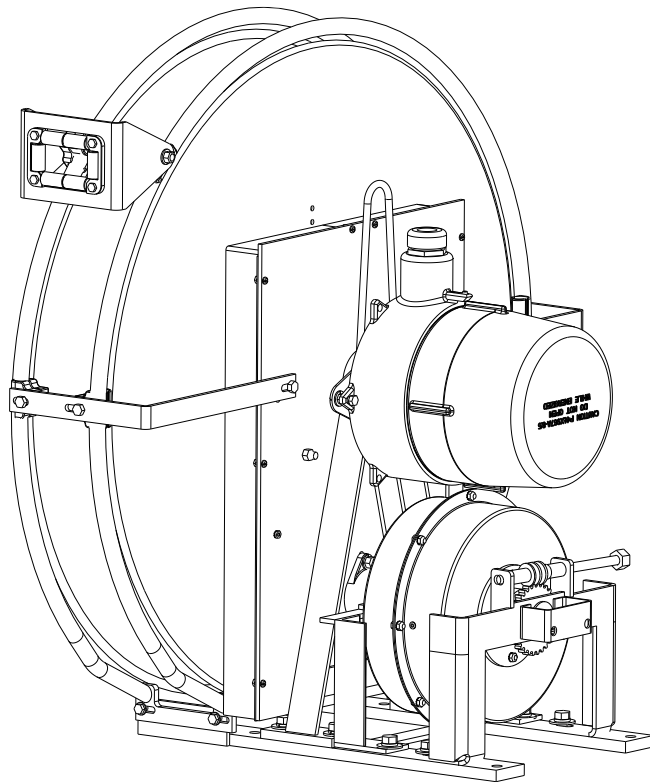


Cable Reels Series 3500



Conductix Incorporated

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Except where the nature of the defect is such that it is appropriate, in Seller's judgment, to effect repairs on site, Seller's obligation hereunder to remedy defects shall be limited to repairing or replacing (at Seller's option) FOB point of original shipment by Seller, any part returned to Seller at the risk and cost of Buyer. Defective parts replaced by Seller shall become the property of Seller.

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Additionally, Seller's obligation shall be limited by the manufacturer's warranty (and is not further warranted by Seller) for all parts procured from others according to published data, specifications or performance information not designed by or for Seller.

Seller further agrees to replace or at Seller's option to provide a refund of the sales price of any goods that do not conform to applicable specifications or which differ from that agreed to be supplied which non-conformity is discovered and forthwith reported to Seller within thirty (30) days after shipment to the Buyer. Seller's obligation to replace or refund the purchase price for non-conforming goods shall arise once Buyer returns such goods FOB point of original shipment by Seller at the risk and cost of Buyer. Goods replaced by Seller shall become the property of Seller.

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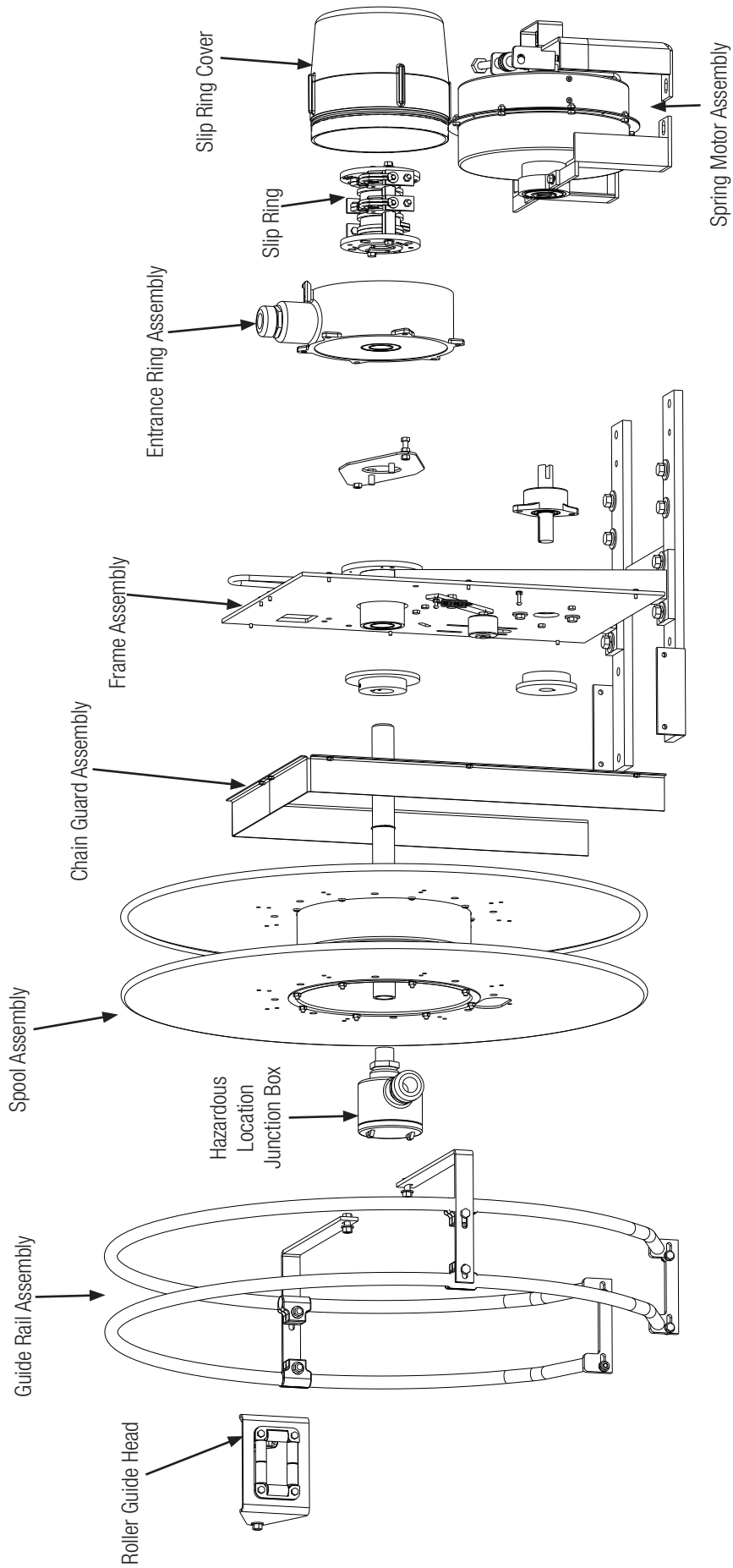
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3500 Overview



1.0 Safety

1.1 Electrical Warnings

- 1.1.1 This equipment should be properly grounded before use, in accordance with both the National Electric Code and local codes and ordinances.
- 1.1.2 The electrical power should be disconnected from the cable reel before any service functions are performed.
- 1.1.3 The cable reel must not be used for loads greater than the voltage and current rating of the cable. The ampacity rating of the cable reel shall be in accordance with the National Electric Code.

