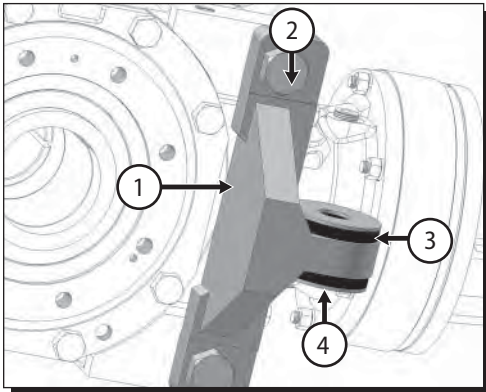
There should be no metal-to-metal contact between the two during a complete revolution of the driven equipment.



Metal-to-Metal contact between these two components may lead to catastrophic failure of the reducer/gearmotor.

Torque Arm Installation, continued

T-Type Torque Arm



T-Type Torque Arm

Sumitomo Supplied Components for T-Type Torque Arm

Table 14. T-Type Torque Arm Components

Item Number	Description
1	Torque Arm Bracket
2	Bracket Hardware
3	Rubber Bushing (qty 3)
4	Washer (qty 2)

T-Type Torque Arm Installation Procedure

1

Attach the T-Type Torque Arm Bracket to the Cyclo® BBB4 using the supplied mounting hardware.

Tighten mounting bolts according to the values listed in Table 15:

Table 15. T-Bracket Bolt Torques

BBB4 Size	Bracket Bolt Size ^[1]	Torque	
		lb-ft	(N·m)
4A	2 x M16	152 – 167	(206 – 227)
4B	2 x M20	290 – 319	(392 – 431)
4C	2 x M24	507 – 558	(686 – 755)
4D	2 x M24	507 – 558	(686 – 755)
4E	2 x M24	507 – 558	(686 – 755)
4F	T-Type Not Available		

Note: [1] Bolt class equal to ISO/JIS Class 8.8

2

Place washer and rubber bushing on bolt.

Insert torque arm bolt (supplied by customer) through torque arm mounting tab. T-Type bolt sizes listed in Table 16.



Make sure bolt is parallel to T-Type Torque Arm side when fully installed.

3

Follow these steps to attach the mounting angle bracket:

- Place rubber bushing and mounting angle bracket on bolt.
- Verify that the mounting angle bracket hole is the correct diameter for customer supplied bolt.
- Place remaining bushing, washer and two nuts on the bolt.



Do not over-tighten nuts. Tighten to point where rubber bushings can still be hand rotated.

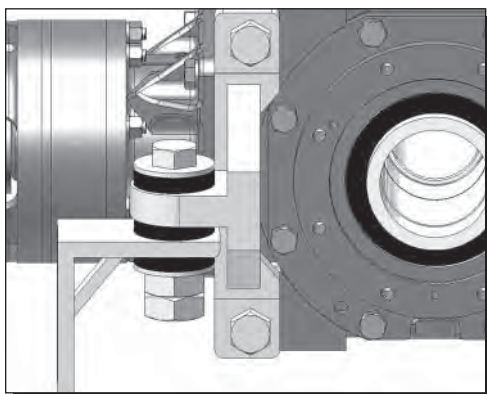
Torque Arm Installation, *continued*

T-Type Torque Arm

Table 16. T-Type Bolt Dimensions

Unit Size	Bracket Tab Bore	Typical Bolt Size ^[1]
4A	Ø18mm	M16
4B	Ø18mm	M16
4C	Ø22mm	M20
4D	Ø26mm	M24
4E	Ø33mm	M30

Note: [1] Bolt class should be greater or equal to ISO/JIS Class 8.8. Application with multiple start/stops and/or shock loading should use ISO/JIS 10.9 at a minimum.



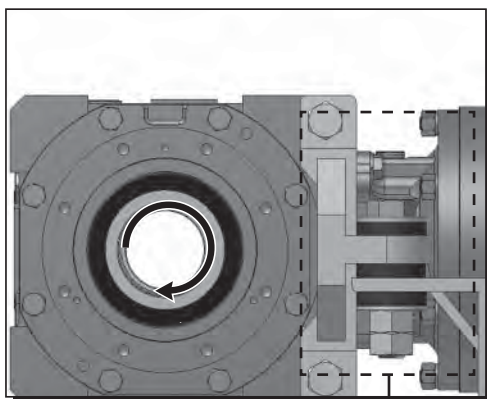
4

Confirm that the **rubber bushings** can still be rotated by hand. This indicates the bushing has not been over tightened.



Compressed bushings will not allow the bushings to properly absorb the loads of the shaft mounted gearbox. This can lead to premature failure.

Mounting angle bracket must be secured to the machine structure.



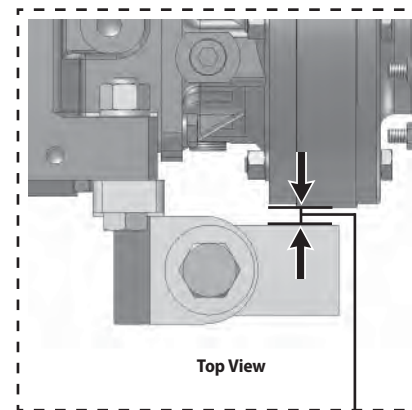
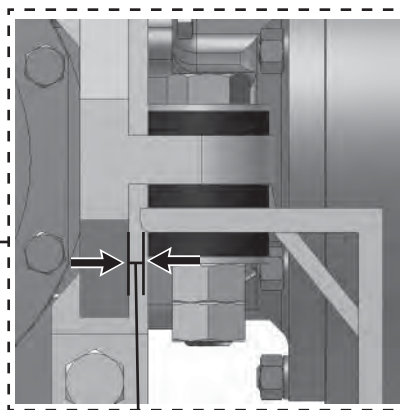
5

Confirm the mounting angle bracket does not interfere with the torque arm.

There should be no metal-to-metal contact between the two during a complete revolution of the driven equipment.

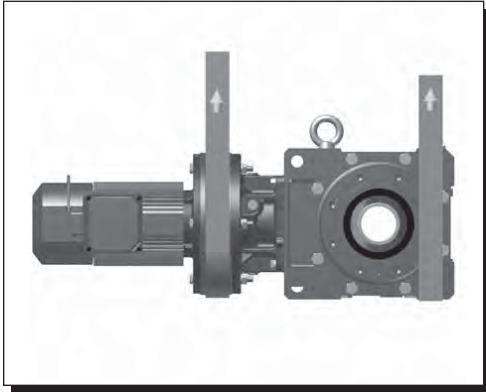


Metal-to-Metal contact between these two components may lead to catastrophic failure of the reducer/ gearmotor.



Removal from Driven Shaft

Removal of Cyclo® BBB4 with Taper-Grip® Bushing



Removal of Cyclo® BBB4 with Taper-Grip® Bushing



Before starting unit removal process, ensure that electrical power to unit has been safely locked out and that electrical connections to the unit have been disconnected.

1

Externally support the Cyclo® BBB4 unit such that all unit weight is removed from the driven shaft.

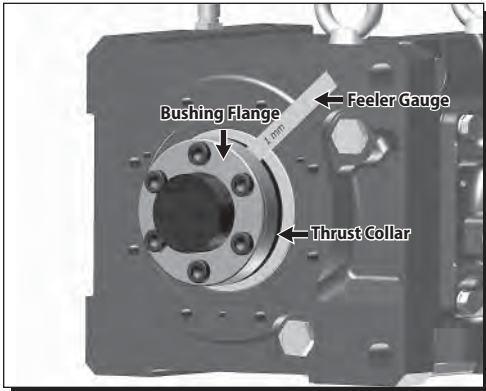


The weight of the Cyclo® BBB4 must be externally supported throughout the entire removal process.

Do not raise the unit too high. Shaft binding may occur.

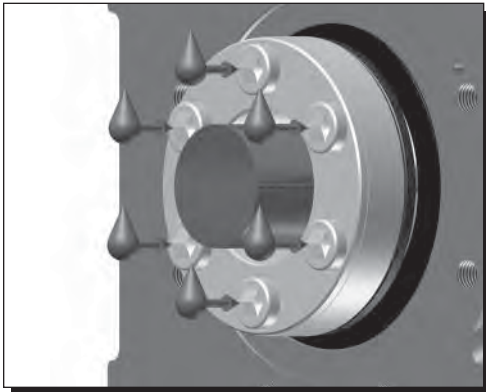
2

Remove safety guard from unit. Inspect the Taper-Grip® bushing to ensure that a gap exists between the thrust collar and the bushing flange.



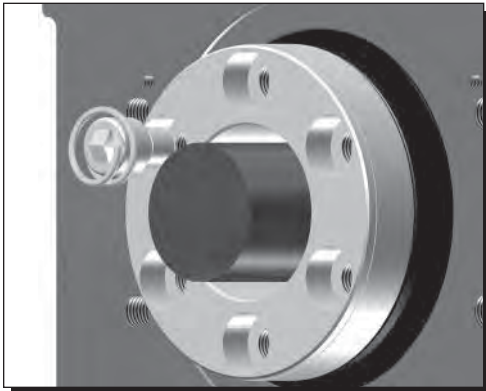
3

Apply a liquid-penetrant onto each of the Taper-Grip® bushing socket-head cap screws. Allow time for the penetrant to settle into the threads of the screws.



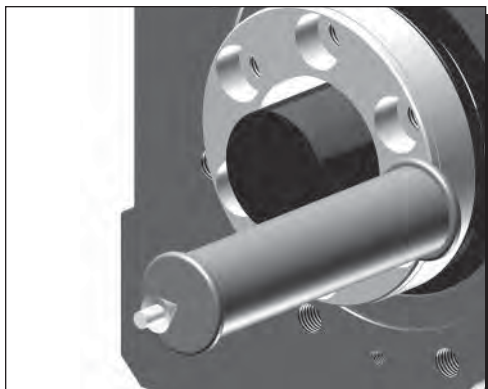
4

After the penetrant has settled, remove the socket head cap screws one at a time.



Removal from Driven Shaft, *continued*

Removal of Cyclo® BBB4 with Keyed Hollow Bore



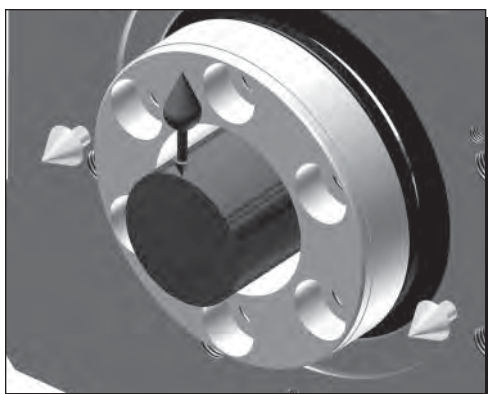
5

Place a soft-metal (i.e. brass) bar against the flange of the Taper-Grip® bushing and carefully strike end of bar with a hammer to release the bushing.

If shaft removal is difficult, a jig such as the one shown shown in Table 17 may be used to ease the removal process. **Sumitomo does not supply the removal jig . This information is supplied for reference only.**

Table 17. Removal Jig Dimensions

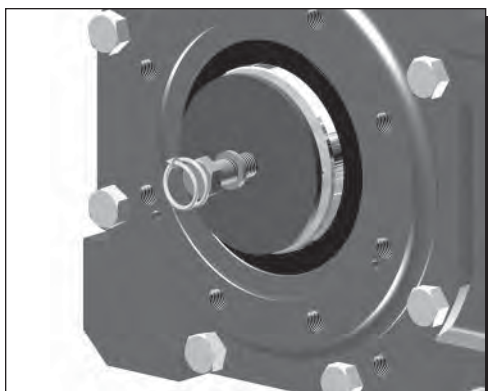
Size	a	f	g	h
	CC (ISO/JIS)	A3	BOLT	A8
4A	55	19	M24x250	6
4B	65	19	M24x300	6
4C	75	19	M24x300	5
4D	85	24	M30x400	5
4E	100	19	M30x400	5
4F	120	30	M36x450	7



6

Apply a liquid penetrant to the shaft where it contacts the bushing. Allow time for the liquid to settle between the shaft and the bushing wall. Once the penetrant has settled adequately, carefully remove the Cyclo® BBB4 from the driven shaft.

If the Taper-Grip® bushing releases but the unit cannot be removed from the driven shaft, a puller may need to be applied to the bushing flange to pull the unit free from the shaft.



Removal of Cyclo® BBB4 with Keyed Hollow Bore



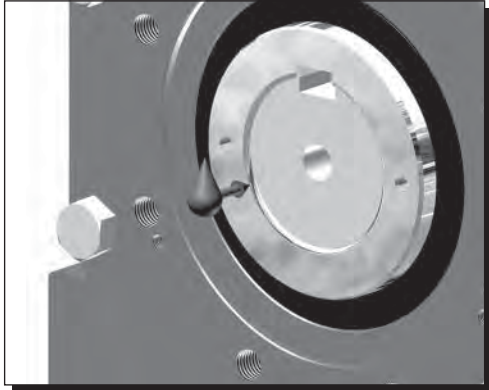
Before starting unit removal process, ensure that electrical power to unit has been safely locked out and that electrical connections to the unit have been disconnected.

1

Remove safety cover and the shaft-retaining device from the driven shaft.

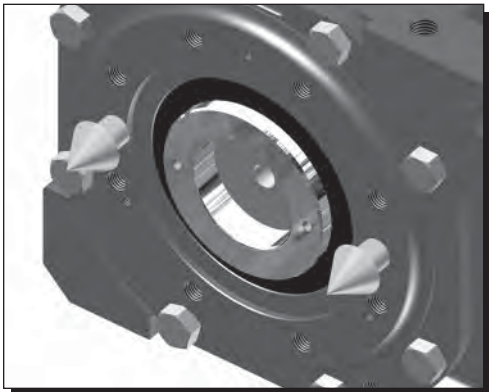
Removal from Driven Shaft, continued

Removal of Cyclo® BBB4 with Shrink Disc



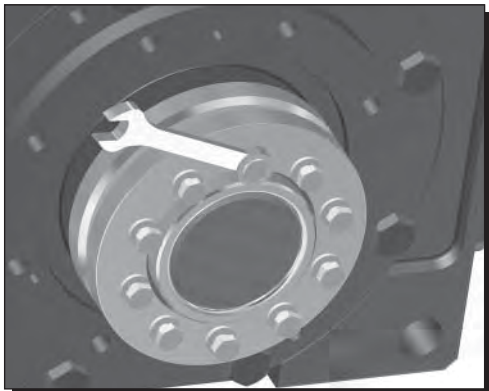
2

Apply a liquid penetrant to the shaft where it contacts the keyed hollow bore. Allow time for the liquid to penetrate between the shaft and the wall of the keyed hollow bore.



3

Once the penetrant has settled adequately, carefully remove the Cyclo® BBB4 from the driven shaft.



Removal of Cyclo® BBB4 with Shrink Disc



Before starting unit removal process, ensure that electrical power to unit has been safely locked out and that electrical connections to the unit have been disconnected.

1

Remove the safety cover and apply liquid penetrant to the shrink disc bolts and shaft/bore allowing adequate time for proper penetration.

Loosen the locking bolts on the shrink disc.

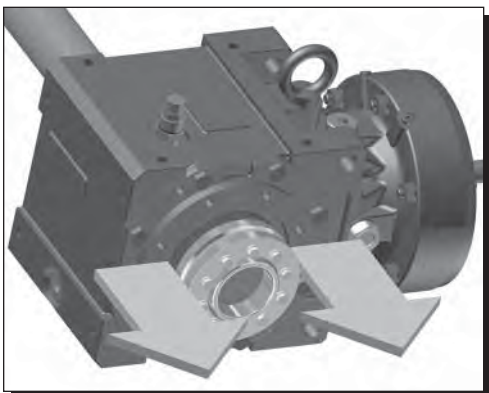
Complete bolt removal should not be required.

Tapping the shrink disc flanges with a rubber dead blow hammer may be required if any fretting corrosion has occurred.

2

Remove the gearbox from the shaft.

