GMS, INC.
CONSULTING ENGINEERS
611 NORTH WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903-1074

TELEPHONE (719) 475-2935
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EDWARD D. MEYER, P.E.
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THOMAS A. McCLERNAN, P.E.

KEN L. WHITE, P.L.S.
DAVID R. FRISCH, P.L.S.
MARK A. MORTON, P.E.
JASON D. MEYER, P.E.

March 22, 2013

Mr. Wes Weaver, President
Weaver Construction Management, Inc.
c/o Garney Construction
7911 Shaffer Parkway
Littleton, CO 80127

Via Email to: wes@weavercm.com
No Hard Copy to Follow

Re: Harold D. Thompson Regional Water Reclamation Facility (HDTRWRF)
Lower Fountain Metropolitan Sewage Disposal District (LFMSDD)

Dear Wes:

Reference is made to your shop submittal identified as follows:

Submittal No.:	14555-002
Date of Submittal:	March 13, 2013
Title:	Shaftless Screw Conveyor-Biosolids Handling Complex
Specification Section:	14555
Manufacturer:	Spirac USA, Inc.

The referenced submittal has been stamped ***"Revise and Resubmit"***. Our comments are as follows:

1. WCMI included an Additional Submittal Review Comments letter in this submittal. Those comments applying to the conveyor manufacturer shall be appropriately responded to in the resubmittal package. Our comments to some of the items included in that letter are as follows.

   a. Regarding the proposed use of 11 gage thick stainless steel material for the conveyor inlet chute and discharge slide gates in lieu of the 3/16" material required by the Project Specifications: Please provide for consideration by the Owner a cost savings summary that can be applied to the equipment for the proposed reduction in material thickness. We take no exception to the use of Type 304 stainless steel hardware proposed for this conveyor.

   b. The proposed 5 hp conveyor drive motor meets the motor horsepower requirement of the Project Specifications as amended by Addendum No. Eleven (11). From this and other comments throughout the submittal documents, it appears as if the conveyor supplier has not reviewed or does not possess Addendum No. Eleven (11). WCMI shall coordinate with its equipment supplier to assure they have all pertinent project documentation and that submitted equipment and components are in conformance with all project documentation.

   c. Regarding the maximum trough filling at design loading: The submittal documents indicate a design loading of 316 cubic feet per hour and a design fill of 33% while the Project

Specifications require a design loading of 313 cubic feet per hour and a design fill of 30%. We take no exception to the proposed design loadings provided the entire conveyor system is properly designed to accommodate the larger proposed loading values, while complying with all other design requirements of the Project Specifications.

d. Regarding the conveyor support connections to the supplemental building members: The supplemental building members appear to be submitted with an 8-inch flange width rather than the 6-inch flange width indicated in the WCMI comment. Coordination is required between the building manufacturer and the conveyor supplier to ensure proper fabrication, installation and connection of these members. Refer to subsequent comments of this letter.

e. Regarding the size and length of the conveyor supports required to meet the building member design, the conveyor manufacturer shall be responsible for coordinating all their design data and requirements. Please note that the marked up submittal drawing No. GA-741-04 included bottom of supplemental building member elevations according to metal building submittal documents. However, in reviewing those elevations with the supplemental information given for the metal building submittal, the marked up elevations still do not match those for the building members. Correction and coordination on these elevations is required.

2. Submittal drawing GA-741-02 indicates a center-to-center dimension of the conveyor support legs as 1'-11¼". This dimension varies from that given on the Project Drawings and will require coordination with the building supplier to ensure proper placement of the supplemental building frame members.

3. The following items apply to submittal drawing GA-741-03:

   a. The drawing must be revised regarding the conveyor support leg length and the associated elevation of the supplemental building frame member required for attachment.

   b. Please revise this drawing to indicate the materials of construction and coating system proposed for the rope pulley assembly.

4. The following items apply to submittal drawing GA-741-04:

   a. Make the appropriate revisions regarding the conveyor support length and elevation of its foot plate.

   b. Please verify the cross brace members and foot plates are to be fabricated from stainless steel.

   c. This drawing indicates several field welds will be required on the conveyor support assemblies. It is preferred that field welding be held to the absolute minimum required for this installation. It is requested that shop welding of the stainless steel components be accomplished wherever possible to better insure proper welding under controlled conditions. Please revise this drawing accordingly.

5. Revise the pull rope eye bolt arrangement shown on submittal drawing GA-741-05. The Project Drawings call for the eye bolts to be placed at the slide gate centerline in order to provide a straight horizontal pull on the gate to better assure proper operation in both directions without binding. Please revise the drawing accordingly.

6. Revise control drawing E-741-01-01 to show the disconnect switch as installed within the conveyor control panel as required by the Project Specifications, not an exterior device as indicated on the submittal drawing.