1.2 Operational Warnings

- 1.2.1 Exercise care when handling the cable reel during normal operation. This cable reel has a rotating spool powered by springs under tension.
- 1.2.2 Do not use cable different from that for which the reel is intended. Changes in diameter, weight per foot, length of cable or flexibility will affect the operation of the reel.
- 1.2.3 Mounting hardware and fasteners should be installed to maintain tightness under vibration and checked periodically to assure tightness.
 - 1.2.3.1 Overhead installation mountings should be such that the reel is not supported by bolts in tension. A safety chain or cable is strongly recommended to minimize damage and/or possible injury in the event of a mounting failure.

1.3 Maintenance Warnings

- 1.3.1 **WARNING:** Modification of this equipment may cause excessive wear and will void the warranty. Contact the manufacturer regarding changes or modifications of equipment which could affect reliability or safety.
- 1.3.2 **DO NOT DISASSEMBLE THE SPRING MOTOR FOR ANY REASON.** Serious personal injury could result. This cable reel is equipped with springs under tension. Contact the factory for assistance.

US: 1-800-521-4888
Canada: 1-800-667-2487

1.4 Specifications & Listings

- 1.4.1 The following specifications apply to all 3500 Series Cable Reels.
 - 1.4.1.1 3500 Series Cable Reels are intended for commercial / industrial use and are provided with a permanent mounting base.
 - 1.4.1.2 3500 Series Cable Reels are built to NEMA 4 Specifications and are suitable for indoor/outdoor use.
 - 1.4.1.3 Spring Motors for the 3500 Series are sealed for safety and weather-tight for long life.
 - 1.4.1.4 Ampere capacity of the 3500 Series Reels range from 10 to 150 Amperes at 600 Volts maximum. Reels are available in 3 to 30 conductor configurations.
 - 1.4.1.5 3500 Series Cable Reels are available with optional features which increase serviceability. Options include: ratchet, pivot base, spool lock, junction box, and guide rails.
 - 1.4.1.6 Custom power and signal circuit slip rings using silver plated rings and silver graphite brushes are available upon request.

1.5 Electrical Rating

1.5.1 Reels Equipped with Cable

- 1.5.1.1 Reels equipped with flexible cable should not be used at voltages and/or amperages above the rating of the reel or cable.

1.0 Safety

1.6 Labels & Marking

1.6.1 Every cable reel is marked with a label on the frame which includes the Conductix name and logo, the product catalog number and the individual product serial number.

1.6.2 Reels equipped with cable:

1.6.2.1 The marking on reels equipped with a flexible cable shall include the current and voltage ratings.

Type W (90°C)	
Cable	Ampacity
W 8/2	50
W 8/3	50
W 8/4	45
W 6/2	65
W 6/3	65
W 6/4	55
W 4/2	75
W 4/3	75
W 4/4	65
W 2/2	110
W 2/3	110
W 2/4	100
W 1/2	140

Type G-GC(90°C)	
Cable	Ampacity
G 8/3	50
G 6/3	65
G 4/3	85
G 2/3	115

Type SOW-A, SOOW-A (90° C)			
Cable	Ampacity	Cable	Ampacity
16/2	10	12/2	20
16/3	10	12/3	20
16/4	8	12/4	16
16/5	8	12/5	16
16/6	8	12/6	16
16/7	7	12/7	14
16/8	7	12/8	14
16/10	7	12/10	14
16/12	7	12/12	14
16/14	7	12/14	14
16/16	7	12/16	14
16/20	7	12/20	14
16/24	6	12/24	14
16/30	6	12/30	12
16/36	6	10/2	25
14/2	15	10/3	25
14/3	15	10/4	20
14/4	12	10/5	20
14/5	12	10/6	20
14/6	12	10/7	17.5
14/7	10.5	10/8	17.5
14/8	10.5	10/10	17.5
14/10	10.5	10/12	17.5
14/12	10.5	10/14	17.5
14/14	10.5	10/16	17.5
14/16	10.5	-	-
14/20	10.5	-	-
14/24	10.5	-	-
14/30	9	-	-
14/36	6	-	-

Color Code Chart		
Cond. No.	Base Color	Tracer Color
1	Green	-
2	Black	-
3	White	-
4	Red	-
5	Orange	-
6	Blue	-
7	White	Black
8	Red	Black
9	Green	Black
10	Orange	Black
11	Blue	Black
12	Black	White
13	Red	White
14	Green	White
15	Blue	White
16	Black	Red
17	White	Red
18	Orange	Red
19	Blue	Red
20	Red	Green
21	Orange	Green
22	Black	-
23	White	-
24	Red	-
25	Green	-
26	Orange	-
27	Blue	-
28	White	Black
29	Red	Black
30	Green	Black
31	Orange	Black
32	Blue	Black
33	Black	White
34	Red	White
35	Green	White
36	Blue	White

2.0 Installation

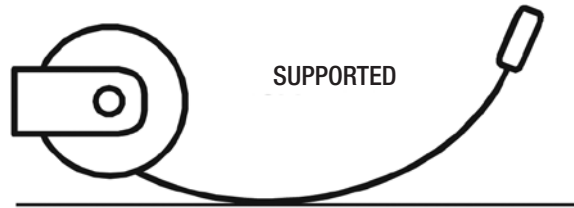
2.1 Application Types

2.1.1 Stretch Applications



2.1.1.1 The cable is suspended without any intermediate support. Stretch reels generally require a line pull equal to two times the weight of the cable, which allows approximately 6% sag. On long applications where sag cannot be tolerated, it is sometimes desirable to put supports at intervals of 5 to 10 feet.

2.1.3 Drag Applications



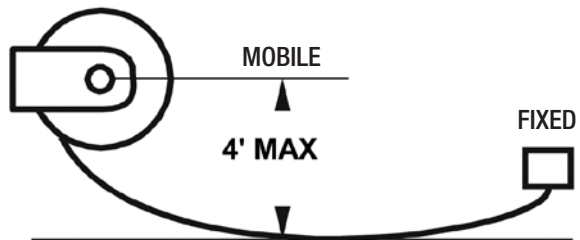
2.1.3.1 The reel is mounted on a stationary object and is required to drag the cable over the surface to the reel. A ratchet and/or ball stop may be desired.



2.1.2 Lift Applications

2.1.2.1 The cable is lifted vertically. The reel is normally designed to handle only the total weight of the cable. Some lift applications may require a ratchet and/or ball stop to control the retracted length of cable.