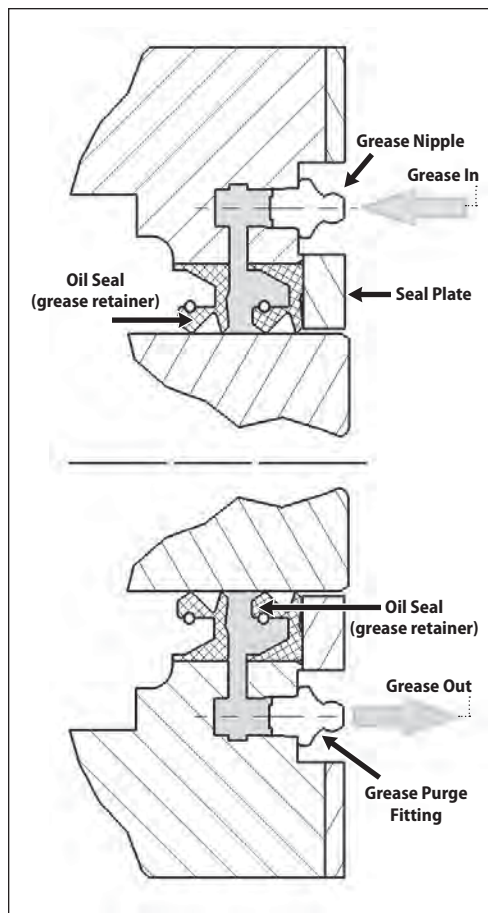
If shaft removal is difficult, a jig such as the one shown in the Removal of Cyclo® BBB4 with Taper-Grip® Bushing section may be used to ease the removal process. **Sumitomo does not supply the removal jig. This information is supplied for reference only.**



Lubrication

Taconite Seal Lubrication Procedure

Figure 1. Taconite Seal Assembly



1. Introduction

Taconite seals may be used in high dust operating environments. They use a grease purging system to prevent outside contaminants from entering the speed reducer/gearmotor. Figure 1 to the left details the Taconite Seal assembly as utilized in the 4-Series Bevel Buddybox®.

2. Procedure

Please follow these instructions to maintain lubrication of the Taconite Seal system:

- a. Unless otherwise specified, the Taconite output seals are each packed with NLGI #2 EP mineral grease prior to unit shipment from the factory location.
- b. **Grease does not need to be added to the seals prior to unit start-up.**
- c. Add grease to the seals according to the guidelines indicated in Table 18. Refer to Table 19 for recommended greases.

Table 18. Lubrication Cycle

Output Shaft RPM	Hours of Operation
>200	5,000

Please note that a highly contaminated environment may require a more frequent lubrication cycle.

Table 19. Recommended NLGI#2 Mineral Greases

Grease	BP	Castrol			Chevron/Texaco		Exxon/Mobil		Shell	Total
Mineral	Ener-Grease LS EP2	Spheerol AP3	Olista Longtime 3EP	Tribol 3020/ 1000-2	Duralith Grease EP2	Multifak Grease EP2	Beacon EP2	Mobilux EP2	Alvania EP2	Multis EP2
Food Grade					FM EP2					

Lubrication, continued

Taconite Seal Lubrication Procedure, continued

- d. If the unit will not be operated for a period greater than 6 months, apply a thin layer of grease to the outside surface of the seals to prevent dry-out. Before starting the unit, check the seals' integrity and replace if required. If seal replacement is required, purge and add grease to the newly installed seals prior to unit operation.
- e. Units may be equipped with either a spring loaded grease relief fitting, or a plug in the grease purge port.
 - If your unit has a plug, begin by removing the plug.
 - While rotating the reducer shafts to ensure even grease distribution, **slowly** add grease until new grease begins to come out of the grease purge port. **NOTE: Rotate shafts by hand in this process. Exercise caution in rotating shaft in order to avoid injury.**
 - Wipe away excess grease and reinstall plug if necessary.

Lubrication Introduction

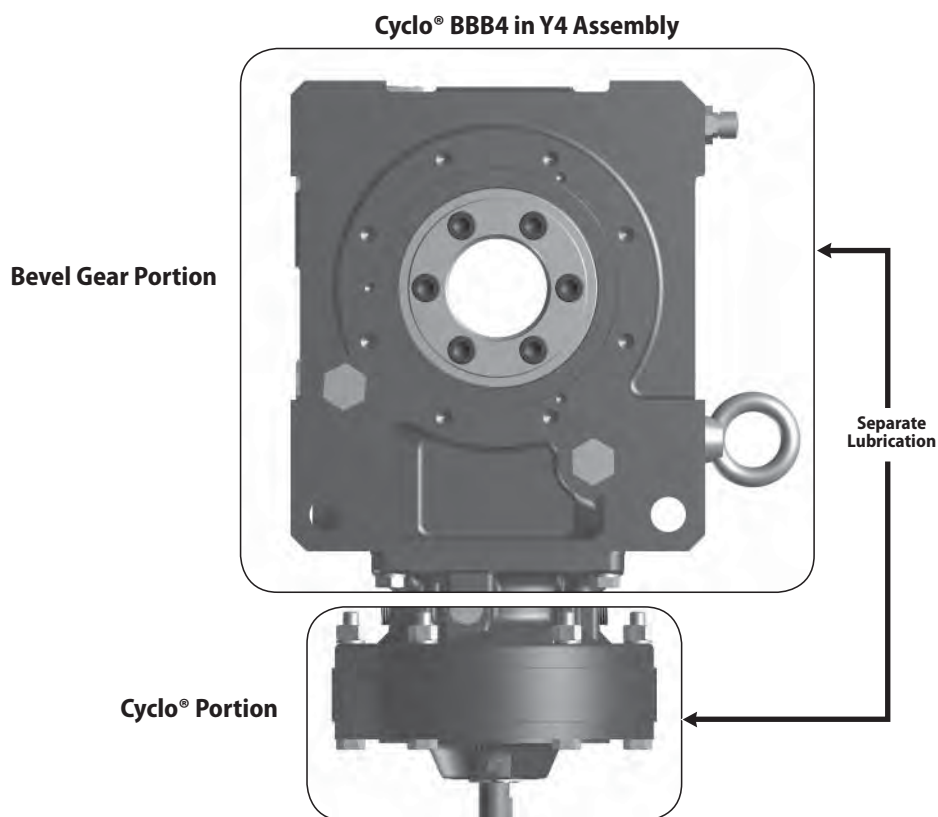


Sumitomo Cyclo® BBB4s units are shipped from the factory **without** lubricating oil, unless the customer specified otherwise when the unit was ordered.

The unit must contain the correct type and amount of lubrication before operating.

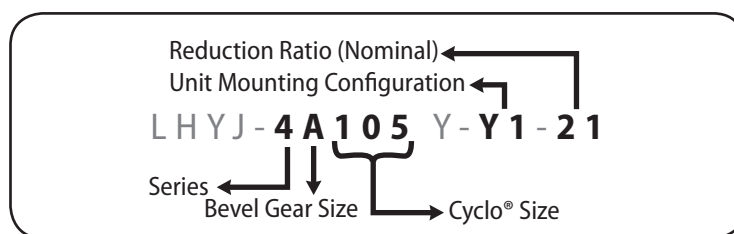
For all Y4 motor down mounting configuration models, the Cyclo® portion is filled at the factory with **grease**. For these units, the Cyclo® portion **does not** need to be filled with lubricant before start-up. The Bevel Gear portion of models built for the Y4 mounting configuration requires filling with gear oil before start-up. Refer to the Lubrication Method section for details.

For the Cyclo® BBB4 built for the Y4 mounting configuration, the Cyclo® and the bevel gear portions **must** be filled with lubricant separately and maintained separately. Lubricant **does not** flow from one section to the other.



Lubrication Nomenclature

Refer to the **Model** portion of the unit's nameplate to determine the unit size, reduction ratio, and mounting configuration:



Lubrication, continued**Lubrication Method****Lubrication Method**

Using the model number and mounting configuration, refer to Tables 20 and 21 to determine the unit's lubrication method.

Table 20. Lubrication Method for Configurations Y1, Y2, Y3, Y5, Y6






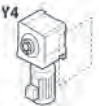
Mounting Configuration	Unit Size		Lubrication Method	
	Bevel Gear Size	Cyclo® Size		
    	4A - 4F	100, 105, 110, 115, 120, 125, 140, 145, 160, 165, 170, 175, 180, 185, 190, 195 10DA, 12DA, 12DB, 14DA, 14DB, 14DC, 16DA, 16DB, 17DA, 17DB, 17DC	Complete Unit (Bevel Gear Portion and Cyclo® Portion)	Common Oil Sump

Table 21. Lubrication Method for Y4 Configuration

Mounting Configuration	Unit Size		Lubrication Method	
	Bevel Gear Size	Cyclo® Size		
	4A-4F	100, 105, 110, 115, 120, 125	Cyclo® Portion	Maintenance Free Grease ^[1]
		10DA, 12DA, 12DB	Bevel Gear Portion	Oil
		140, 145, 160, 165, 170, 175, 180, 185, 190, 195	Cyclo® Portion	Grease ^[2]
		14DA, 14DB, 14DC, 16DA, 16DB, 17DA, 17DB, 17DC, 18DA, 18DB, 19DA, 19DB	Bevel Gear Portion	Oil

Notes: [1] Maintenance Free Grease: the input Cyclo® portion is grease lubricated as standard from the factory and usually does not require replacement or replenishment.

[2] Grease: the input Cyclo® portion is grease lubricated as standard from the factory. Please refer to Tables 27, 28 and 29 for the proper grease replenishment and change interval.

Bevel Gear Portion and Cyclo® Portion Lubricants

Recommended Oils

Table 22, Recommended Oils, lists the oils that may be used to lubricate the Bevel Gear portion of the unit. These oils may also be used in the Cyclo® portion if it is oil lubricated.

Table 22. Recommended Oils.

Ambient Temp. °F (C)	Manufacturer					
	Gulf Oil	Esso Oil	Mobil Oil	Shell Oil	Caltex Oil	BP Oil
14° – 41°F (-10° – 5°C)	EP Lubricant HD 68	Spartan EP 68	Mobilgear 600 XP 68 (ISO VG 68)	Omala S2 G 68	—	Energol GR-XP 68
32° – 95°F (0° – 35°C)	EP Lubricant HD 100 HD150	Spartan EP 100 EP 150	Mobilgear 600 XP 100, 150 (ISO VG 100, 150)	Omala S2 G 100 150	Meropa 100 150	Energol GR-XP 100 GR-XP 150
86° – 122°F (30° – 50°C)	EP Lubricant HD 220 HD 320 HD 460	Spartan EP 220 EP 320 EP 460	Mobilgear 600 XP 220, 320, 460 (ISO VG 220, 320, 460)	Omala S2 G 220 320 460	Meropa 220 320 460	Energol GR-XP 220 GR-XP 320 GR-XP 460

- Use lubricants with low viscosity for operation during winter or at relatively low temperatures.
- Use a lubricant with a viscosity within the range listed in **Table 23, Recommended Oil Viscosity**.

Table 23. Recommended Oil Viscosity

Minimum allowable viscosity	15 cSt (mm^2/s) or more at operating temperature	Viscosity that ensures oil film strength adequate for load transmission.
Maximum allowable viscosity	4300 cSt (mm^2/s) max.	Viscosity that permits start-up of Buddybox®

- Consult local distributor, nearest authorized agent or Sumitomo directly when the unit will be operated in ambient temperatures other than 14° – 104°F (-10° – 40°C). Special unit modifications may be necessary.

Cyclo® Portion Approved Greases

Table 24, Cyclo® Portion Approved Greases, lists the greases that may be used to lubricate the Cyclo® portion if grease is the specified lubrication method (refer to the Lubrication Method section for details).

Table 24. Cyclo® Portion Approved Greases

Ambient Temp. °F (C)	Overall Reduction Ratio	All Unit Sizes
14° – 122°F (-10° – 50°C)	11:1 through 18:1	Shell Gadus S2 V220 NLGI 00
	19:1 and higher	ExxonMobil Unirex N2 grease

Cyclo® portions have unique operating characteristics that require specific lubricant properties. Please consult Sumitomo if alternate lubricants are required.

Lubrication, continued

Oil Quantities

Oil Quantities

Table 25. Single Reduction Approximate Oil Quantity

Units: US liquid gallon (*liter*) **Note: Output = Bevel Gear Portion Input = Cyclo® Portion**

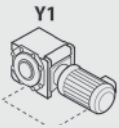
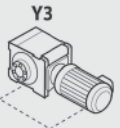
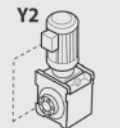
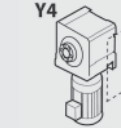
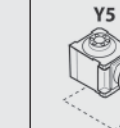
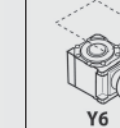
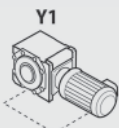
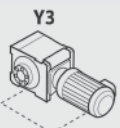
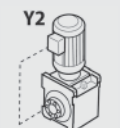
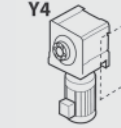
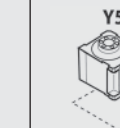
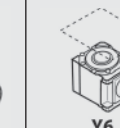
Bevel Gear Unit Size	Mounting Configuration							
								
	Output		Input					
4A10	0.4 (1.62)		0.8 (3.17)		0.3 (1.13)	Grease	0.4 (1.36)	0.5 (1.84)
4A11	0.4 (1.66)		0.9 (3.26)				0.4 (1.40)	0.5 (1.88)
4A12	0.5 (1.71)		0.9 (3.35)				0.4 (1.45)	0.5 (1.93)
4A14	0.5 (1.91)		1.0 (3.77)				0.4 (1.65)	0.6 (2.13)
4B12	0.9 (3.29)		1.7 (6.50)		0.5 (1.72)	Grease	0.9 (3.34)	0.9 (3.23)
4B14	0.9 (3.49)		1.8 (6.97)				0.9 (3.54)	0.9 (3.43)
4B16	1.0 (3.92)		2.0 (7.61)				1.0 (3.97)	1.0 (3.86)
4C14	1.5 (5.52)		2.9 (11.1)		0.7 (2.72)	Grease	1.4 (5.30)	1.6 (5.88)
4C16	1.6 (5.96)		3.1 (11.8)				1.5 (5.74)	1.7 (6.32)
4C17	1.7 (6.34)		3.3 (12.5)				1.6 (6.12)	1.8 (6.70)
4D16	2.7 (10.1)		5.3 (19.9)		1.2 (4.61)	Grease	2.6 (9.69)	2.8 (10.4)
4D17	2.8 (10.4)		5.4 (20.5)				2.6 (10.0)	2.8 (10.8)
4D18	2.8 (10.7)		5.5 (21.0)				2.7 (10.3)	2.9 (11.1)
4E17	3.8 (14.6)		7.6 (28.8)		1.7 (6.26)	Grease	3.5 (13.1)	4.2 (16.1)
4E18	3.9 (14.7)		7.7 (29.1)				3.5 (13.2)	4.3 (16.2)
4E19	4.1 (15.7)		8.0 (30.4)				3.8 (14.2)	4.5 (17.2)
4F18	5.3 (20.0)		10.4 (39.4)		1.9 (7.28)	Grease	4.9 (18.5)	5.7 (21.4)
4F19	5.5 (20.8)		10.7 (40.6)				5.1 (19.3)	5.9 (22.2)

Table 26. Double Reduction Approximate Oil Quantity

Units: US liquid gallon (*liter*) **Note: Output = Bevel Gear Portion Input = Cyclo® Portion**

Bevel Gear Unit Size	Mounting Configuration							
								
	Output		Input					
4A10DA	0.4 (1.65)		0.8 (3.20)		0.3 (1.13)	Grease	0.4 (1.39)	0.5 (1.87)
4A12DA	0.5 (1.74)		0.9 (3.38)				0.4 (1.48)	0.5 (1.96)
4A12DB	0.5 (1.78)		0.9 (3.43)				0.4 (1.52)	0.5 (2.00)
4B12DA	0.9 (3.32)		1.7 (6.53)		0.5 (1.72)	Grease	0.9 (3.37)	0.9 (3.26)
4B12DB	0.9 (3.36)		1.7 (6.57)				0.9 (3.41)	0.9 (3.30)
4B14DA	0.9 (3.52)		1.8 (7.00)				0.9 (3.57)	0.9 (3.46)
4B14DB	0.9 (3.56)		1.9 (7.04)				1.0 (3.61)	0.9 (3.50)
4C14DA	1.5 (5.55)		2.9 (11.2)		0.7 (2.72)	Grease	1.4 (5.33)	1.6 (5.91)
4C14DB	1.5 (5.59)		3.0 (11.2)				1.4 (5.37)	1.6 (5.95)
4C14DC	1.5 (5.64)		3.0 (11.3)				1.4 (5.42)	1.6 (6.00)
4C16DA	1.6 (6.03)		3.1 (11.8)				1.5 (5.81)	1.7 (5.39)
4C16DB	1.6 (6.08)		3.1 (11.9)				1.5 (5.86)	1.7 (6.44)
4C17DA	1.7 (6.41)		3.3 (12.6)		1.2 (4.61)	Grease	1.6 (6.19)	1.8 (6.77)
4D16DA	2.7 (10.1)		5.3 (20.0)				2.6 (9.76)	2.8 (10.5)
4D16DB	2.7 (10.2)		5.3 (20.0)				2.6 (9.81)	2.8 (10.6)
4D17DB	2.8 (10.5)		5.4 (20.6)				2.7 (10.2)	2.9 (10.9)
4D17DC	2.8 (10.7)		5.5 (20.7)		2.7 (10.3)	2.9 (11.0)		
4E17DA	3.9 (14.6)		7.6 (28.8)		1.7 (6.26)	Grease	3.5 (13.1)	4.3 (16.1)
4E17DB	3.9 (14.7)		7.6 (28.9)				3.5 (13.2)	4.3 (16.2)
4E17DC	3.9 (14.8)		7.7 (29.0)				3.5 (13.3)	4.3 (16.3)