7. The following items pertain to control drawing E-741-01-02:

    a. Lines 214 and 218 of the wiring diagram appear to represent interconnection to a screenings compactor control panel. It would appear these two lines can be deleted from the wiring diagram as the proposed screw conveyor does not have any automation or interconnect with other process equipment. Please confirm this with the proposed control strategy and revise the drawing accordingly.

    b. Should the items described above in the previous comment at lines 214 and 218 of the control diagram be deleted, it would appear that the HOA switch may also be deleted. Please confirm these items are not required for the conveyor to function according to the controls description given in the Project Specifications and revise the drawing accordingly. Refer to subsequent comment No. 8.b. regarding the Forward/Off/Reverse switch.

    c. The three contacts shown connecting to the belt conveyor control panel can be deleted as the proposed screw conveyor will not have any automation or interconnect linked to other process equipment.

8. The following items pertain to submitted control drawing E-741-01-03:

    a. Revise this drawing as necessary regarding previous comment No. 7.b. on the necessity of the HOA switch.

    b. Regarding the conveyor Forward/Off/Reverse switch, the model number included in the Bill of Material on this drawing indicates the operator type for this switch to be Maintained/Maintained/Spring Return. From the control description given in the Project Specifications, it would appear that this switch should be a Maintained/Maintained/Maintained operator type so the conveyor can be run in either direction continuously. Please confirm and revise the drawing accordingly.

    c. Provide a main disconnect switch on the proposed control panel that will be capable of being locked in the Off position according to the Project Specification requirements.

    d. The Conveyor Reverse indicating light is submitted as amber in color. Please revise this to be green.

    e. The control panel Power On indicating light is submitted as being green in color. Please revise this to be white.

Please call if you should have any questions.

Sincerely,

Mark A. Morton, P.E.

MAM/kmw

ec (letter only):
Mr. Jim Heckman, Manager, LFMSDD, lfmanager@lfmsdd.org
Ms. Cindy Murray, Office Manager, Fountain Sanitation District, fsdistrict@fsd901.org
Mr. Jeff Burst, Project Supt., Weaver Construction Management, Inc., jeff@weavercm.com
Mr. John Jacob, Project Mgr., Weaver Construction Management, Inc., john@weavercm.com
Mr. Adam Roeder, Weaver Construction Management, Inc., aroeder@weavercm.com
Ms. Solange Huggins, Project Engineer, Garney Construction, shuggins@garney.com
cc (letter only): Mr. Jerry Miller, Resident Project Representative, GMS, Inc.

Weaver
CONSTRUCTION MANAGEMENT
3679 S Huron Street, Suite 404 Englewood, Colorado 80110
Phone: (303) 789-4111 FAX: (303) 789-4310

SUBMITTAL TRANSMITAL

March 11, 2013
Submittal No: 14555-02

PROJECT: **Harold Thompson Regional WRF**
Birdsall Rd.
Fountain, CO 80817
Job No. 2908

ENGINEER: **GMS, Inc.**
611 No. Weber St., #300
Colorado Springs, CO 80903
719-475-2935 Roger Sams

OWNER: **Lower Fountain Metropolitan Sewage Disposal District**
901 S. Santa Fe Ave.
Fountain, CO 80817
719-382-5303 James Heckman

CONTRACTOR: Spirac
75 Jackson Street, Suite 300
Newman, GA 30263
Robert 770-632-9833

SUBJECT: Biosolids Shaftless Screw Conveyor

SPEC SECTION: 14555 Shaftless Screw Conveyor – Biosolids Handling Complex

PREVIOUS SUBMISSION DATES:
DEVIATIONS FROM SPEC: __X__ YES ___ NO See Attached WCM comments

CONTRACTOR'S STAMP: This submittal has been reviewed by Weaver Construction Management and, unless indicated otherwise, has been found to be in conformance with the intent of the contract documents.

Contractor's Stamp:	Engineer's Stamp:
Date: 3/11/13 Reviewed by: John Jacob () Reviewed Without Comments (X) Reviewed With Comments	

ENGINEER'S
COMMENTS:_____
_____

Weaver
CONSTRUCTION MANAGEMENT

PH 303-789-4111 3679 So. Huron St., Suite 404
FX 303-789-4310 Englewood, Colorado 80110

Project: HDTWRF **Submittal No.: 14555-002**

Location: Fountain, CO

Supplier: Spirac

Date: 3/11/13

Submittal 14555-002 Shaftless Screw Conveyor at Biosolids Handling Complex

Additional Submittal Review Comments:

1. Spirac has noted deviations to sections 2.2.B.2, 2.2.B.7 and 2.2.B. 11. GMS to review acceptance of deviations.
2. Spirac also noted that section 2.3.C.5.a list 5 hp max. However, Addendum No. 11 changes this to allow fo 5 hp max.
3. Spirac has included a copy of a Warranty. The Warranty for this purchase is per the Terms and Condition of the Purchase Agreement between Spirac and WCM.
4. Spirac has included a copy of the O&M and installation manuals for their equipment. Spirac will be required to submit a separate O&M manual per Sections 14555 and O&M Manuals 01730.
5. Part 2.1.B.3.b stated that max trough filling design loading is 30% while the submittal states 33%. GMS to review acceptance of submittal.
6. It does not appear Spirac has confirmed that torsional rating in Part 2.1.B.7, and the trough load per 2.1.B.10. Spriac to confirm.
7. The metal building manufacture is providing support beams for attachment of the equipment supports. It is noted that the building supplier is providing 8" deep wide flanges with 1/8" web and 6" x ¼" flanges. Spirac is providing support plates at 6" with holes at 4 ½". These dimensions will work.
8. The top of the equipment support foot plate has been established by the metal building shop submittals based on the bottom of beam elevations being supplied by metal building manf and have been referenced on the attached marked up copy of drawing GA-741-04. The support length is calculated by top of support foot plate to the bottom of the support bracket which the support is welded to. Please note that these support lengths vary. Spirac shall fabricate all supports 8-inches longer than noted in the attached marked up drawing GA-741-04. Also, in conversations with Spirac, the supports are current sized at 3" with a maximum length of 6'. The lengths of the supports vary between 6.59 feet to 8.89 feet. Spirac shall determine if larger supports (such as 4") are needed to accommodate the longer support lengths.