2.1.4 Retrieve Applications

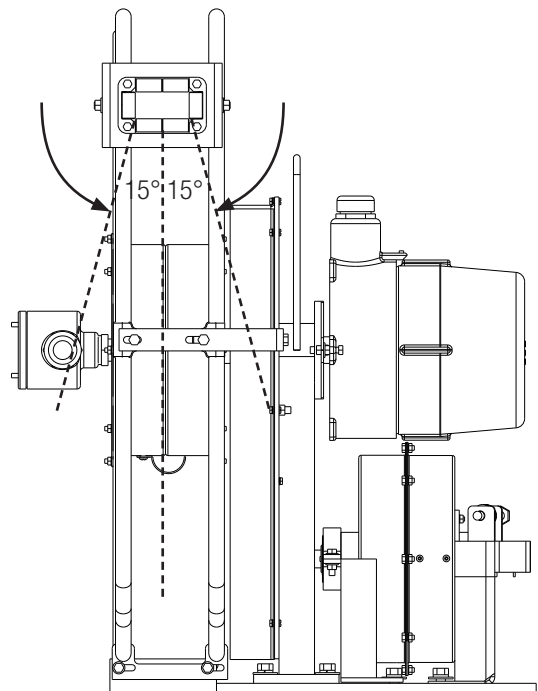


2.1.4.1 The reel is mounted on the moving object and winds up or pays out the cable as the machine approaches or moves away from the power source. Vertical Retrieve applications are possible.

2.2 Mounting

2.2.1 Standard Mounting

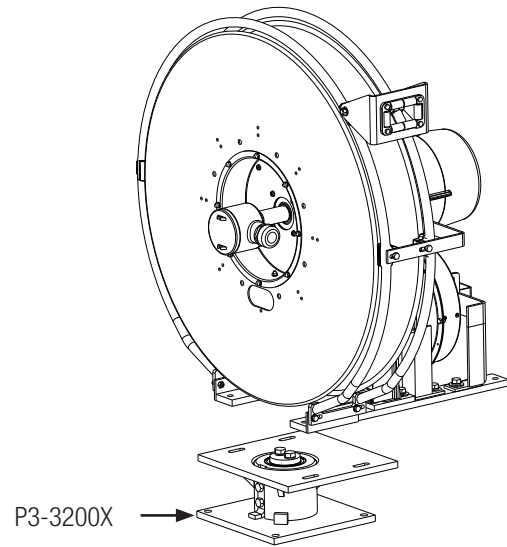
- 2.2.1.1 Mount the base of the reel to any flat surface which is structurally sound enough to support the reel and the forces of winding and unwinding the cable.
- 2.2.1.2 The spool drum must be mounted horizontally axis.
- 2.2.1.3 The cable should extend perpendicular to the rotation of the spool. The total cable deflection should not exceed 15° to either side of the centerline of the spool.
- 2.2.1.4 If deflection is constant to either side of the reel and operation is impaired, re-mount the reel.
- 2.2.1.5 If the angle of deflection exceeds 30°, a Pivot Base or two way payout guide should be used or the reel should be repositioned, otherwise excessive cable wear and unreliable operation will result.
- 2.2.1.6 A safety chain is recommended for all overhead installations. Attach the safety chain using the 0.39" hole provided in the base.



2.0 Installation

2.2.2 Pivot Base Mounting

- 2.2.2.1 All 3500 Series Cable Reels can be furnished with a pivot base to allow the reel to rotate and keep the extended cable perpendicular to the application.
- 2.2.2.2 Pivot Bases rotate up to 330°. If 360° rotation is required contact the factory.
- 2.2.2.3 A pivot base is required in carousel or loop-track applications.
- 2.2.2.4 When a pivot base is used the reel must be mounted horizontally ("ceiling" or "floor" mounted).
- 2.2.2.5 The Roller Guide should be mounted to require the cable to travel perpendicular to the axis of pivot base rotation. This will guard against cable twisting and ensure effective swivel action from the pivot base.

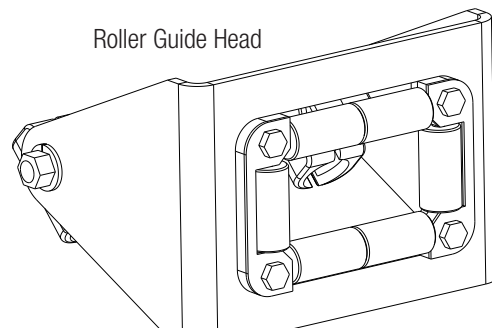


2.3 Guide Rails

- 2.3.1 Guide Rails provide a barrier between the cable and the rotating spool flange rim. They also act as a safety barrier for installations where human contact with the rotating spool flange is likely to occur.
- 2.3.2 Guide Rails provide additional assurance that the cable will wrap efficiently on the spool for applications involving rigorous motion.
- 2.3.3 Guide Rails can act as a substitute for the roller guide in applications that require a two-way pay-out.

2.4 Roller Guides

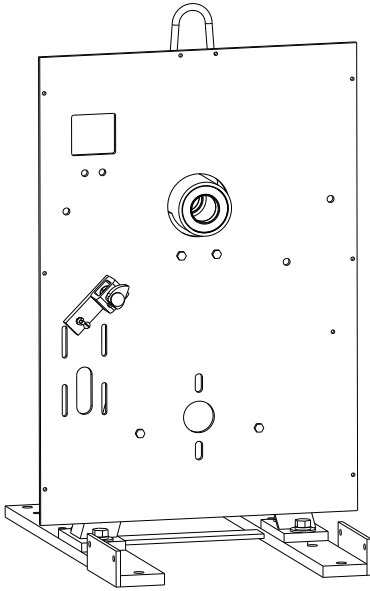
- 2.4.1 All 3500 Series Cable Reels are equipped with an adjustable roller guide. The guide's function is to center the cable on the spool and to help the reel wrap cable more evenly.
- 2.4.2 Level winding is inhibited by the cable bearing against either of the spool flanges during operation. The Roller Guide helps to alleviate this condition.
- 2.4.3 The guide consists of the guide head. The guide must be adjusted and secured prior to terminating any electrical connections.
- 2.4.4 The guide should be secured at the position that causes the least change of cable direction to occur at the guide; otherwise, cable life will be reduced.
 - 2.4.4.1 The guide head is mounted to the guide rails with the use of four clamp halves and two 3/8 - 16 carriage bolts. Mount the guide head on the guide rails in the desired position by placing one half clamp on each side of each rail and placing the guide head around the outside of the clamps. Insert the carriage bolts from the inside outward such that the carriage head is towards the center of the spool. This will prevent the cable from rubbing on any square edges. Install lock washers and nuts. The guide head may be tipped through 90° of travel to allow for minimum cable drag through the roller guide.