Oil Supply Procedure



- Always stop the unit before adding oil



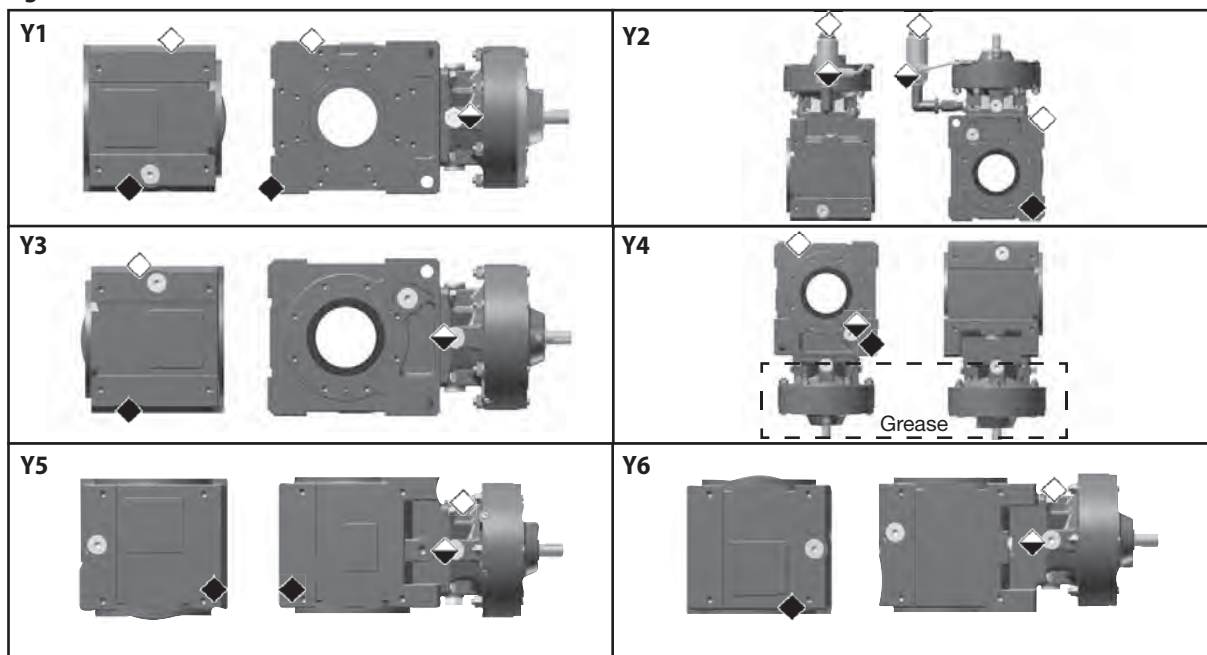
- Oil level may drop during operation, depending on the oil viscosity, temperature and direction of rotation. Additional oil is not necessary. Check the oil level when the unit is stopped to ensure that it has the correct amount of oil.
- It may take some time for the oil to settle when the oil viscosity is high. Be careful not to add too much oil.
- There may be two different oil fill locations for some combinations; refer to oil fill/ drain locations figure for details.
- Consider implementing an oil analysis program to ensure lubricant continues to operate at peak performance. Follow your lubrication provider's oil analysis recommendations to ensure reducer performance.
- Always consult factory and warehouses for overhaul of gearmotors and reducers. Familiarity with Cyclo® products is necessary for proper overhaul.

1. Remove the oil fill plug, as referenced in Figure 2.
2. Slowly add oil while checking the level through the oil gauge.
3. After the oil has settled, make sure the level is midway between the high and low marks on the oil gauge.
4. Insert the oil fill plug after wrapping it with sealing compound or tape.

Table 27. Oil Change Intervals

Task	Change interval		Conditions of use
Supply of Oil	At installation		All
Oil Change	First Change	500 hrs operation or 6 months, whichever comes first.	All
	Second change and thereafter	2500 hrs operation or 6 months, whichever comes first. 5000 hrs operation or 1 year, whichever comes first.	When case oil temperature is 158° F (70° C) or higher When case oil temperature is lower than 158° F (70° C)

Figure 2. Oil Fill/Drain Locations



◇=Oil filler plug ◊=Oil level (Oil gauge) ◆=Oil drain plug

Oil Discharge Procedure

1. Remove the drain plug as shown in Figure 2, to discharge oil.
2. Properly discard or recycle lubricant according to applicable regulations.
3. Replace the drain plug after wrapping it with sealing compound or tape.

Lubrication, continued

Grease Quantities

Grease Quantities



- Grease quantities listed in this section are for the Cyclo® portion of the reducer/gearmotor.
- The Bevel portion is always oil lubricated unless otherwise specified at time of order entry.
- Refer to the Oil Quantities section, Tables 25 & 26, for Bevel portion oil quantities.
- Installing grease into Bevel Gear portion will result in damage to the unit.

The Cyclo® (input) portion of **only Y4 double reduction** units is grease lubricated at the factory. Additional grease is not required before initial start-up. All assemblies other than Y4 have oil lubricated Cyclo® portions. The following tables are provided for user rebuild or refurbishment reference.

Table 28. Single Reduction Approximate Grease Quantity

Units: ounce (*gram*)

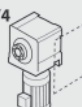
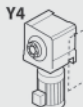
Unit Size	Unit Lubrication Portion	Lube Quantity oz. (<i>gram</i>)
		 Y4 only
4A100/105	Cyclo®	4.24 (120)
4A110/115		6.71 (190)
4A120/125		8.83 (250)
4A140/145		15.89 (450)
4B120/125		8.83 (250)
4B140/145		15.89 (450)
4B160/165		26.48 (750)
4C140/145		15.89 (450)
4C160/165		26.48 (750)
4C170/175		35.3 (1000)
4D160/165		26.48 (750)
4D170/175		35.3 (1000)
4E170/175		35.3 (1000)
4F180/185		38.8 (1100)
4F190/195		52.9 (1500)

Table 29. Double Reduction Approximate Grease Quantity

Units: ounce (*gram*)

Unit Size	Cyclo® Stage	Lube Quantity oz. (<i>gram</i>)
		 Y4 only
4A10DA	First (Input)	0.88 (25)
	Second	4.24 (120)
4A12DA	First (Input)	0.88 (25)
	Second	8.83 (250)
4A12DB	First (Input)	2.12 (60)
	Second	8.83 (250)
4B12DA	First (Input)	0.88 (25)
	Second	8.83 (250)
4B12DB	First (Input)	2.12 (60)
	Second	8.83 (250)
4B14DA	First (Input)	0.88 (25)
	Second	15.86 (450)
4B14DB	First (Input)	2.12 (60)
	Second	15.86 (450)
4C14DA	First (Input)	0.88 (25)
	Second	15.86 (450)
4C14DB	First (Input)	2.12 (60)
	Second	15.86 (450)
4C14DC	First (Input)	4.24 (120)
	Second	15.86 (450)
4C16DA	First (Input)	2.12 (60)
	Second	26.48 (750)
4C16DB	First (Input)	4.24 (120)
	Second	26.48 (750)

Grease Replenishment and Draining Procedure, Grease Replacement

Grease Replenishment and Draining Procedure

Procedure for adding grease to grease-lubrication models (excluding maintenance-free models)

1. Remove the grease discharge plug from the outside cover.
2. Add grease with a grease gun from the grease nipple in the inside cover section or motor connection cover.
3. Insert the grease discharge plug.



Add grease while manually rotating the input shaft to ensure proper, uniform circulation.

Add grease slowly, to prevent internal pressure and possible seal damage.

Do not add more grease than the amount shown in Table 28 and 29. Adding too much grease may cause the grease temperature to rise, or force the grease to leak into the motor.

Always consult factory and warehouses for overhaul of gearmotors and reducers. Familiarity with Cyclo® products is necessary for proper overhaul.

Table 30. Grease Replenishment Intervals

Hours of operation	Replenishment interval	Remarks
10 hr. max./day	3 - 6 months	Shorten the supply interval when the operating conditions are severe or the frame size is large
10 - 24 hr. max./day	500 - 1000 hours	

Table 31. Grease Replacement Intervals

Change Interval	Remarks
Every 20,000 hrs or 3-5 years	Shorten the supply interval when the operating conditions are severe or the frame size is large

Grease Replacement

- Maintenance free units may be safely operated for an extended time because it is sealed with maintenance free grease. Tables 28 & 29 are provided for generalized reference.



- Adequate care should be taken to ensure the lubricant continues to meet the specified lubrication characteristics.
- If refurbishment or rebuild is required, do not add more grease than the amount shown in Tables 28 and 29.
- Adding too much grease may cause the grease temperature to rise or force the grease to leak into the motor.



- Consider implementing a lube analysis program to ensure lubricant continues to operate at peak performance.
- Follow your lubrication providers analysis recommendations to ensure reducer performance.
- Always consult factory and warehouses for overhaul of gearmotors and reducers. Experience is necessary for proper overhaul.

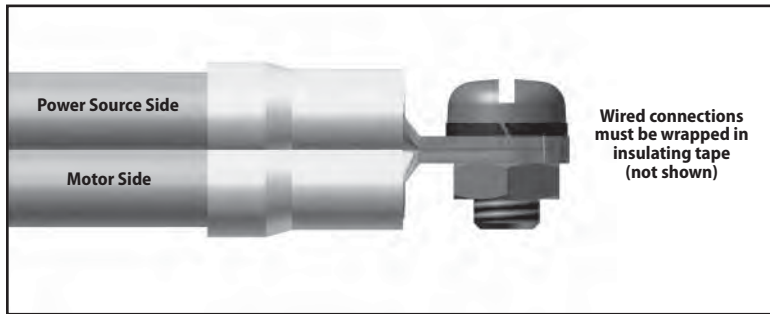
Motor Wiring

Motor Wiring

Wiring Guidelines

This section details wiring for standard Sumitomo three-phase motors and brakemotors. If using a motor manufactured by a company other than Sumitomo, please refer to that manufacturer's instruction manual for wiring, operating and maintenance details. When wiring motors into the power supply, Sumitomo recommends the use of terminal rings to facilitate the connection:

Figure 3. Terminal Ring Wiring Connection



- Do not handle the unit when cables are live. Be sure to turn-off the power; otherwise electric shock may result.
- Connect the power cables to the unit according to the connection diagram shown inside the terminal box or in the maintenance manual; otherwise electric shock or fire may result.
- Correctly ground the grounding bolt; otherwise electric shock may result.
- Keep all wiring and electrical parts dry and moisture free.
- Follow local electrical codes and regulations when wiring; otherwise burning, electrical shock, injury and/or fire may result.
- The motor is not equipped with an overload device. Sumitomo strongly recommends that another protective device (i.e.: ground fault interrupters, etc.), in addition to an overload device, be installed in order to prevent burning, electric shock, personal injury and/or fire.
- For single phase motors, exercise caution so as to not damage the vinyl cover of the starting capacitor, otherwise shock may result.
- For brakemotors, do not electrify a brake coil continuously when the motor is stopped otherwise the brake coil may burn and fire may result.



- For brakemotors, install the rectifier where the temperature is less than 140°F (60°C)
- Long wires cause the voltage to drop. Select cables with appropriate diameter so that the voltage drop will be less than 2%.
- After wiring the motor, check that the terminal box mounting bolts are tight.

Measuring Insulation Resistance

When measuring insulation resistance, disconnect the motor from the control panel. Check the motor separately.



Never touch the terminals when measuring insulation resistance otherwise electrical shock may occur.

Measure the insulation resistance before wiring. Insulation resistance varies according to the motor voltage, insulation type, coil temperature, humidity, length of operation, test electrification time, etc.

Under most conditions, the insulation resistance exceeds the value shown in this table:

Table 32. Insulation Resistance

Mega-Ohm	Insulation Resistance
500V	1M (Ω)

A drop in resistance may be attributed to poor insulation. In such case, do not turn on the power. Contact the nearest Sumitomo representative, distributor, or sales office.

Motor Protection



- Use a molded case circuit breaker for protection against short circuit.
- Use an overload protection device that protects the unit against voltage surges.

U.S. Standard Motors Motor Wiring Method



- For additional information please refer to the motor name plate.
- Due to changes in design features, this diagram may not always agree with that on the motor.
- In such cases, connection diagram found inside the conduit box of the motor should be used.

1

Based on motor power, determine if motor is **WYE** or **DELTA** type

2

Wire the motor to the power source using the correct connection type:

Table 33. Typical 230/460V, Three-Phase Wiring Configuration by Motor Type

Motor HP (kW) x P	Motor		Duty		
	Standard	CSA	AF-Motor	AF-Motor	
1/8 (0.1) x 4	WYE	WYE	WYE	WYE	
1/4 (0.2) x 4					
1/3 (0.25) x 4					
1/2 (0.4) x 4					
3/4 (0.55) x 4					
1 (0.75) x 4					
1.5 (1.1) x 4					
2 (1.5) x 4					
3 (2.2) x 4					
5 (3.7) x 4					
7.5 (5.5) x 4	DELTA	DELTA	DELTA	DELTA	
10 (7.5) x 4					
15 (11) x 4					
20 (15) x 4					
25 (18.5) x 4					
30 (22) x 4			—	—	—
40 (30) x 4					
50 (37) x 4					
60 (60) x 4					
75 (56) x 4					

Figure 4. Three-Phase WYE Connection Motor

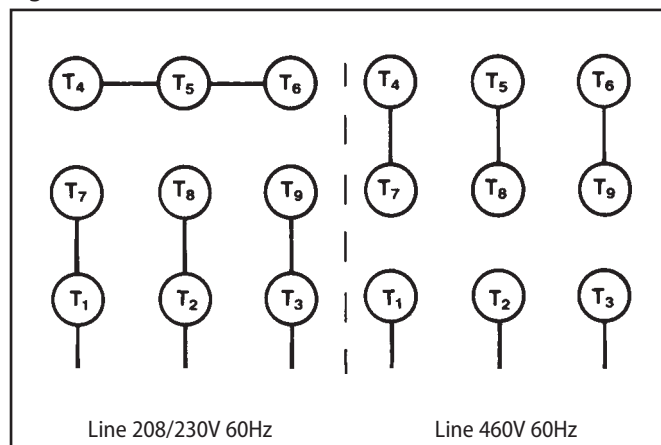


Figure 5. Three-Phase DELTA connection Motor

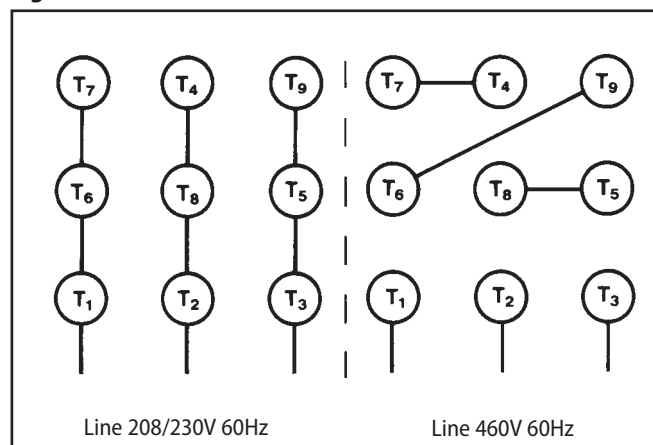


Figure 6. Three-Phase Motor, 575V, 60Hz

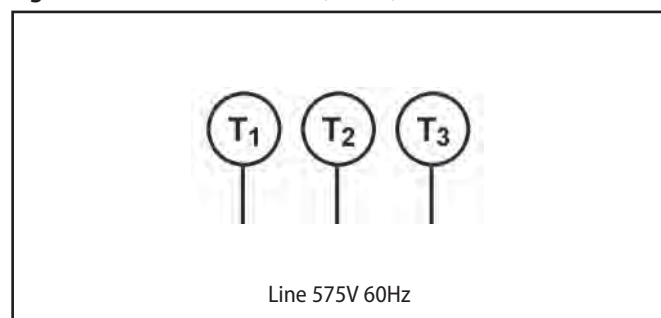
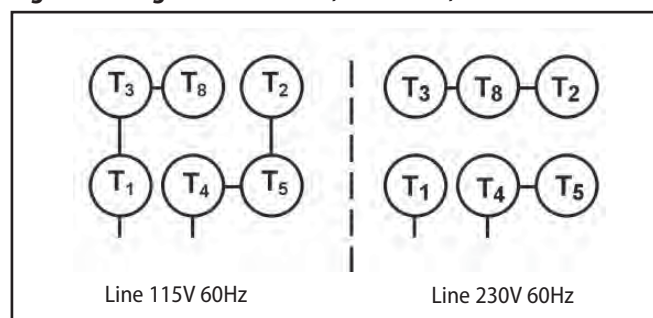


Figure 7. Single-Phase Motor, 115/230V, 60Hz



Motor Wiring, continued

Motor Wiring Method, Brake Wiring

CE Motors

Table 34. Typical 220/380V, Three-Phase Wiring Configuration by Motor Type

Motor HP (kW) x P	Voltage Configuration	Wiring Configuration
1/8 (0.1) x 4	220/380V, 50Hz Three Phase	DELTA-WYE
1/4 (0.2) x 4		
1/3 (0.25) x 4		
1/2 (0.4) x 4		
3/4 (0.55) x 4		
1 (0.75) x 4		
1.5 (1.1) x 4		
2 (1.5) x 4		
3 (2.2) x 4		
4 (3.0) x 4		
5 (3.7) x 4	380V, 50Hz Three Phase	WYE-Start DELTA-Run
7.5 (5.5) x 4		
10 (7.5) x 4		
15 (11) x 4		
20 (15) x 4		
25 (18.5) x 4		
30 (22) x 4		
40 (30) x 4		

Motor Wiring Method



- For additional information please refer to the motor name plate.
- Due to changes in design features, this diagram may not always agree with that on the motor.
- In such cases, connection diagram found inside the conduit box of the motor should be used.