2.0 Installation

2.5 Ratchet

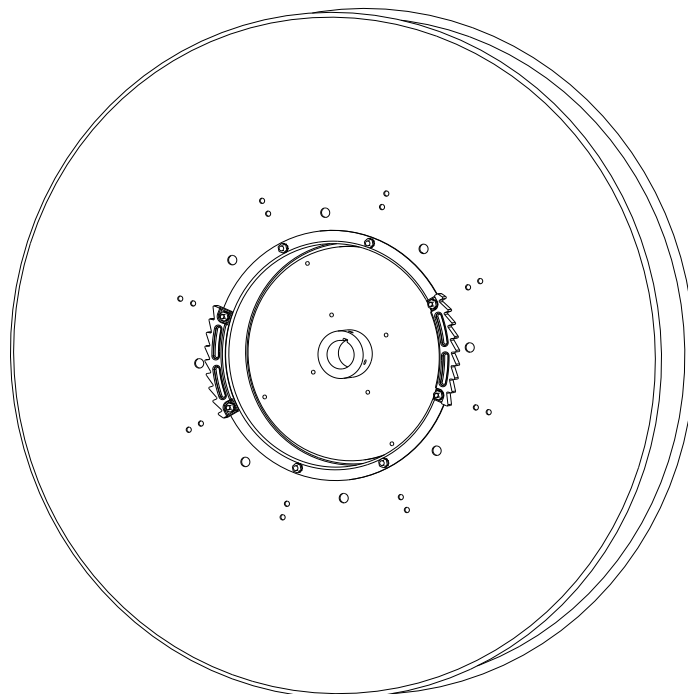
- 2.5.1 The ratchet option allows the extended cable to be pulled out and held from retraction by spring tension; generally appropriate for operator attended applications.
- 2.5.2 The ratchet for the 3500 Series Cable Reels is spring loaded. It is designed to function in all acceptable mounting configurations.
- 2.5.3 The ratchet option can be installed at the time of purchase or later added to reels that have already been introduced to service.



2.5.4 Ratchet Option Installation

- 2.5.4.1 **WARNING:** Power should be disconnected from the reel before beginning any service or maintenance functions. Follow lock-out/tag-out procedures appropriate to the installation.

2.5.4.2 Ratchet Pawl Installation



- 2.5.4.2.1 The ratchet pawl assembly is attached to the reel frame as a unit. The holes provided for the attachment of The ratchet pawl assembly are located in the lower middle area of the frame.
- 2.5.4.2.2 Insert the (1) provided 3/8 - 16 bolt in the frame.
- 2.5.4.2.3 Position the ratchet pawl assembly over the protruding bolt shaft.
- 2.5.4.2.4 Secure using the two (2) provided sets of 3/8-16 hex nuts & lockwashers.

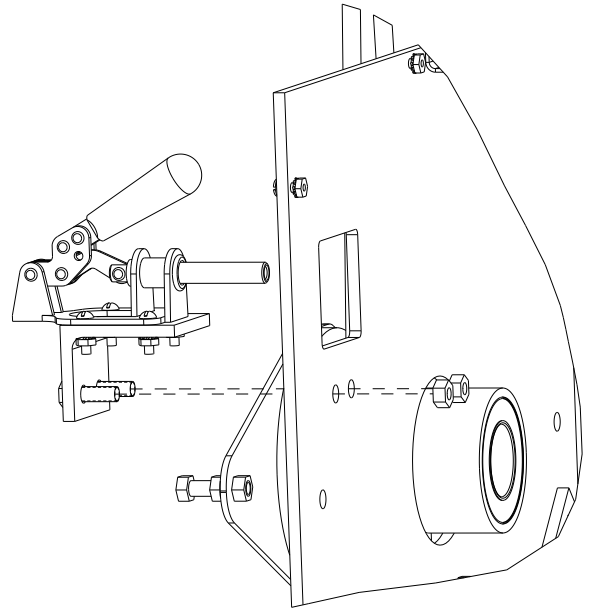
2.5.4.3 Ratchet Plate Installation

- 2.5.4.3.1 The cable must be extended far enough to allow the removal of the two or four frame side flange bolts. (See figure below).
- 2.5.4.3.2 Substitute the provided longer flange bolts and nuts for the removed bolts and nuts.
- 2.5.4.3.3 Position the ratchet plate over the bolts on the outside of the frame side flange. The ratchet teeth should be oriented as in the figure below (for standard rotation reels).
- 2.5.4.3.4 Secure the ratchet plate to the spool by tightening the nuts to approximately 7 (seven) ft-lbs.
- 2.5.4.3.5 Additional ratchet plates may be installed but will increase the likelihood of spool lock-up at full cable extension.

2.0 Installation

2.6 Spool Lock

- 2.6.1 All 3500 Series Cable Reels can be equipped with an optional Spool Lock.
- 2.6.2 The Spool Lock allows the power spring tension to be locked out from the cable spool. Applications that often require cable replacement would benefit from the addition of the Spool Lock.
- 2.6.3 The lever action design of the Spool Lock maintains engagement under conditions of shock & vibration. This is good for applications which require the cable to remain extended and are subject to severe service conditions.



2.7 Electrical Connections

2.7.1 Electrical Warnings

- 2.7.1.1 Electrical connections are determined by the requirements of the application and the configuration of the reel.
- 2.7.1.2 All electrical work should be performed by a qualified electrician.
- 2.7.1.3 Factory installed cable is wired with ring one (the ring closest to the drive collar) designated as ground, with a green jumper cable terminated to ground.
- 2.7.1.4 A continuity check should be performed prior to energizing the reel to verify electrical connections.

2.7.2 Supply Cable Connections

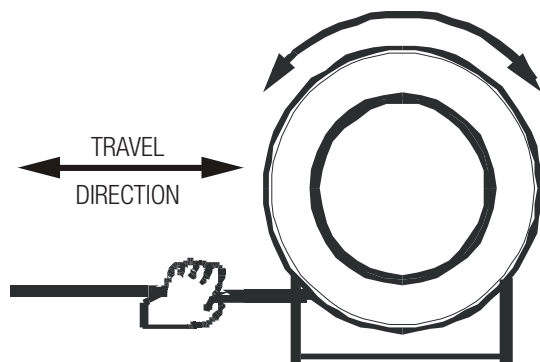
- 2.7.2.1 Supply cable connections are made to the brush leads of the slip ring using crimp ring connectors. (See diagram in Section 2.8)
- 2.7.2.2 Connections made at the slip ring require adequate clearance.

2.0 Installation

2.8 Spring Tension Adjustment

2.8.1 Spring Tension Warnings

- 2.8.1.1 More demanding applications may require spring tension adjustments for proper cable retraction.
- 2.8.1.2 **WARNING:** Do not allow cable to retract without restraining the retraction speed. Walk the cable back to the reel. The retraction speed should not exceed 150 ft / min (approximately 1.7 mi / hr).

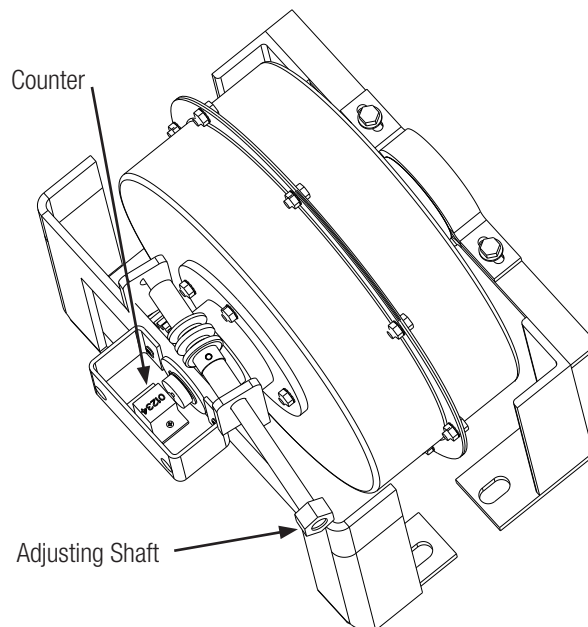


2.8.2 Spring Cycling

- 2.8.2.1 The spring should be cycled after mounting but before terminating the free end to assure that the cable will retract properly and operate under the correct tension.
- 2.8.2.2 This is accomplished by pulling the cable out the required distance and allowing it to rewind. This procedure should be performed five to ten (5-10) times.

2.8.3 Spring Pre-Tensioning

- 2.8.3.1 The proper pre-tensioning required for effective operation varies by cable diameter and cable weight. Trial and error is the most effective means of setting the proper spring pre-tension. Pre-tensioning is achieved by pre-loading the spring with setup turns (reel revolutions).
- 2.8.3.2 Pre-tensioning is not required on the 3500 Series Cable Reels. However, some pre-tension may save adjusting time later.



2.8.4 Adjusting Spring Tension

- 2.8.4.1 Set-up turns can be installed on the 3500 Series Cable Reels after installation of the reel and termination of the cable ends. Spring tension should be adjusted so that the cable reel retracts the cable through the entire travel length and at the desired travel speed.
- 2.8.4.2 To add tension to the cable reel use a 15/16 wrench or socket and turn the shaft on the end of the spring motor(s). Rotate the shaft in the direction that causes the motor housing to rotate in the same direction as the spool would rotate to retract the cable.
- 2.8.4.3 Watch the counter, mounted on the tail end of each motor, to read the number of turns added to the spring. It will take 32 turns of the input shaft to install 1 turn on the spring. On units equipped with two spring motors only apply one turn to each motor at a time. Most reels are sized to work with 2 set-up turns per spring in each motor however trial and error is the best means to determine the total number of set-up turns required in your application. Use caution not to apply too many set-up turns. This will result in excessive tension on the cable. There should be no less than two turns left on each spring motor when reel is paid out all the way. Consult factory for the maximum number of set-up turns allowed on your reel model number.

3.0 Operation

- 3.1 Do not exceed the voltage or ampere rating of the cable. Do not exceed the voltage or ampere rating of the reel. Overheating, fire, damage to equipment or personal injury could result. Do not allow cable to retract without restraining the retraction speed.
- 3.2 Operate the reel within the cable size and length and spring tensioning limits for which it was intended.
 - 3.2.1 Two wraps of cable should remain on the reel at maximum extension to avoid excessive tension on the cable entrance watertight and slip ring terminations.
 - 3.2.2 The spring should not be wound to the last two turns at maximum payout. This prevents over-stressing the spring(s), thus reducing its life or damaging the reel.
- 3.3 Keep the reel and cable clean to avoid excessive wear and damage.
- 3.4 Arrange for maintenance service if damage is found on the cable or reel.
- 3.5 To maximize spring life, cable should be fully retracted when not in use.

4.0 Maintenance

4.1 Maintenance Warnings

- 4.1.1 Be sure the power is off for maintenance.
- 4.1.2 Follow lock-out/tag-out procedures as outlined in OSHA section 1910.147

4.2 Lubrication

- 4.2.1 All springs and bearings are lubricated for life at the factory. Additional lubrication should not be required.
- 4.2.2 Do not apply any lubricants or solvent cleaning agents to the slip ring, brush or insulator surfaces.
 - 4.2.2.1 Inspect the ring surface for dirt, oxidation, or other contaminants. A properly operating ring will have a film that appears burnished in color with a darker surrounding color where the brushes track. If the ring requires cleaning, order Slip Ring Polishing Kit #41286.

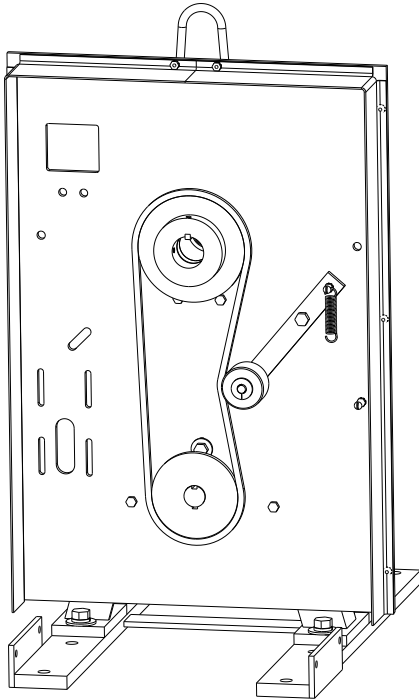
4.3 Inspections

- 4.3.1 Periodically check the reel for any loose or missing fasteners. Tighten or replace as necessary.
- 4.3.2 The slip ring assembly should be checked periodically as follows:
 - 4.3.2.1 Clean and remove any accumulated dust or dirt from the slip ring housing area.
 - 4.3.2.2 Check all brush and ring surfaces in the slip ring assembly and remove any accumulated dust.
 - 4.3.2.3 Brushes should be centered on the slip rings and brush springs should be seated in the slot on top of the brush. Terminal screw connections should be tight.
 - 4.3.2.4 Replace Brushes when the brush spring is within 0.09" of the ring insulator.