1

Based on motor power, determine if motor is **WYE** or **DELTA** type.

2

Wire the motor to the power source using the correct connection type:

Figure 8. DELTA-WYE Connection Motor

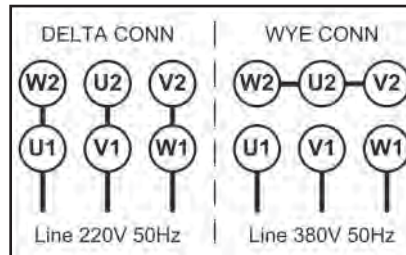
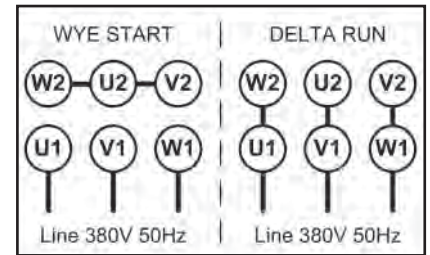


Figure 9. WYE-DELTA Start Connection Motor



Brake Wiring

Varistor Selection

For wiring of Fast Brake Action, Sumitomo recommends the use of a Varistor (VR). Refer to Table 35 to assist in the selection of the appropriately sized Varistor.

Table 35. Varistor Specifications Table

Operating Voltage		190 - 230V	380-460V	575V
Varistor Rated Voltage Varistor Voltage		AC260-300V 430-470V	AC510V 820V	AC604V 1000V
Rated Watts	FB01A, 02A FB-05A FB-1D FB-2D, 3D FB-5B, 8B FB10B, 15B	Over 0.4W Over 0.4W Over 0.6W Over 1.5W Over 1.5W Over 1.5W	Over 0.4W Over 0.4W Over 0.6W Over 1.5W Over 1.5W Over 1.5W	Over 0.4W Over 0.4W Over 0.6W Over 1.5W Over 1.5W Over 1.5W

U.S. Standard and CSA Approved Motor Brake Wiring

The brake portion (if supplied) of the motor may be wired using one of the following these methods:

FB-01A through FB-15B

- MC: Electromagnetic Relay
- MCB: Magnetic Circuit Breaker
- OLR: Overload or Thermal Relay
- VR: Varistor (protective device)^[1]

Figure 10. Normal Brake Action, 230V, 575V

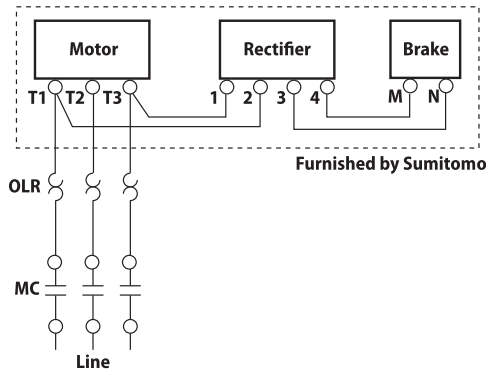


Figure 11. Fast Brake Action, 230V

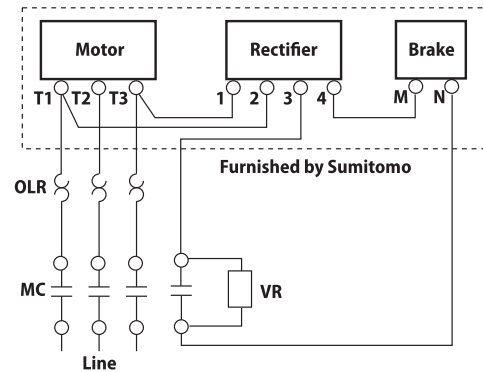


Figure 12. Normal Brake Action, 460V

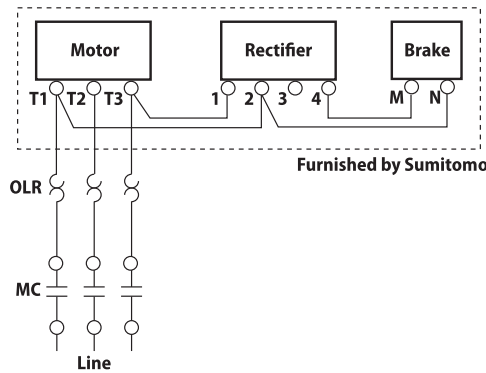
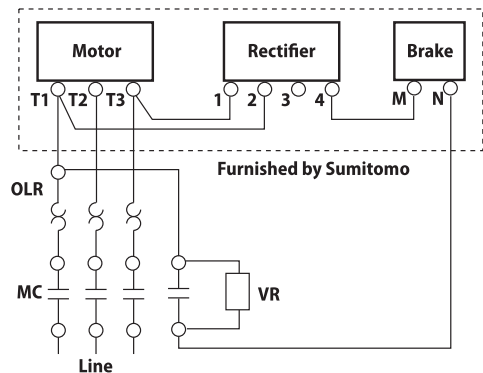


Figure 13. Fast Brake Action, 460V, 575V



Models FB-20 / FB-30 Brakes

Figure 14. Normal Brake Action, 230V, 460V

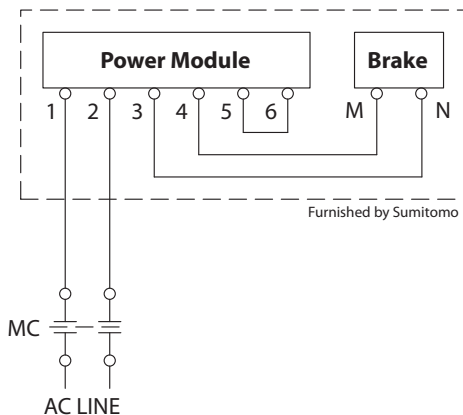
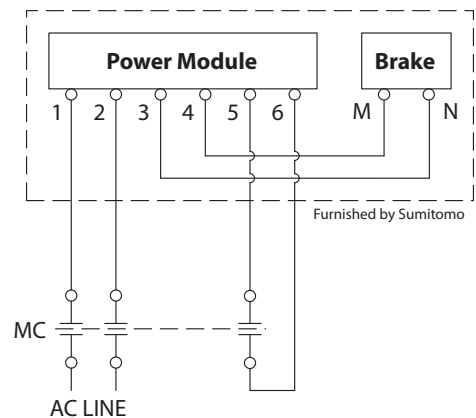


Figure 15. Fast Brake Action, 230V, 460V



Note: [1] Refer to Varistor Specifications Table

Motor Wiring, continued

U.S. Standard and CSA Approved Motor Brake Wiring

Models CMB-20 Brakes

Figure 16. Normal Brake Action, 230V

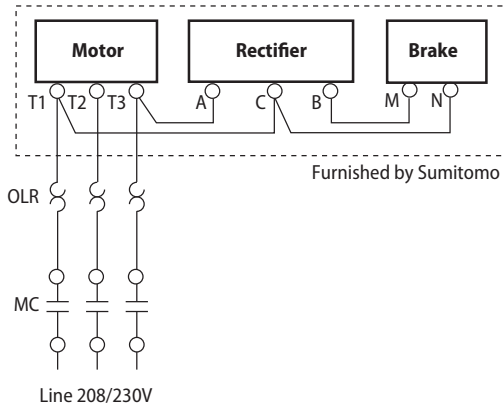


Figure 17. Fast Brake Action, 230V

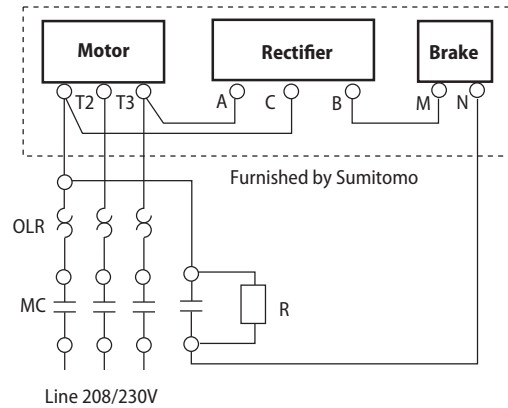


Figure 18. Normal Brake Action, 460V

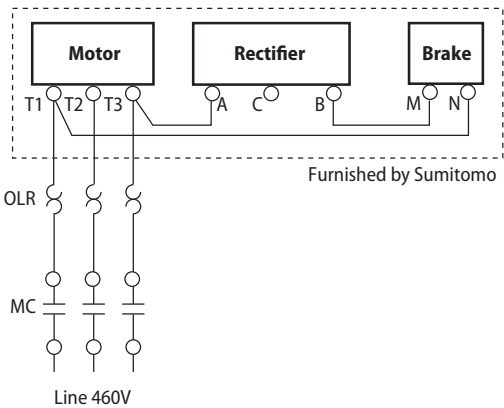


Figure 19. Fast Brake Action, 460V

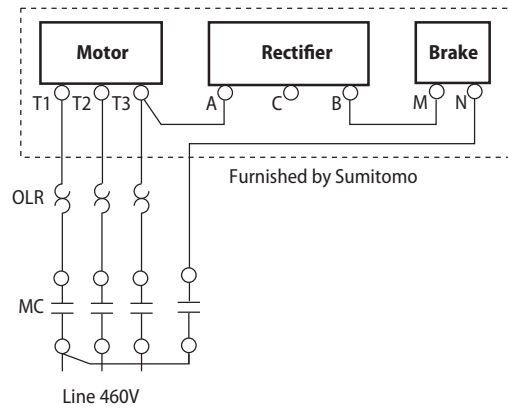


Figure 20. Normal Brake Action, 575V

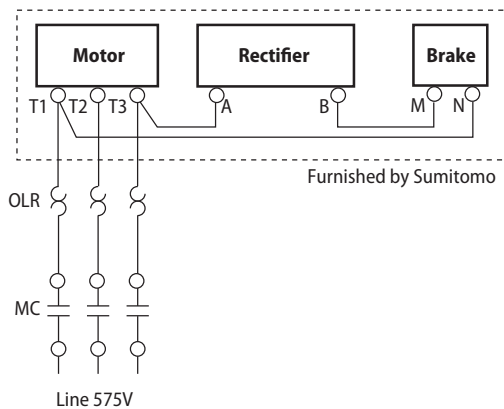
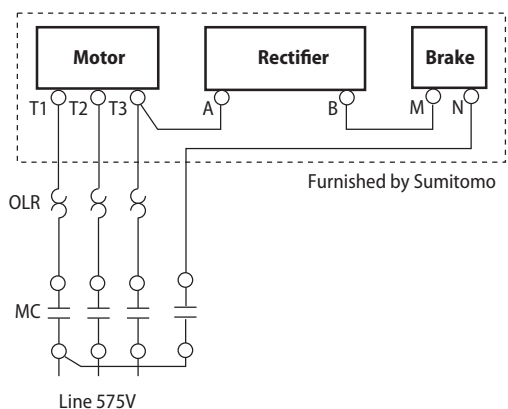


Figure 21. Fast Brake Action, 575V



- MC: Electromagnetic Relay
- MCB: Magnetic Circuit Breaker
- OLR: Overload or Thermal Relay
- VR: Varistor (protective device)^[1]

Note: [1] Refer to Varistor Specifications Table

CE Motor Brake Wiring

Models FB-01A through FB-5B, 220/380V, 50Hz

Figure 22. Normal Brake Action, 220V Motor 220V Brake

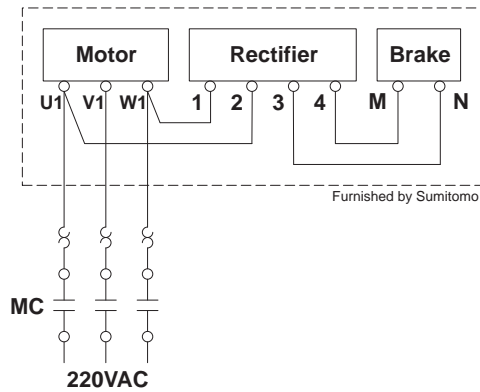


Figure 23. Fast Brake Action, 220V Motor 220V Brake

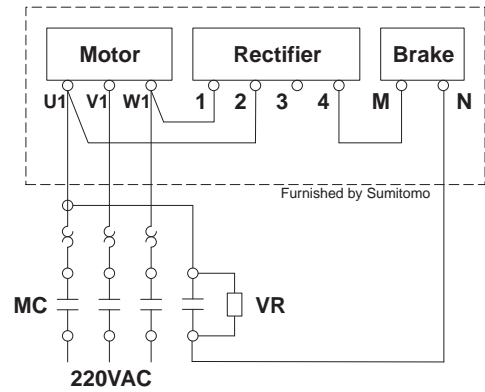


Figure 24. Normal Brake Action, 380V Motor, 220V Brake, Tapped

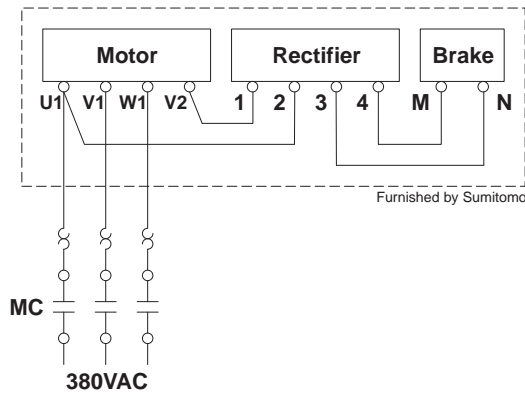


Figure 25. Fast Brake Action, 380V Motor, 220V Brake, Tapped

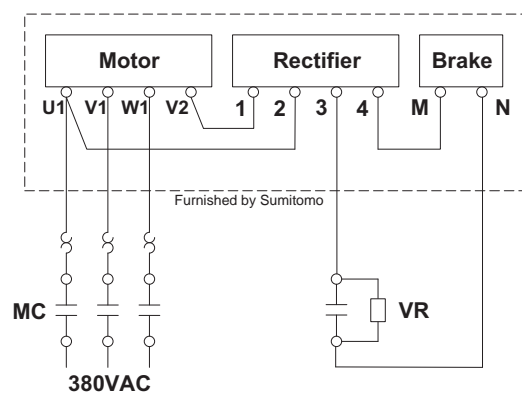


Figure 26. Normal Brake Action, 380V Motor, 220V Brake, Separated

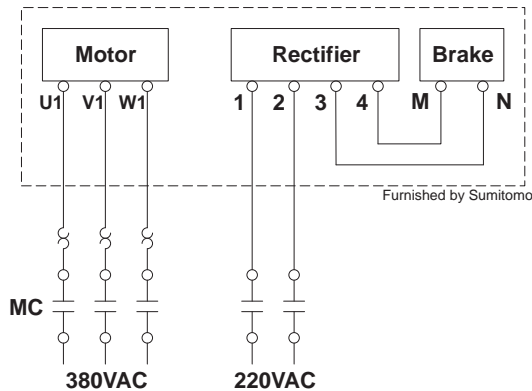
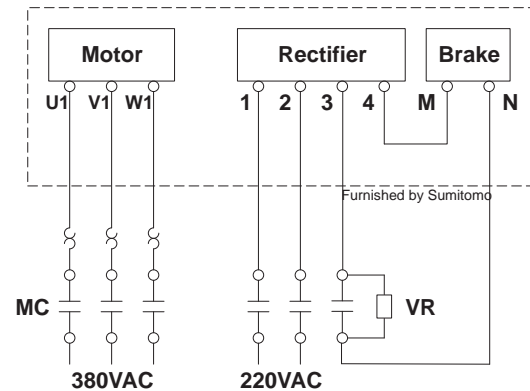