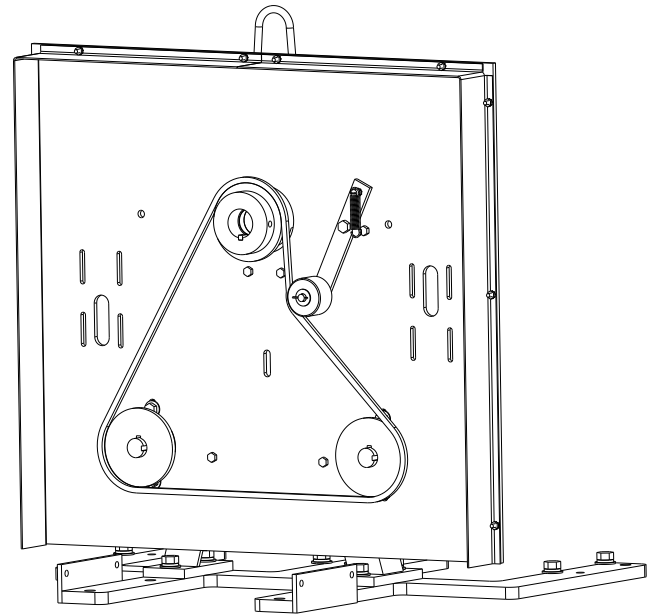
4.4 Spring Motor Replacement

- 4.4.1 Carefully adjust reel to the fully retracted position.
- 4.4.2 Take note of the counter reading on the faulty spring motor. Remove all set-up turns from faulty spring motor by turning input shaft on the tail end of the motor in the direction that rotates the motor housing in the direction that the spool would rotate to pay the cable out. This will cause the counter to reduce in numbers. Adjust until all spring tension is removed from the motor.
- 4.4.3 Remove the (4) 1/2-13 bolts from the motor mounting legs and slide motor straight back away from frame. This will disengage the spring motor shaft from the sprocket stub shaft.
- 4.4.4 Set new motor on frame and slide forward. Align the tang in the motor shaft to the slot in the sprocket shaft and slide motor into place. Bolt motor down with the four (4) 1/2-13 bolts removed from the old motor.
- 4.4.5 If it is known that the tension was never changed from the initial installation, reset the set-up turns to the same number as read from the old motor. If tension was changed during the life of the reel follow procedure 2.8 to adjust reel from scratch.

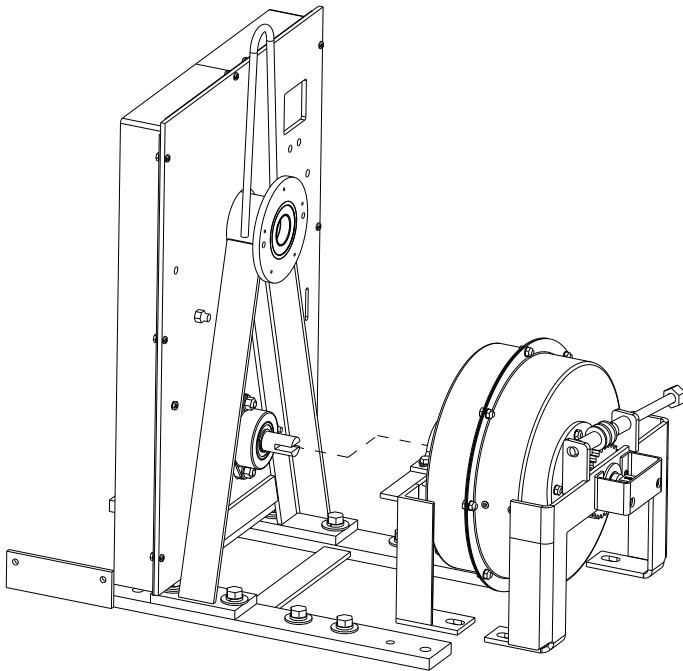
4.0 Maintenance



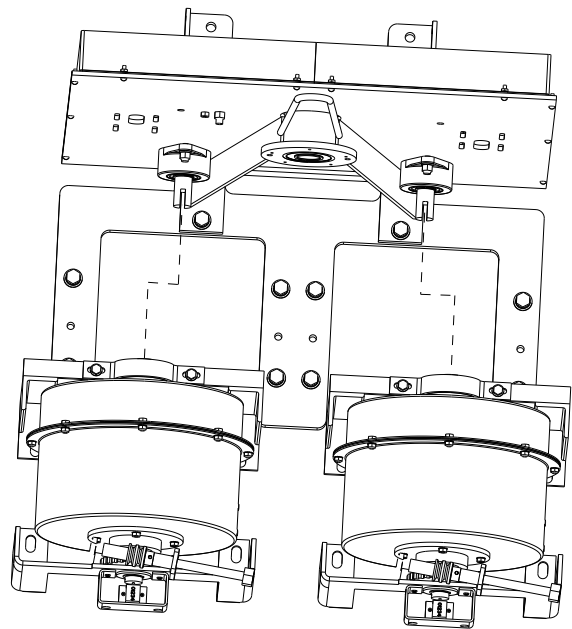
Single Motor Chain Configuration



Dual Motor Chain Configuration



Single Motor Mount



Dual Motor Mount

5.0 Replacement Parts

5.1 R-Series Slip Rings for 3500 Series Cable Reels

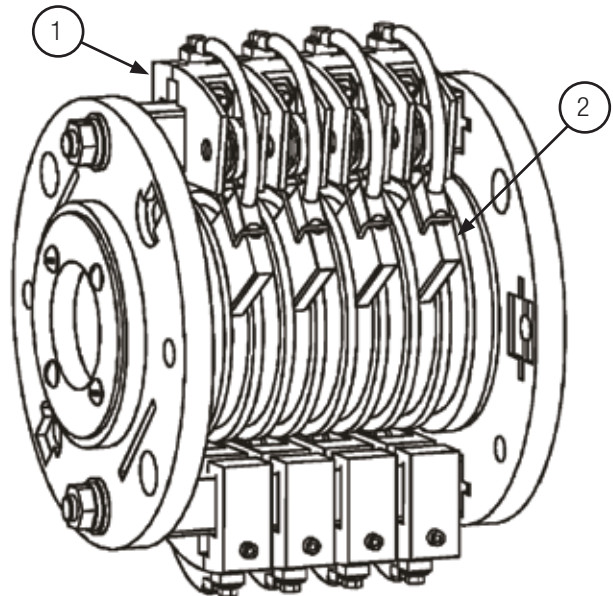
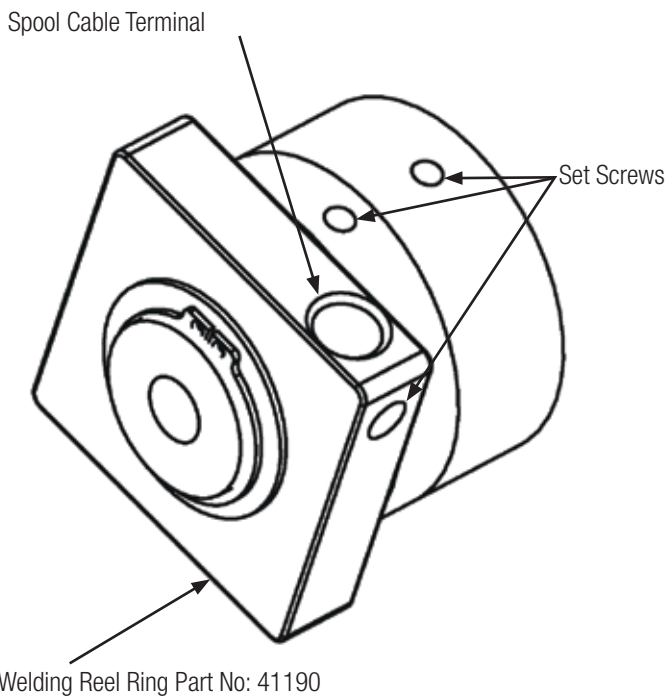
To identify the slip ring in the 3500 Series reels for replacement parts, it is necessary to precede the amperage profile section with the product code "RA-". This code specifies that the Slip Ring is a member of the R-Series Slip Ring family and designates the bore size as 1-1/2 inches.