Figure 27. Fast Brake Action, 380V Motor, 220V Brake, Separated



MC: Electromagnetic Relay
MCB: Magnetic Circuit Breaker
OLR: Overload or Thermal Relay
VR: Varistor (protective device)^[1]

Note: [1] Refer to Varistor Specifications Table

Motor Wiring, continued

CE Motor Models FB-8B through FB-15B

Figure 28. Normal Brake Action, 380V Motor, 380V Brake

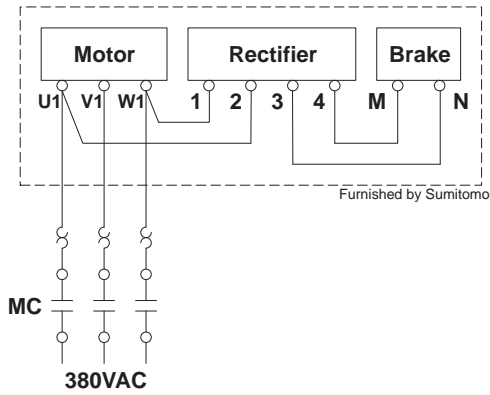
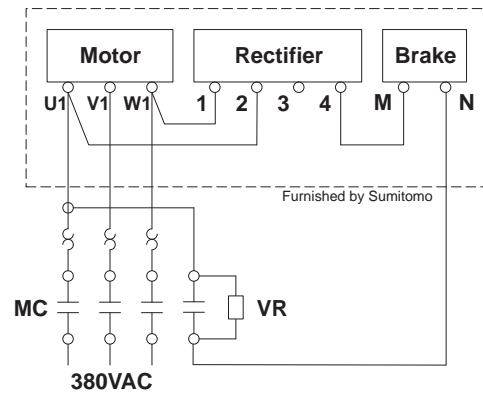


Figure 29. Fast Brake Action, 380V Motor, 380V Brake



CE Motors Models FB-01A through FB-15B with Inverter

Figure 30. Normal Brake Action

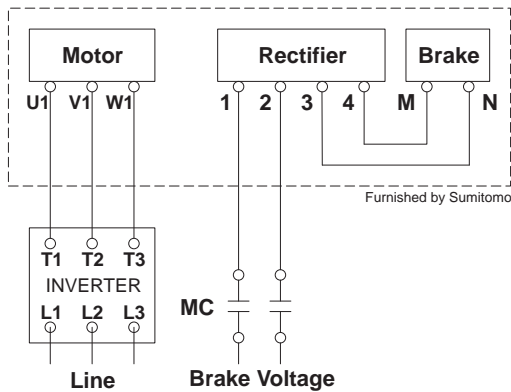
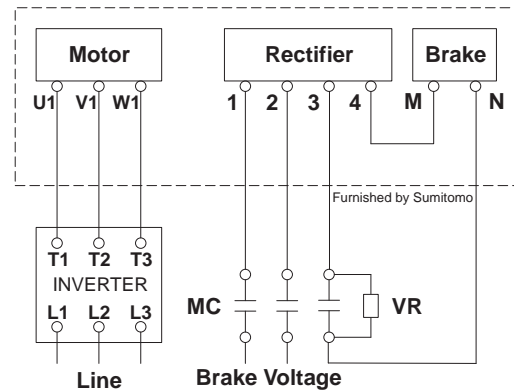


Figure 31. Fast Brake Action



MC: Electromagnetic Relay
 MCB: Magnetic Circuit Breaker
 OLR: Overload or Thermal Relay
 VR: Varistor (protective device)^[1]

Table 36. Standard CE Motor, Motor / Brake Voltage Table

HP (kW) x P	Brake Model	Motor Voltage	Brake Voltage		
1/8 (0.1) x 4	FB-01A	220/380V, 50Hz	220V, 50Hz		
1/4 (0.2) x 4	FB-02A				
1/3 (0.25) x 4					
1/2 (0.4) x 4	FB-05A				
3/4 (0.55) x 4	FB-1D				
1 (0.75) x 4					
1.5 (1.1) x 4					
2 (1.5) x 4					
3 (2.2) x 4	FB-3D			380V, 50Hz	380V, 50Hz
4 (3) x 4	FB-5B				
5 (3.7) x 4					
7.5 (5.5) x 4					
10 (7.5) x 4	FB-10B				
15 (11) x 4	FB-15B				

Note: [1] Refer to Varistor Specifications Table

Brake Rectifiers and Power Modules

Table 37. Standard Brake Rectifiers

Brake Type	Motor HP (kW) x P	230V/460V Rectifier		575V Rectifier	
		Model Number	Part Number	Model Number	Part Number
FB-01A	1/8 (0.1) x 4	25FW-4FB3	EW107WW-01	10F-6FB3	EW104WW-01
FB-02A	1/4 (0.2) x 4 1/3 (0.25) x 4				
FB-05A	1/2 (0.4) x 4				
FB-1D	3/4 (0.55) x 4 1 (0.75) x 4				
FB-2D	1.5 (1.1) x 4 2 (1.5) x 4				
FB-3D	3 (2.2) x 4				
FB-5B	5 (3.7) x 4				
FB-8B	7.5 (5.5) x 4				
FB-10B	10 (7.5) x 4				
FB-15B	15 (11) x 4				
CMB-20	20 (15) x 4				

Table 38. Brake Rectifiers for CE Motors

Brake Type	Motor HP (kW) x P	220V Rectifier		380V Rectifier					
		Model Number	Part Number	Model Number	Part Number				
FB-01A	1/8 (0.1) x 4	10F-2FB2	MP983WW-01	Consult Factory	Consult Factory				
FB-02A	1/4 (0.2) x 4 1/3 (0.25) x 4								
FB-05A	1/2 (0.4) x 4								
FB-1D	3/4 (0.55) x 4 1 (0.75) x 4								
FB-2D	1.5 (1.1) x 4 2 (1.5) x 4								
FB-3D	3 (2.2) x 4								
FB-5B	4 (3.0) x 4 5 (3.7) x 4								
FB-8B	7.5 (5.5) x 4					Consult Factory	Consult Factory	05F-4FB2	MP985WW-01
FB-10B	10 (7.5) x 4					Consult Factory	Consult Factory	15F-4FB1	EW397WW-01
FB-15B	15 (11) x 4								

Table 39. Brake Power Modules

Brake Type	Motor HP (kW) x P	170 ~ 300VAC Module		380 ~ 480VAC Module	
		Model Number	Part Number	Model Number	Part Number
FB-20	20 (15) x 4	13SR-2	ES075WW-01	10SR-4	MQ003WW-01
FB-30	25 (18.5) x 4 30 (22) x 4 40 (30) x 4				

Parts

Cyclo® BBB4 Reducer

Figure 32. Cyclo® BBB4 Reducer Parts

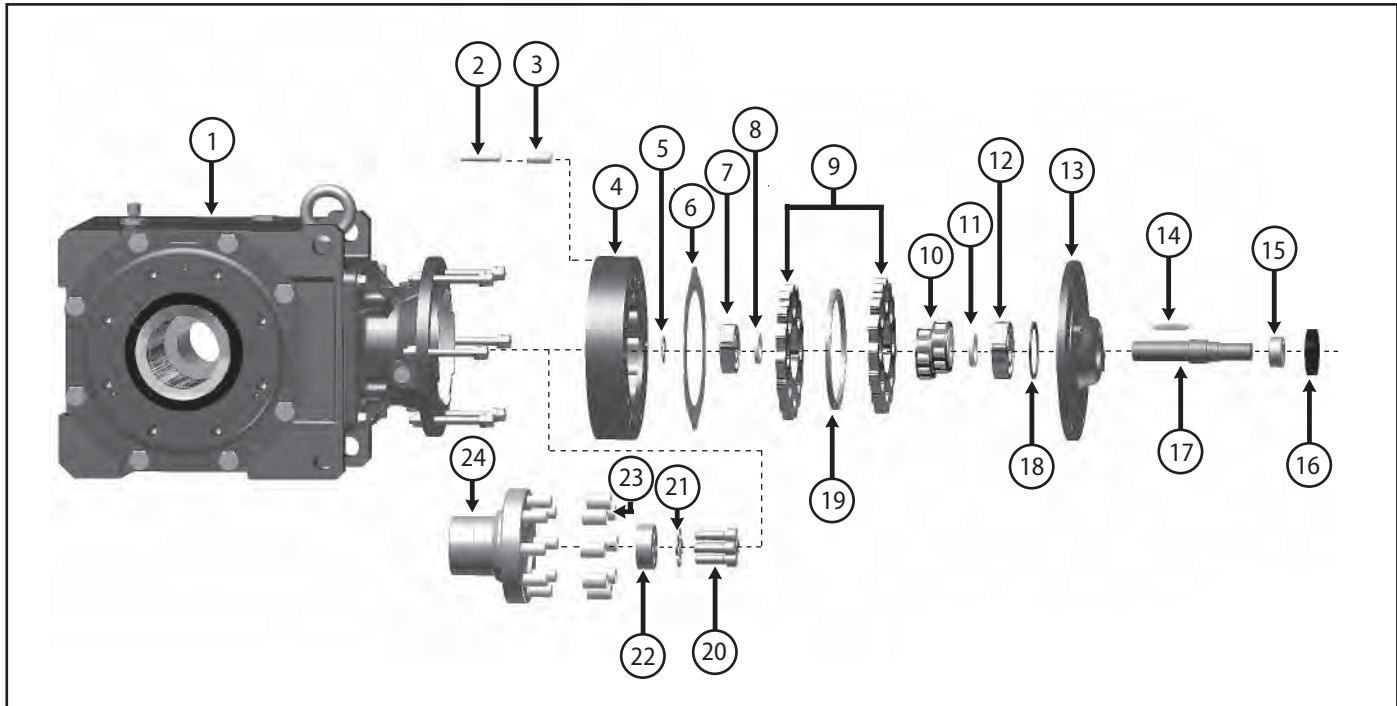


Table 40. Cyclo® BBB4 Reducer Parts

Number	Description
1	BBB4 Gear Assembly
2	Cyclo® Ring Gear Housing Pins
3	Cyclo® Ring Gear Housing Rollers
4	Cyclo® Ring Gear Housing
5	Snap Ring
6	Gasket Set
7	High Speed Shaft A Bearing
8	Spacer
9	Cycloid Discs
10	Cyclo® Eccentric Cam Assembly
11	Spacer
12	High Speed Shaft B Bearing

Number	Description
13	Cyclo® High-Speed End Shield
14	Eccentric Key
15	High Speed Shaft Oil Seal Collar
16	High Speed Shaft Oil Seal
17	High Speed Shaft
18	Snap Ring
19	Cycloid Disc Spacer
20	Retaining Bolts
21	Lock Washers
22	End Plate
23	Pin Carrier Rollers
24	Pin Carrier

Cyclo® Planetary Reduction Component Parts

Cyclo® Planetary Reduction Component Parts (Cyclo® Ratios 11 - 18:1)

Figure 33. Cyclo® Planetary Reduction Component

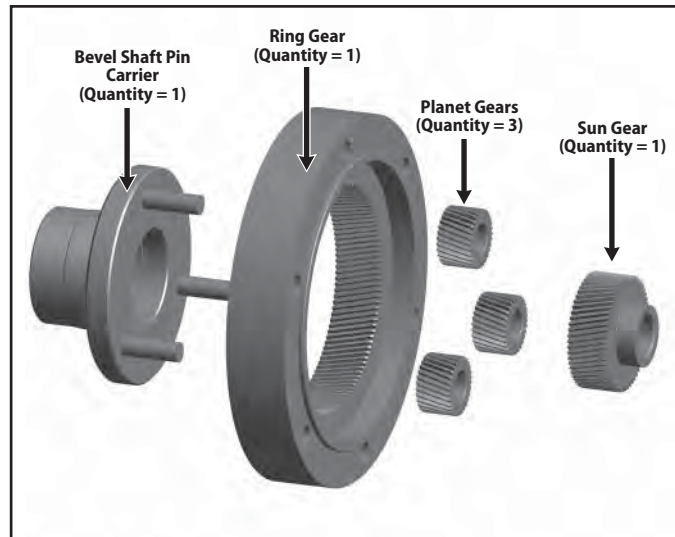


Table 41. Cyclo® Planetary Reduction Component Part Numbers (Ratios 11 - 18:1)

Unit Size	Reduction Ratio (nominal)		Cyclo® Planetary Reduction Part Numbers					
	Overall	Cyclo® Planetary	Reduction Block Set (gears & bearings)	Planet Gear	Ring Gear	Sun Gear	Unit Size	Bevel Shaft Pin Carrier
4A100 4A105	11	3	See Note ^[1]	AN8911G	AN8303G	AN8910G	4A100, 4A105	BL515LG
	13, 14	4	See Note ^[1]	AN8870G	AN8871G	AN8869G	4A120, 4A125	CJ701LG
	16, 18	5	See Note ^[1]	AN8305G	AN8306G	AN8304G	4B120, 4B125	CJ703LG
4A120, 4A125 4B120, 4B125	11	3	931BB612-003G	AN8308G	AN8309G	AN8307G	4A140, 4A145	CJ702LG
	13, 14	4	931BB612-004G	AP8706G	CJ554LG	AP8705G	4B140, 4B145	CJ704LG
	16, 18	5	931BB612-005G	AN8311G	AN8312G	AN8310G	4C140, 4C145	CJ706LG
4A140, 4A145 4B140, 4B145 4C140, 4C145	11	3	931BB614-003G	AP0884G	AP0885G	AP0883G	4B160, 4B165	CJ705LG
	13, 14	4	931BB614-004G	AP8708G	CJ555LG	AP8707G	4C160, 4C165	CJ707LG
	16, 18	5	931BB614-005G	AN8317G	AN8318G	AN8316G	4D160, 4D165	CH457LG
4B160, 4B165 4C160, 4C165 4D160, 4D165	11	3	931BB616-003G	AP0890G	AP0891G	AP0889G	4C170, 4C175	CJ938LG
	13, 14	4	931BB616-004G	AP8710G	CJ556LG	AP8709G	4D170, 4D175	CH738LG
	18	5	931BB616-005G	AN8323G	AN8324G	AN8322G	4E170, 4E175	CH738LG
4C170, 4C175 4D170, 4D175 4E170, 4E175	11	3	931BB617-003G	AN8913G	AN8914G	AN8912G	4D180, 4D185 4E180, 4E185 ^[2]	CJ961LG
	13, 14	4	931BB617-004G	AP9280G	CJ994LG	AP9279G		CJ960LG
	16, 18	5	931BB617-005G	AN8329G	AN8330G	AN8328G		CJ959LG
4D180, 4D185 4E180, 4E185 ^[2]	11	3	931BB618-003G	AP9285G	CJ997LG	AP9284G	4E190, 4E195	CJ962LG
	13, 14	4	931BB618-004G	AP9287G	CJ997LG	AP9286G		CJ963LG
	16, 18	5	931BB618-005G	AP9289G	CJ997LG	AP9288G		CJ964LG
4E190, 4E195 4F190, 4F195 ^[2]	11	3	931BB619-003G	AP9292G	CK004LG	AP9291G	4F190, 4F195 ^[2]	CJ968LG
	13, 14	4	931BB619-004G	AP9294G	CK004LG	AP9293G		CJ969LG
	16, 18	5	931BB619-005G	AP9296G	CK004LG	AP9295G		CJ970LG

Note: [1] Consult Factory
[2] 18:1 ONLY

Cyclo® Reduction Component Parts

Cyclo® BBB4 Reduction Component Part Numbers (Ratios ≥ 19:1)

Figure 34. Cyclo® BBB4 Reduction Components - 4A100 thru 4F195

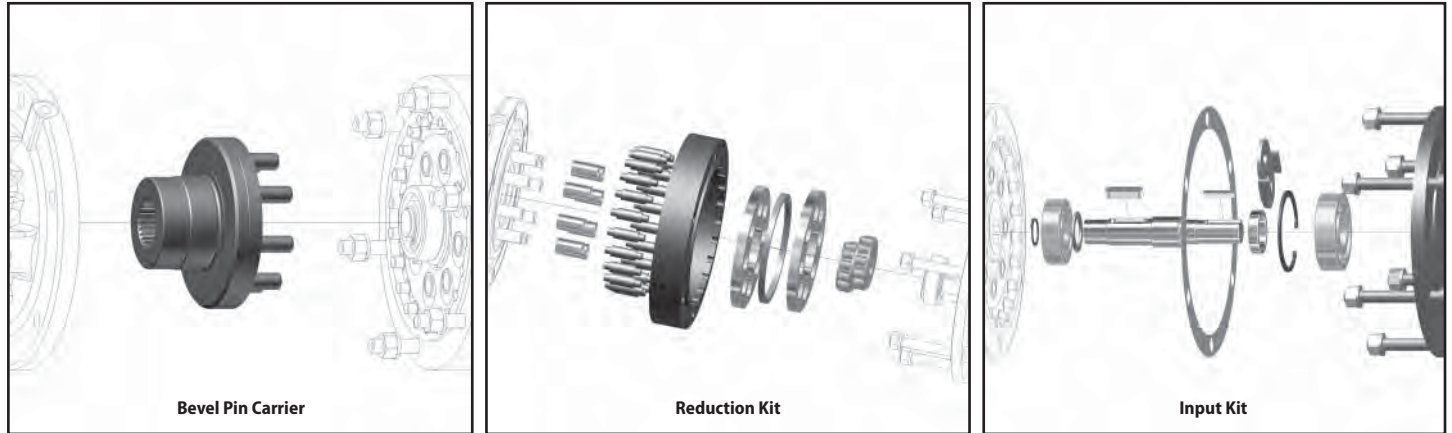


Table 42. Cyclo® BBB4 Reduction Component Part Numbers (Ratios ≥ 19:1)

Unit Size	Reduction Ratio		Part Numbers		
	Overall	Cyclo®	Input Kit	Reduction Kit	Bevel Pin Carrier
4A100 4A105	19, 21	6	D78622	D78675	BL514LG
	22, 25	7		See Note ⁽¹⁾	
	26, 28	8		D78676	
	35, 39	11		D78677	
	42, 46	13		D78678	
	48, 53	15		D78679	
	54, 60	17		D78680	
	67, 74	21		D78681	
	80, 88	25		D78682	
	93, 102	29		D78683	
	112, 123	35		D78684	
	138, 151	43		D78685	
	163, 179	51		D78686	
	189, 207	59		D78687	
	227, 249	71		D78688	
	278, 305	89		D78689	
	364	104		See Note ⁽¹⁾	
364, 417	119	See Note ⁽¹⁾			
≥ 424	≥ 121	See Note ⁽¹⁾			
4A110 4A115	19, 21	6	D78504	D78520	CJ690LG
	22, 25	7		See Note ⁽¹⁾	
	26, 28	8		D78521	
	35, 39	11		D78522	
	42, 46	13		D78523	
	48, 53	15		D78524	
	54, 60	17		D78525	
	67, 74	21		D78526	
	80, 88	25		D78527	
	93, 102	29		D78528	
	112, 123	35		D78529	
	138, 151	43		D78530	
	163, 179	51		D78531	
	189, 207	59		D78532	
	227, 249	71		D78533	
	278, 305	87		D78534	
	364	104		See Note ⁽¹⁾	
364, 417	119	See Note ⁽¹⁾			
≥ 424	≥ 121	See Note ⁽¹⁾			

Note: [1] Consult Factory

Cyclo® Reduction Component Parts

Table 42. Cyclo® BBB4 Reduction Components Part Numbers (Ratios >19:1), continued

Unit Size	Reduction Ratio		Part Numbers				Unit Size	Reduction Ratio		Part Numbers				
	Overall	Cyclo®	Input Kit	Reduction Kit	4A12	4B12		Overall	Cyclo®	Input Kit	Reduction Kit	4A14	4B14	4C14
					Bevel Pin Carrier	Bevel Pin Carrier						Bevel Pin Carrier	Bevel Pin Carrier	Bevel Pin Carrier
4A120	19, 21	6	D78623	D78690	CJ691LG	CJ693LG	4A140	19, 21	6	D78623	D78535	CJ692LG	CJ694LG	CJ696LG
	22, 25	7		See Note ⁽¹⁾				D78536						
	26, 28	8		D78691				D78537						
	35, 39	11		D78692				D78538						
	42, 46	13		D78693				D78539						
	48, 53	15		D78694				D78540						
	54, 60	17		D78695				D78541						
	67, 74	21		D78696				D78542						
	80, 88	25		D78697				D78543						
	93, 102	29		D78698				D78544						
	112, 123	35		D78699				D78545						
	138, 151	43		D78700				D78546						
	163, 179	51		D78701				D78547						
	189, 207	59		D78702				D78548						
	227, 249	71		D78703				D78549						
	278, 305	89		D78704				See Note ⁽¹⁾						
364	104	See Note ⁽¹⁾	See Note ⁽¹⁾											
364, 417	119	See Note ⁽¹⁾	See Note ⁽¹⁾											
≥ 424	≥ 121	See Note ⁽¹⁾	See Note ⁽¹⁾											

Unit Size	Reduction Ratio		Part Numbers				Unit Size	Reduction Ratio		Part Numbers				
	Overall	Cyclo®	Input Kit	Reduction Kit	4B16	4C16		4D16	Overall	Cyclo®	Input Kit	Reduction Kit	4C17	4D17, 4E17
					Bevel Pin Carrier	Bevel Pin Carrier		Bevel Pin Carrier					Bevel Pin Carrier	Bevel Pin Carrier
4B160	19, 21	6	D78625	D78720	CJ695LG	CJ697LG	CJ699LG	4C170	19, 21	6	D78626	D78735	CJ698LG	CJ700LG
	22, 25	7		See Note ⁽¹⁾					D78736					
	26, 28	8		D78721					D78737					
	35, 39	11		D78722					D78738					
	42, 46	13		D78723					D78739					
	48, 53	15		D78724					D78740					
	54, 60	17		D78725					D78741					
	67, 74	21		D78726					D78742					
	80, 88	25		D78727					D78743					
	93, 102	29		D78728					D78744					
	112, 123	35		D78729					D78745					
	138, 151	43		D78730					D78746					
	163, 179	51		D78731					D78747					
	189, 207	59		D78732					D78748					
	227, 249	71		D78733					See Note ⁽¹⁾					
	278, 305	89		D78734					See Note ⁽¹⁾					
364	104	See Note ⁽¹⁾	See Note ⁽¹⁾											
364, 417	119	See Note ⁽¹⁾	See Note ⁽¹⁾											
≥ 424	≥ 121	See Note ⁽¹⁾	See Note ⁽¹⁾											

Unit Size	Reduction Ratio		Part Numbers				Unit Size	Reduction Ratio		Part Numbers				
	Overall	Cyclo®	Input Kit	Reduction Kit	4D18	4E18		4F18	Overall	Cyclo®	Input Kit	Reduction Kit	4E19	4F19
					Bevel Pin Carrier	Bevel Pin Carrier		Bevel Pin Carrier					Bevel Pin Carrier	Bevel Pin Carrier
4D180	19, 21	6	D78627	See Note ⁽¹⁾	CK012LG	CK016LG	4E190	19, 21	6	D78628	See Note ⁽¹⁾	CJ956LG	CJ931LG	
	22, 25	7		See Note ⁽¹⁾				See Note ⁽¹⁾						
	26, 28	8		See Note ⁽¹⁾				D78763						
	35, 39	11		D78749				D78764						
	42, 46	13		D78750				D78765						
	48, 53	15		D78751				D78766						
	54, 60	17		D78752				D78767						
	67, 74	21		D78753				D78768						
	80, 88	25		D78754				D78769						
	93, 102	29		D78755				D78770						
	112, 123	35		D78756				D78771						
	138, 151	43		D78757				D78772						
	163, 179	51		D78758				D78773						
	189, 207	59		D78759				D78774						
	227, 249	71		D78760										
	278, 305	87		D78761										

Unit Size	Reduction Ratio		Part Numbers				Unit Size	Reduction Ratio		Part Numbers				
	Overall	Cyclo®	Input Kit	Reduction Kit	4D18	4E18		4F18	Overall	Cyclo®	Input Kit	Reduction Kit	4E19	4F19
					Bevel Pin Carrier	Bevel Pin Carrier		Bevel Pin Carrier					Bevel Pin Carrier	Bevel Pin Carrier
4D180	19, 21	6	D78627	See Note ⁽¹⁾	CK012LG	CK016LG	4E190	19, 21	6	D78628	See Note ⁽¹⁾	CJ956LG	CJ931LG	
	22, 25	7		See Note ⁽¹⁾				See Note ⁽¹⁾						
	26, 28	8		See Note ⁽¹⁾				D78763						
	35, 39	11		D78749				D78764						
	42, 46	13		D78750				D78765						
	48, 53	15		D78751				D78766						
	54, 60	17		D78752				D78767						
	67, 74	21		D78753				D78768						
	80, 88	25		D78754				D78769						
	93, 102	29		D78755				D78770						
	112, 123	35		D78756				D78771						
	138, 151	43		D78757				D78772						
	163, 179	51		D78758				D78773						
	189, 207	59		D78759				D78774						
	227, 249	71		D78760										
	278, 305	87		D78761										

Unit Size	Reduction Ratio		Part Numbers				Unit Size	Reduction Ratio		Part Numbers				
	Overall	Cyclo®	Input Kit	Reduction Kit	4D18	4E18		4F18	Overall	Cyclo®	Input Kit	Reduction Kit	4E19	4F19
					Bevel Pin Carrier	Bevel Pin Carrier		Bevel Pin Carrier					Bevel Pin Carrier	Bevel Pin Carrier
4D180	19, 21	6	D78627	See Note ⁽¹⁾	CK012LG	CK016LG	4E190	19, 21	6	D78628	See Note ⁽¹⁾	CJ956LG	CJ931LG	
	22, 25	7		See Note ⁽¹⁾				See Note ⁽¹⁾						
	26, 28	8		See Note ⁽¹⁾				D78763						
	35, 39	11		D78749				D78764						
	42, 46	13		D78750				D78765						
	48, 53	15		D78751				D78766						
	54, 60	17		D78752				D78767						
	67, 74	21		D78753				D78768						
	80, 88	25		D78754				D78769						
	93, 102	29		D78755				D78770						
	112, 123	35		D78756				D78771						
	138, 151	43		D78757				D78772						
	163, 179	51		D78758				D78773						
	189, 207	59		D78759				D78774						
	227, 249	71		D78760										
	278, 305	87		D78761										

Note: [1] Consult Factory

Bearings and Oil Seals

Figure 35. Cyclo® BBB4 Bearings and Oil Seals

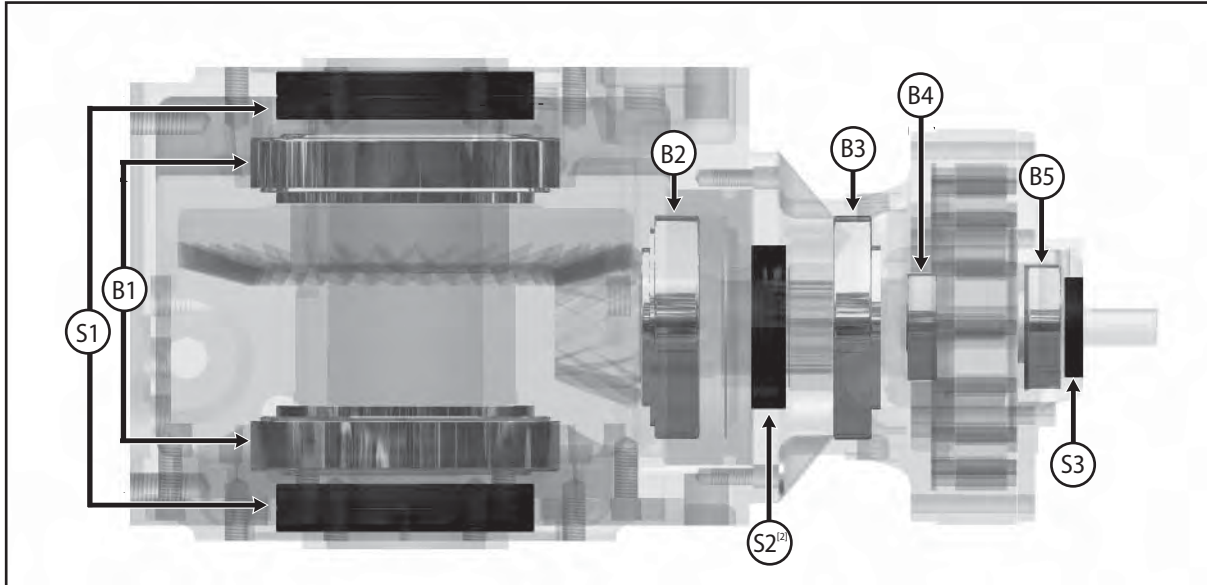


Table 43. Cyclo® BBB4 Reducer Bearings and Oil Seals

Unit Size	Bearings					Oil Seals ^[1]				
	B1	B2	B3	B4	B5	S1 ^[2]	S2 ^[2]	S3		
4A100 4A105 4A110 4A115 4A120 4A125	32017	32308	32011	6302RSH2	6302Z	D 85 x 110 x 13	S 50 x 68 x 9	S 20 x 35 x 7		
4A140 4A145			32013	6304	6305Z			D 32 x 52 x 8		
4B120 4B125			32020	32310	30215			6305R	6306	D 38 x 58 x 11
4B140 4B145					32013			6304	6305Z	D 32 x 52 x 8
4B160 4B165					30215			6305R	6306	D 38 x 58 x 11
4C140 4C145					32024			32312	30217	6307R
4C160 4C165	30215	6305R	6306	D 38 x 58 x 11						
4C170 4C175	30217	6307R	6308	D 55 x 78 x 12						
4D160 4D165	32028	32314	30220	6406		6407	D 62 x 82 x 12			
4D170 4D175			30217	6307R	6308	D 55 x 78 x 12				
4D180 4D185			30220	6406	6407	D 62 x 82 x 12				
4E170 4E175			32032	32315	30222	6407	6409	D 65 x 88 x 12		
4E180 4E185	30217	6307R			6308	D 55 x 78 x 12				
4E190 4E195	30220	6406			6407	D 62 x 82 x 12				
4F180 4F185	32036	32319			30222	6407	6409	D 65 x 88 x 12		
4F190 4F195			30226	6408	6411	S 70 x 88 x 10				
			30226	6407	6409	D 65 x 88 x 12				
			30230	6408	6411	D 180 x 210 x 16	S 140 x 170 x 14	S 70 x 88 x 10		

Notes: [1] D = Double Lip Seal. S = Single Lip Seal. Seal Dimensions are in mm.

[2] A total of 4 seals are needed - two on top and two on bottom

[3] for "Y4" assembly and grease lubricated units only

Bevel Gearing Parts and Tooth Count

Bevel Gearing Parts and Tooth Count

Bevel gear and pinions are sold in sets only. Individual components are not available for purchase. The information below regarding tooth count of the bevel gearset is provided for vibration analysis purposes.