‡ Multiple Amperage Sections are possible.

* Consult factory for Custom Application Part Numbers.

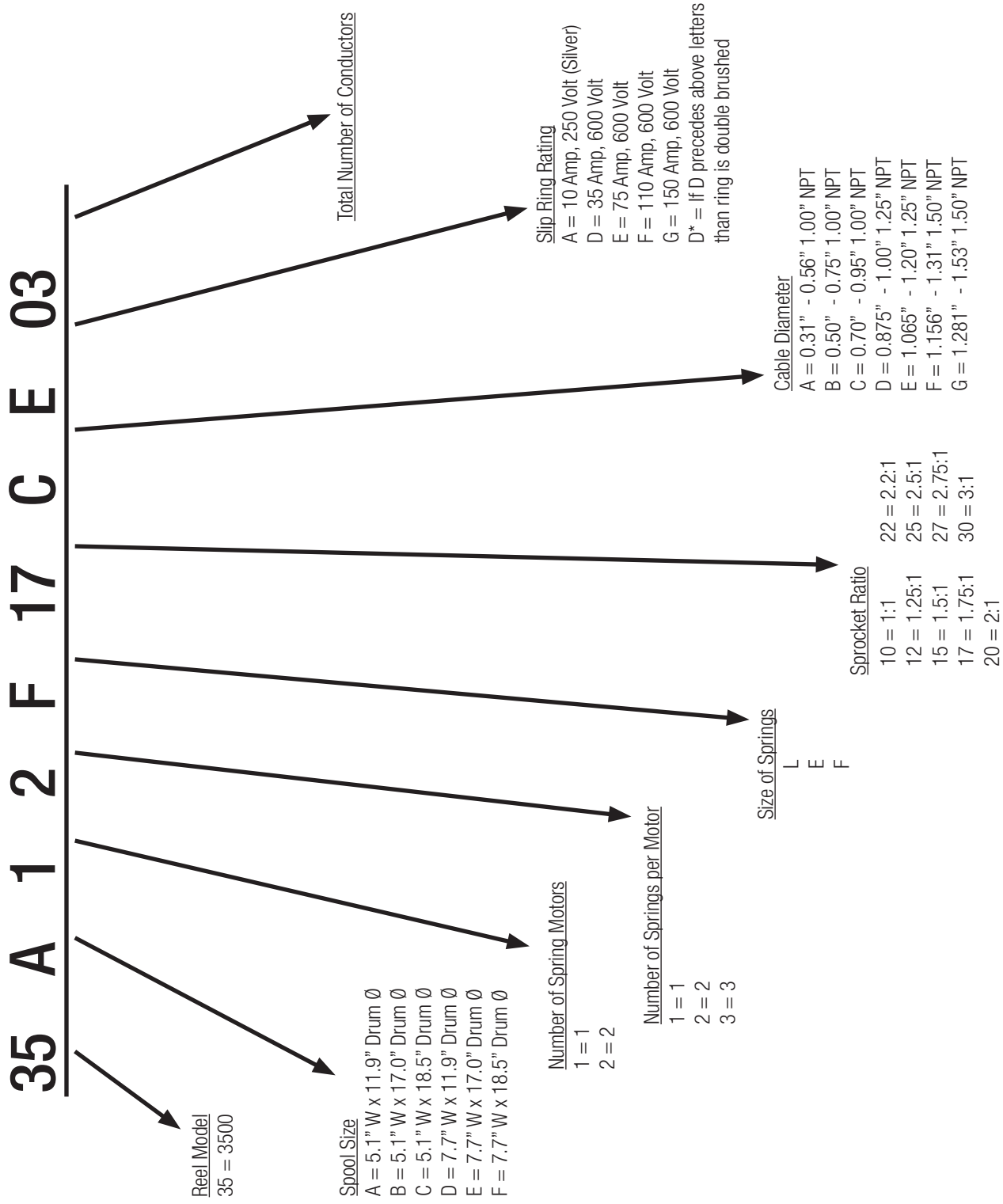
SS Available for Special Applications

Double Brushed		Number of Conductors			
D		A		03	
2	Brushes	Amperage ‡		1	
				Single	Double
	30068A	D	= 35 AMP / 600 V	02801	02808
	30069A	E	= 75 AMP / 600 V	02802	02809
	02840	F	= 110 AMP / 600 V	02803	02810
	02841	G	= 150 AMP / 600 V	02804	02811
	02842	H	= 225 AMP / 600 V	02805	02805
	02843	J	= 300 AMP / 600 V	02806	02806
					SS