Figure 36. Cyclo® BBB4 Bevel Gearing Tooth Count

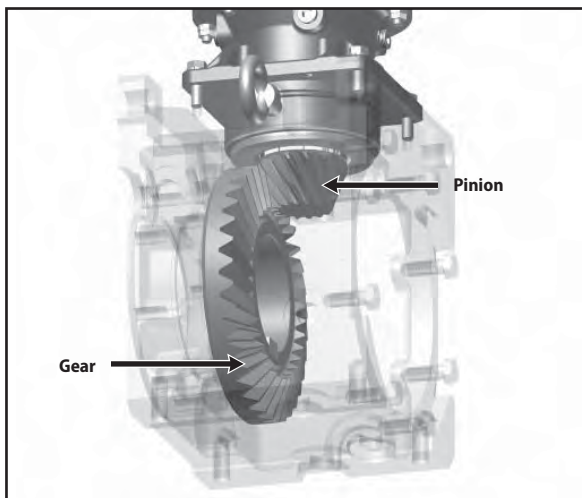


Table 44. Cyclo® BBB4 Ratios

Cyclo® BBB4 Nominal Ratio	Bevel Ratio	Cyclo® Input Ratio
11	3.5	3 ^[1]
13	3.2	4 ^[1]
14	3.5	4 ^[1]
16	3.2	5 ^[1]
18	3.5	5 ^[1]
19	3.2	6
21	3.5	6
22	3.2	7
25	3.5	7
26	3.2	8
28	3.5	8
35	3.2	11
39	3.5	11
42	3.2	13
46	3.5	13
48	3.2	15
53	3.5	15
54	3.2	17
60	3.5	17
67	3.2	21
74	3.5	21

Note: [1] Planetary Input

Cyclo® BBB4 Nominal Ratio	Bevel Ratio	Cyclo® Input Ratio
80	3.2	25
88	3.5	25
93	3.2	29
102	3.5	29
112	3.2	35
123	3.5	35
138	3.2	43
151	3.5	43
163	3.2	51
179	3.5	51
189	3.2	59
207	3.5	59
227	3.2	71
249	3.5	71
278	3.2	87
305	3.5	87
364	3.5	104
417	3.5	119
424	3.5	121
501	3.5	143
578	3.5	165
683	3.5	195

Cyclo® BBB4 Nominal Ratio	Bevel Ratio	Cyclo® Input Ratio
809	3.5	231
956	3.5	273
1117	3.5	319
1320	3.5	377
1656	3.5	473
1957	3.5	559
2272	3.5	649
2559	3.5	731
2944	3.5	841
3511	3.5	1003
4365	3.5	1247
5177	3.5	1479
6472	3.5	1849
7228	3.5	2065
8880	3.5	2537
10658	3.5	3045
12184	3.5	3481
15530	3.5	4437
17966	3.5	5133
21620	3.5	6177
26492	3.5	7569

To determine the bevel tooth count, identify the Cyclo® BBB4 nominal ratio and corresponding bevel ratio from Table 44. Then reference Table 45 to identify the actual number of bevel gear and pinion teeth.

Table 45. Bevel Tooth Count and Part Numbers

Bevel Ratio	Number of Teeth		Bevel Gear Set Part Number						
	Pinion	Gear	4A10, 4A11 4A12, 4A14	4B12, 4B14, 4B16	4C14, 4C16, 4C17	4D16	4D17, 4D18	4E17, 4E18, 4E19	4F18, 4F19
3.2	10	32	998BBB-4A--BG	998BBB-4B--BG	998BBB-4C--BG	998BBB-4D16BG	998BBB-4D17BG	998BBB-4E--BG	998BBB-4F--BG
3.5	10	35	998BBB-2A---G	998BBB-2B---G	998BBB-2C---G	998BBB-2D---G	998BBB-2D17-G	998BBB-2E---G	998BBB-4F--AG

Screw Conveyor Options

Components, Assembly Instructions

Screw Conveyor Components

Figure 37. Cyclo® BBB4 Screw Conveyor Components

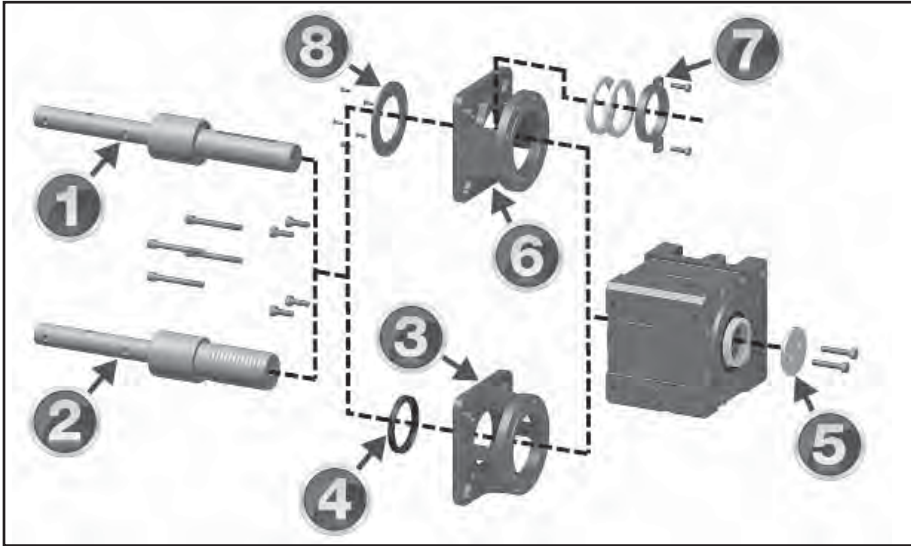
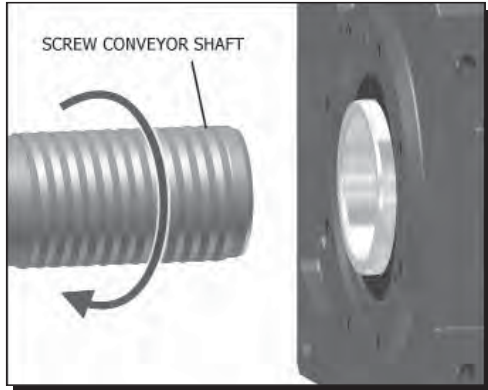


Table 46. Typical Cyclo® BBB4 Screw Conveyor Components

Item Number	Description
1	Screw Conveyor Shaft for KHB
2	Screw Conveyor Shaft for TGB
3	Cast Screw Conveyor Adapter
4	Shaft Seal
5	Shaft Retaining Plate
6	Fabricated Screw Conveyor Adaptor
7	Optional Braided Cord Packing Seal
8	Optional Gland Cover Plate

Screw Conveyor Assembly Instructions

Tapered Grip Bushing Type

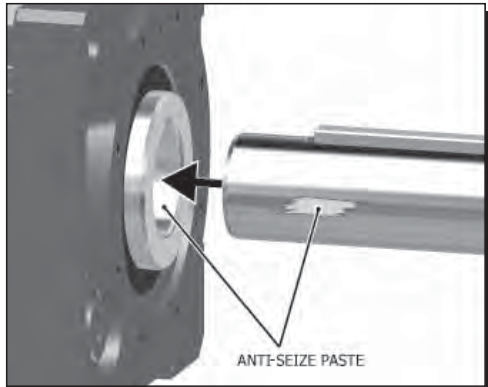


1

Insert the **screw conveyor shaft** completely into the Cyclo® BBB4 **output hub**.

Tapered Grip Bushing Type – Screw the threaded end into the BBB unit.

Keyed Type



Keyed Type – Apply anti-seize paste to the driven shaft, install key into shaft keyway, align the key and hollow shaft keyway and carefully slide the shaft into the BBB unit

Screw Conveyor Options, continued

Assembly Instructions

2

Secure the screw conveyor shaft in place using the **keeper plate** with the supplied hardware.

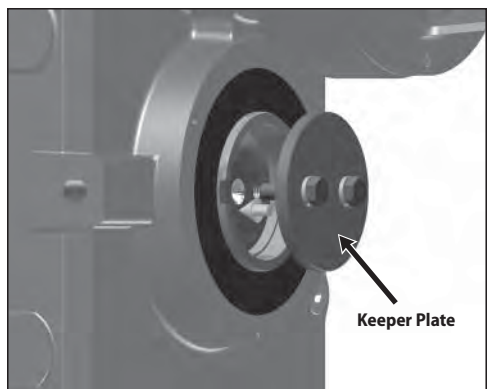
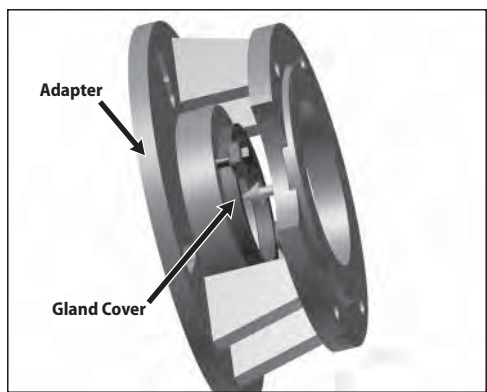


Table 47. Bolt Tightening Torques

Unit Size	Shaft Retaining Bolts	
	Qty. x Bolt Size	Bolt Torque (ft-lbs)
4A	2 x M10	33
4B	2 x M10	33
4C	2 x M12	59
4D	2 x M16	146
4E	2 x M16	146

3

If braided cord is supplied, place the **gland cover** into the screw conveyor adapter and secure it in place with the supplied hardware.



Cover not required with the use of a lipped seal.

Table 48. Bolt Tightening Torques

Unit Size	Gland Cover Bolts	
	Qty. x Bolt Size	Bolt Torque (ft-lbs)
4A	2 x M8	15
4B		
4C		
4D		
4E		

4

Carefully slide the screw conveyor adapter over the shaft and position it against the corresponding threaded holes in the Cyclo® BBB4 housing. Use the included hardware to secure the adapter to the housing.

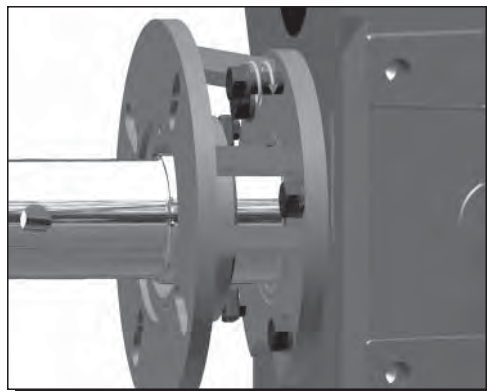
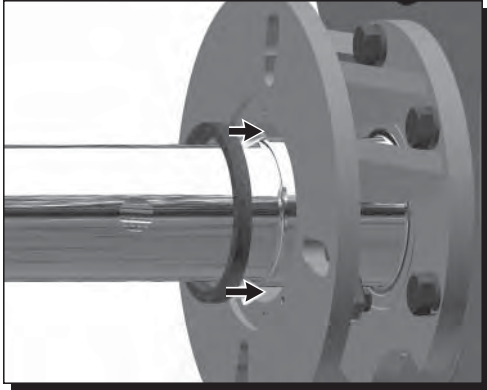


Table 49. Bolt Tightening Torques

Unit Size	Cast Adapter/Housing Bolts		Fabricated Adapter/Housing Bolts	
	Qty. x Bolt Size	Bolt Torque (ft-lbs)	Qty. x Bolt Size	Bolt Torque (ft-lbs)
4A	8 x M10 (HH)	47	4 x M10 (HH)	47
			4 x M10 (SHCS)	57
4B	8 x M12 (HH)	83	4 x M12 (HH)	83
			4 x M12 (SHCS)	100
4C	8 x M16 (HH)	202	4 x M16 (HH)	202
			4 x M16 (SHCS)	247
4D	8 x M20 (HH)	401	4 x M20 (HH)	401
			4 x M20 (SHCS)	285
4E	8 x M20 (HH)	401	8 x M20 (HH)	401

Screw Conveyor Options, continued

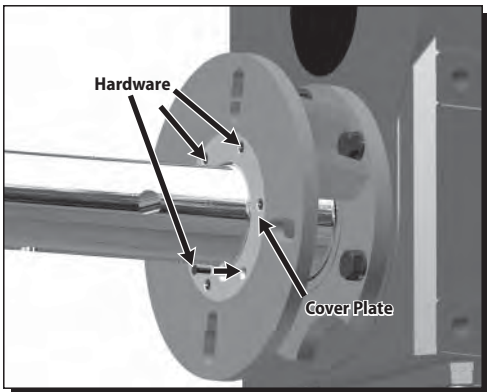
Assembly Instructions



5

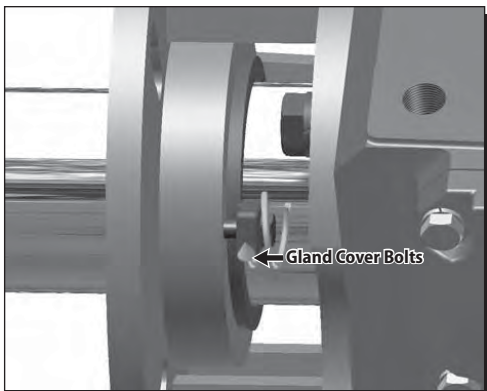
If supplied, carefully insert the application appropriate **sealing material** into the bore of the screw conveyor adapter.

- To seal the output portion of the screw conveyor adapter, Sumitomo provides two different options for each screw conveyor kit:
 - High-Performance Braided Cord: recommended for use if the conveyed material is abrasive.
 - Double-Lip, Nitrile Oil Seal: recommended for use if conveyed material is a nonabrasive liquid.
- Sumitomo **does not** recommend the use of both sealing options at the same time.



6

If using the **braided cord seal**, carefully slide the **cover plate** over the screw conveyor shaft and place it against the screw conveyor adapter. Secure the cover plate using the supplied hardware.



7

If using the **braided cord seal**, tighten the **gland cover bolts** to achieve sufficient sealing on the screw conveyor shaft.

Cyclo® Portion Disassembly/Assembly

Disassembly Procedure

Disassembly/Assembly

The Bevel Gear portion is designed for lower speeds and therefore has lower operating cycles when compared to the Cyclo® input assembly, therefore in most cases does not require rebuilding. Always consult our specialized factory and warehouses for overhaul of gearmotors and reducers. Experience is necessary for proper overhaul.

The Cyclo® portion has significantly higher operating cycles than the Bevel Gear portion, rebuild and repair is a convenient way to extend the useful life of your gearbox.



Cyclo® repairs should be conducted by experienced personnel to prevent damage to components or persons.

Cyclo® Portion – General Disassembly

1

Before starting the disassembly process, Sumitomo recommends draining and properly disposing of all lubrication.

2

Carefully remove the entire Cyclo® BBB4 from the driven shaft by following the instructions outlined in the Removal From Driven Shaft section of this manual.

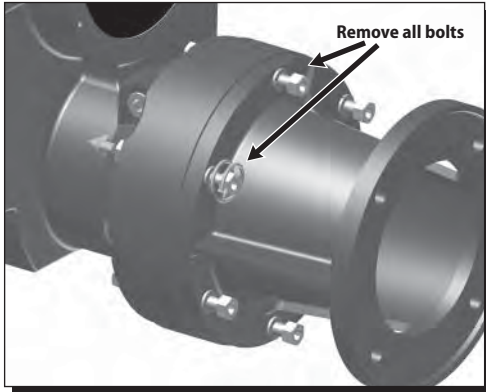


3

While carefully supporting the entire unit, place the unit on a level work surface so that the high speed portion (Cyclo® portion) is facing down.

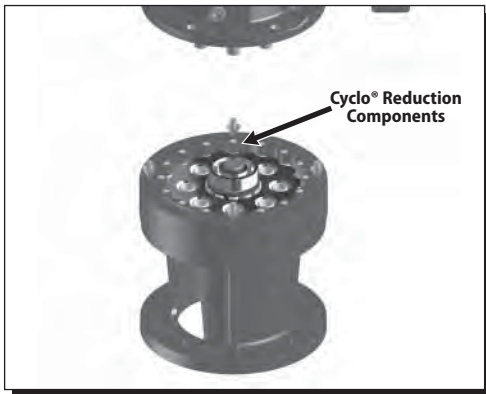
Cyclo® Portion Disassembly/Assembly, continued

Disassembly Procedure



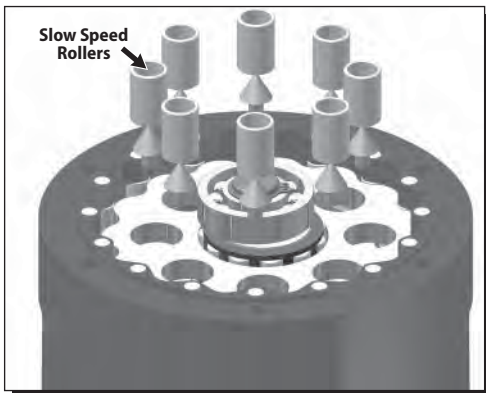
4

While continuing to externally support the entire Cyclo® BBB4 unit, remove each of the bolts from the Cyclo® ring gear housing (shown in horizontal position for clarity).