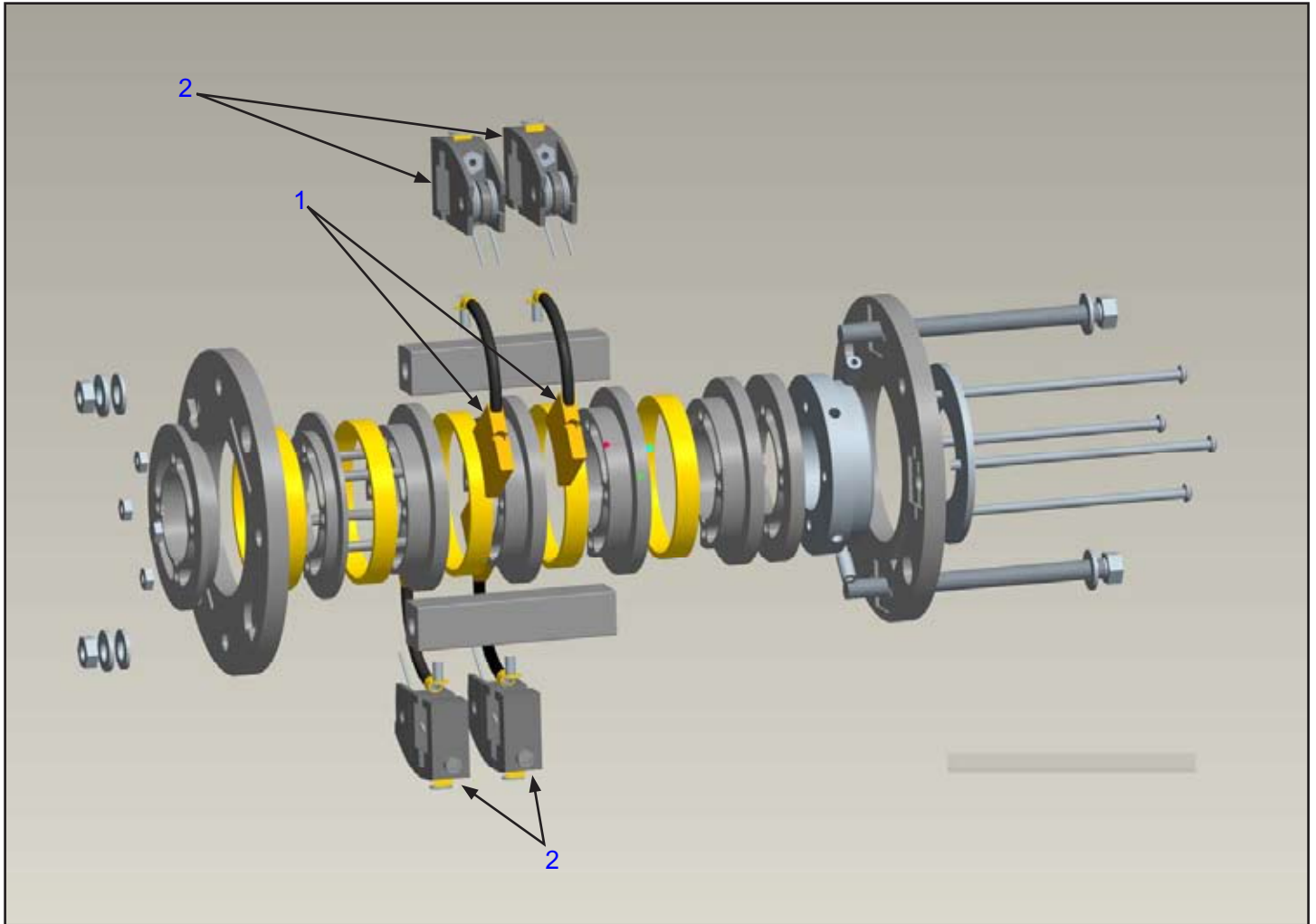
5.0 Replacement Parts

5.2 Spring Reel Descriptive Numbering System for 3500 Series Cable Reels



5.0 Replacement Parts

5.3 Exploded View Parts Identification for 3500 Series Cable Reels



5.0 Replacement Parts

5.4 Part Numbers by Component for 3500 Series Cable Reels

ELECTRICAL COMPONENTS

Example: 35A12F17CE03

		②	①	②	①
	Ring	Single Brush Holder	Single Brush	Double Brush Holder	Double Brush
D03	RA-D03-PR	02801	30068A	02808	30068A x2
D04	RA-D04-PR	02801	30068A	02808	30068A x2
D05	RA-D05-PR	02801	30068A	02808	30068A x2
D06	RA-D06-PR	02801	30068A	02808	30068A x2
D07	RA-D07-PR	02801	30068A	02808	30068A x2
D08	RA-D08-PR	02801	30068A	02808	30068A x2
D09	RA-D09-PR	02801	30068A	02808	30068A x2
D10	RA-D10-PR	02801	30068A	02808	30068A x2
D12	RA-D12-PR	02801	30068A	02808	30068A x2
D14	RA-D14-PR	02801	30068A	02808	30068A x2
D16	RA-D16-PR	02801	30068A	02808	30068A x2
D20	RA-D20-PR	02801	30068A	02808	30068A x2
D24	RA-D24-PR	02801	30068A	02808	30068A x2
D30	RA-D30-PR	02801	30068A	02808	30068A x2
D36	RA-D36-PR	02801	30068A	02808	30068A x2
E02	RA-E02-PR	02802	30069A	02809	30069A x2
E03	RA-E03-PR	02802	30069A	02809	30069A x2
E04	RA-E04-PR	02802	30069A	02809	30069A x2
E06	RA-E06-PR	02802	30069A	02809	30069A x2
F02	RA-F02	02803	02840	02810	02840 x2
F03	RA-F03	02803	02840	02810	02840 x2
F04	RA-F04	02803	02840	02810	02840 x2
G02	RA-G02	02804	02841	02811	02841 x2
G03	RA-G03	02804	02841	02811	02841 x2
G04	RA-G04	02804	02841	02811	02841 x2

OPTIONS

Ratchet	43418
Reelsafe Single Motor	43420
Reelsafe Dual Motor	43419
Pivot Base (330°)	P3-3200X
Spool Lock	44333X

6.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Reel will not retract cable but has some tension.	<ol style="list-style-type: none"> 1) Improper pretension 2) Incorrect reel for application (lift vs. stretch). 3) Improper cable or cable length installed. 	<ol style="list-style-type: none"> 1) See Tension Adjustment section. 2) Quantify application vs. reel selection. 3) Consult Factory.
Reel does not have spring tension.	<ol style="list-style-type: none"> 1) Broken spring. *Quantify application to prevent reoccurrence. 	<ol style="list-style-type: none"> 1) Replace spring motor.
Ratchet will not engage.	<ol style="list-style-type: none"> 1) Broken ratchet pawl spring. 	<ol style="list-style-type: none"> 1) Replace ratchet pawl spring.
Ratchet will not disengage.	<ol style="list-style-type: none"> 1) Over-extension of reel. 	<ol style="list-style-type: none"> 1) Manually rotate reel spool to disengage ratchet. To prevent lockup, two wraps of cable should remain on spool at all times.
Cable wraps improperly (uneven wrapping, wraps above or jumps flange).	<ol style="list-style-type: none"> 1) Reel mounting not level. 2) Cable retraction rate too high. 3) Cable guide out of adjustment. 	<ol style="list-style-type: none"> 1) Mount reel on level surface. 2) Maintain steady retraction rate. 3) Properly adjust cable guide.
Cable twisting or knotting.	<ol style="list-style-type: none"> 1) Improperly installed cable. 2) Cable rubbing on or bending around fixed object. 3) Excessive spring tension. 4) Inadequate anchoring of cable. 	<ol style="list-style-type: none"> 1) See Cable Install section on IOM. 2) Check roller guide for function and cable pay out path. 3) Quantify application vs. reel selection. Also check pretension. 4) Adjust anchoring method. ie. add strain relief.
Open or intermittent circuit.	<ol style="list-style-type: none"> 1) Inadequate connection. 2) Brush loses contact with slip ring. 3) Cable defective. 	<ol style="list-style-type: none"> 1) Check all termination points. 2) Check brush wear, spring tension & alignment. 3) Perform continuity check on cable.
Circuit trips and/or Pitted, burned rings or brushes.	<ol style="list-style-type: none"> 1) Inadequate amp ration of reel. 	<ol style="list-style-type: none"> 1) Quantify application requirements vs. reel & cable rating.
Circuit arcing	<ol style="list-style-type: none"> 1) Amp or voltage above rating of reel. 2) Excessive carbon dust accumulation. 3) Water or moisture in slip ring. 	<ol style="list-style-type: none"> 1) Quantify application requirements vs. reel & cable rating. 2) Clean dust from inside slip ring. 3) Replace brush spring.

Notes

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