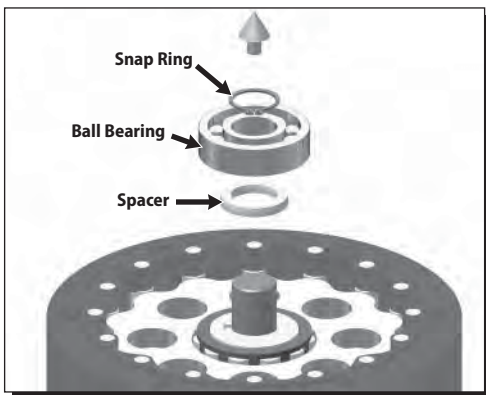
5

Carefully separate the **bevel gear housing assembly** from the Cyclo® portion to gain access to the **Cyclo® reduction components**.



6

Remove the **slow speed rollers**. Additionally, check the pins on the pin carrier to see if any of the rollers have adhered to them.

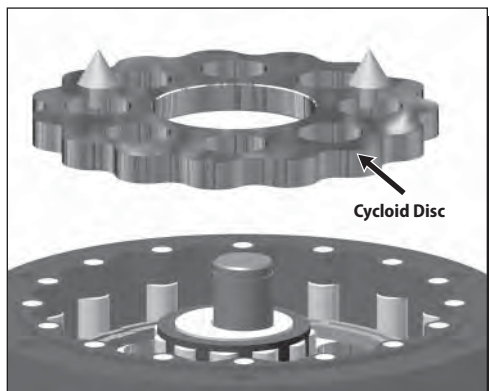


7

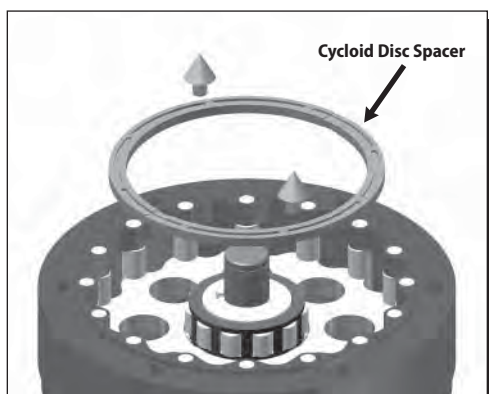
Remove the **snap ring**, the **ball bearing** and the **spacer** from the high speed shaft.

Cyclo® Portion Disassembly/Assembly, *continued*

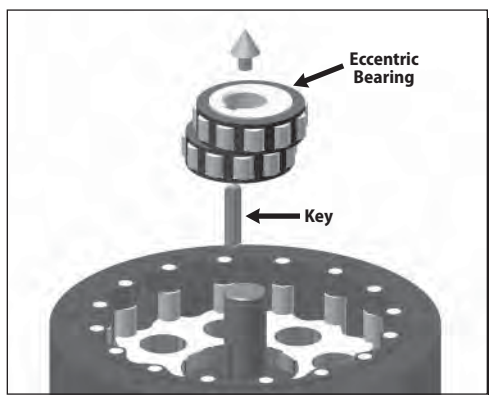
Disassembly Procedure

**8**

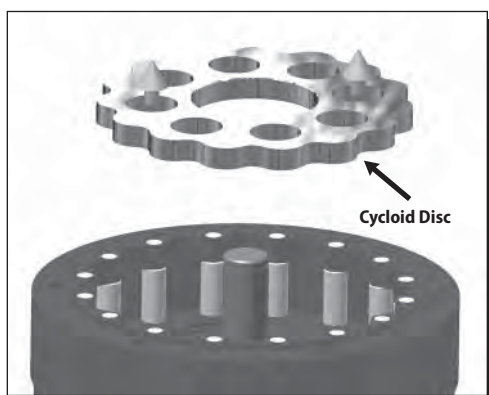
Using both hands, carefully remove the top **Cycloid disc**.

**9**

For Cyclo® units supplied with a **spacer**, remove the **Cycloidal disc spacer**.

**10**

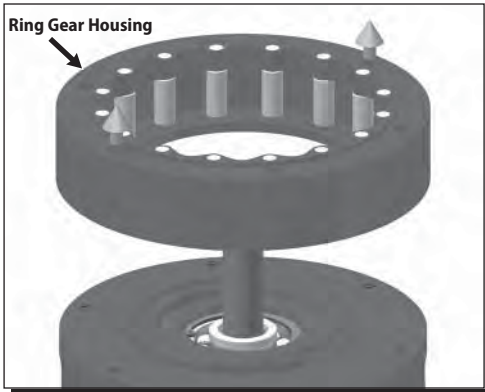
Remove the **eccentric bearing** from the high speed shaft.

**11**

Using both hands, carefully remove the remaining **Cycloid disc**.

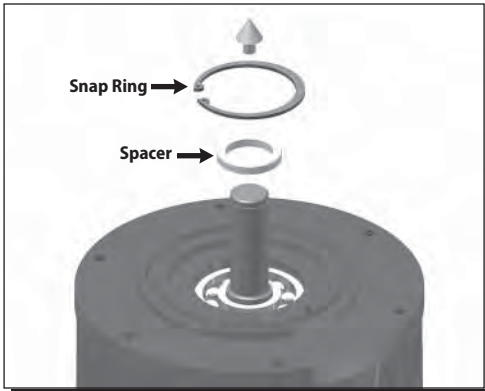
Cyclo® Portion Disassembly/Assembly, continued

Disassembly Procedure



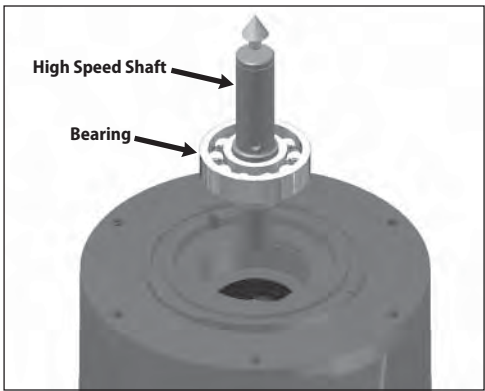
12

Remove the **ring gear housing**



13

Remove the **spacer** and the **snap ring** from the **high speed end shield**.



14

Remove the **high speed shaft**, along with its associated bearing, from the **high speed end shield**.

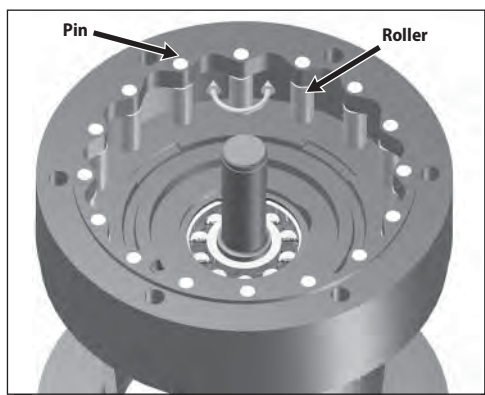
Cyclo® Portion Disassembly/Assembly, continued

Reassembly Procedure

Cyclo® Portion – General Reassembly

The Cyclo® portion of the speed reducer may be reassembled by reversing the disassembly procedure. All parts must be returned to the original order from which they were removed during disassembly. Take care to keep the moving reduction components free of dust or foreign material, and properly align all gaskets in order to keep the assembly oil tight/leak free.

Remember these important notes when assembling the Cyclo® reducer:



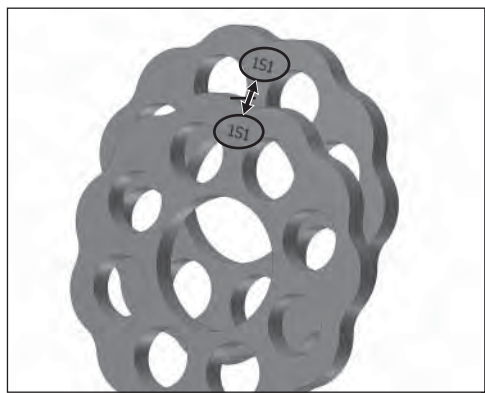
1

Place the **ring gear housing** on the Cyclo® **high speed end shield** (or the motor flange) and insert the ring gear housing **pins** and **rollers** (if they had been removed during the disassembly process). Rotate each of the pins and rollers by hand to assure that they freely move/rotate.

If the Cyclo® portion of the Cyclo® BBB4 is grease lubricated, liberally apply grease to the ring gear pins and rollers before they are inserted into the ring gear housing.



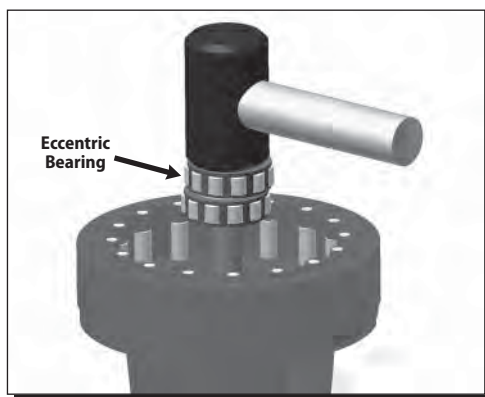
If the Cyclo® portion of the Cyclo® BBB4 unit is oil lubricated – do not add any grease during the reassembly process.



2

Cycloid discs are a matched pair, both discs have the same code etched on one side.

When inserting these discs into the ring gear housing, be sure that the etched number is facing up.

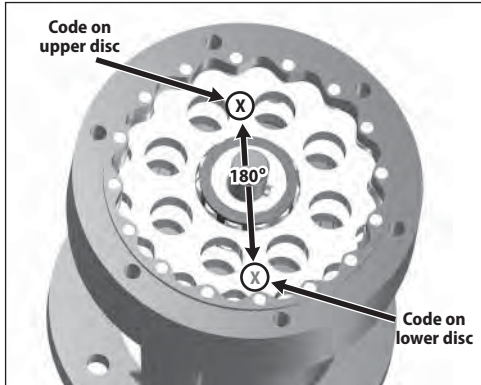


3

When reinserting the **eccentric bearing assembly**, use only a wooden or hard rubber mallet to tap it into place.

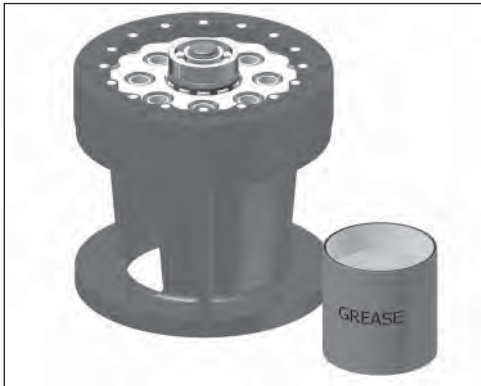
Cyclo® Portion Disassembly/Assembly, continued

Reassembly Procedure



4

Insert the **top Cycloid disc** so that the code engraved on its surface is 180° opposed to the corresponding etched code on the **lower Cycloid disc**.

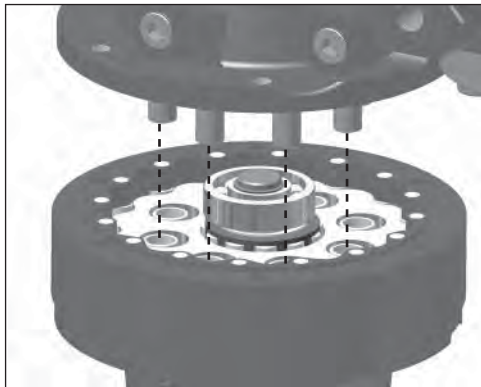


5

If the Cyclo® portion of the Cyclo® BBB4 unit is grease lubricated, refill the reduction components with the amount specified in Grease Quantities section of this manual; **or**, fill to 80% of the space around the reduction mechanism and bearings of single reduction units, and 50% of the space around the reduction mechanism of both the first and second stage of double reduction units.



If the Cyclo® portion of the Cyclo® BBB4 unit is oil lubricated – do not add any grease during the reassembly process.



6

When reassembling the Cyclo® BBB4 gear housing onto the Cyclo® reduction stage, ensure that the **carrier pins** are inserted and aligned with the corresponding bores of the **rollers**.

Troubleshooting

Reducer Troubleshooting

Reducer Troubleshooting

This troubleshooting guide provides assistance in identifying and overcoming common problems with reducers and motors. If a problem with the reducer and/or the motor is not listed below, please consult the factory for assistance.

Reducer Troubleshooting

Problem with the Reducer		Possible Causes	Suggested Remedy
Runs Hot	Overloading	Load exceeds capacity of the reducer	Check the rated capacity of the reducer, replace with unit of sufficient capacity or reduce the load
	Improper lubrication	Insufficient lubricant	Check lubricant level and increase to recommended level
		Excessive lubricant	Check lubricant level and reduce to recommended level
		Incorrect lubricant	Flush old lubricant from the unit and refill with correct recommended lubricant
Vibration or Noise	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/or reinforce mounting & structure
		Loose hold-down bolts	Tighten bolts
	Worn disc and/or bevel gearing	Load exceeds capacity of reducer	If bevel gearset is damaged, contact the factory. If Cycloid discs are damaged, disassemble the Cyclo® portion and replace discs. Re-check the rated capacity of the unit
	Bearing failure	Insufficient lubricant	If output bearings are damaged, contact the factory If bearings in Cyclo® portion are damaged, replace the affected bearings. Clean & flush the reducer and fill with the correct type and quantity of lubricant
		Load exceeds capacity of reducer	Check the rated capacity of the reducer. Replace with unit of sufficient capacity or reduce the driven load
	Insufficient lubricant	Insufficient lubricant	Check lubricant level and adjust to recommended level
Damaged Cyclo® pins and rollers	Load exceeds capacity of reducer	Disassemble Cyclo® portion of reducer and replace ring gear housing pins and rollers. Check load on reducer	
Output Shaft/Hub does not turn	Motor shaft broken	Load exceeds capacity of reducer or repetitive shock loading	Replace broken shaft. Check rated capacity of reducer
	Key missing or sheared off on input shaft		Replace key
	Eccentric bearing broken	Insufficient lubricant	Replace the Eccentric Bearing in the Cyclo® portion. Flush and refill the unit with the recommended lubricant
	Motor does not turn	Motor	Refer to the "Motor" portion of this Troubleshooting guide
Oil Leakage	Worn seals	Caused by dirt or grit entering the seal area	Replace the oil seals
	Leakage into motor	Excessive lubricant	Check the lubricant level and adjust to the recommended level
		Air breather clogged	Clean or replace element, being sure to prevent any dirt from falling into the reducer
		Improper mounting position, such as other than designed mounting angle	Mount the unit in its designed mounting angle

Troubleshooting, continued**Motor Troubleshooting****Motor Troubleshooting**

Problem with the Motor		Possible Causes	Suggested Remedy
Load is disconnected but motor does not rotate	Makes a "groaning" sound	Faulty switch contact	Adjust the contact
		Blown fuse	Replace fuse
		One phase wire of the power supply open	Rewire connection
		Stator coil open	Repair by rewinding or replacing the stator assembly
		Stator and rotor touching due to bearing housing wear	Replace the bearing and bracket
	Starts in either direction when turned by hand	Three-phase is operating as singlephase	Consult the power source with a voltmeter
	Doesn't make any noise	Stator coil open	Repair by rewinding or replacing stator assembly
		External power failure	Contact the local power company.
Open connection wire Faulty Switch contact Faulty Starter contact		Check the source wiring Adjust the contacts	
Rotates with the load disconnected but:	Rotates in the wrong direction	Connection error	Change any two of the three-phase source connections
	Fuse blows	Shorted lead wire	Replace fuse and rewire short
	Speed does not increase	Faulty starter contact	Replace or adjust starter contact
	Makes a "groaning" sound	Overcurrent/Overheating due to Rotor and Stator touching	Repair by rewinding or replacing stator assembly
		Overcurrent due to one phase of Stator Coil shorted	Replace the stator winding
	Makes a highpitched "metallic" noise	Faulty bearing	Replace the bearing
Rotates when the load is disconnected but when the load is connected:	Switch overheats	Insufficient switch capacity	Replace with switch having the rated capacity
		Overload	Decrease load to the rated value
	Fuse blows	Insufficient fuse capacity	Replace with fuse having the rated capacity
	Overheats	Overload	Decrease load to rated value
		Voltage drop	Consult with local power company
	Speed suddenly drops	Voltage drop	Consult with local power company
		Overload	Decrease load to rated value
	Stops	Bearing damaged by overheating	Replace the bearings

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