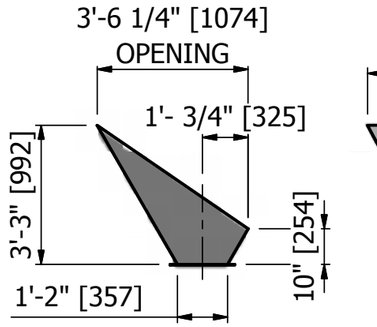
Weaver
CONSTRUCTION MANAGEMENT

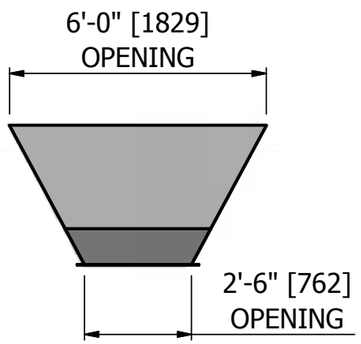
PH 303-789-4111 3679 So. Huron St., Suite 404
FX 303-789-4310 Englewood, Colorado 80110

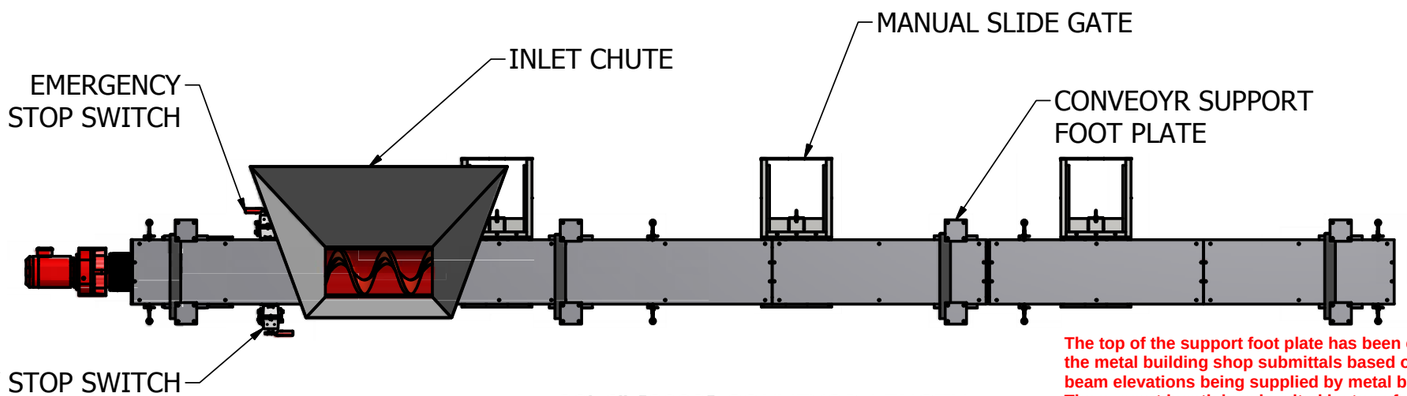
9. Spirac's submittal references the equipment ID as CV-1 which is incorrect. The equipment ID for the headworks conveyor. The correct ID is SCV-1 per Addendum No. 11.

End of Review

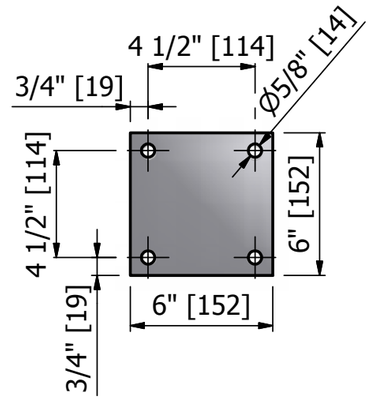
By: John Jacob



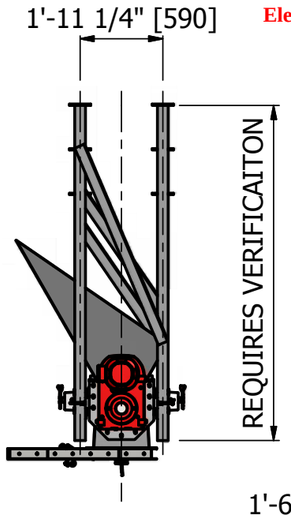


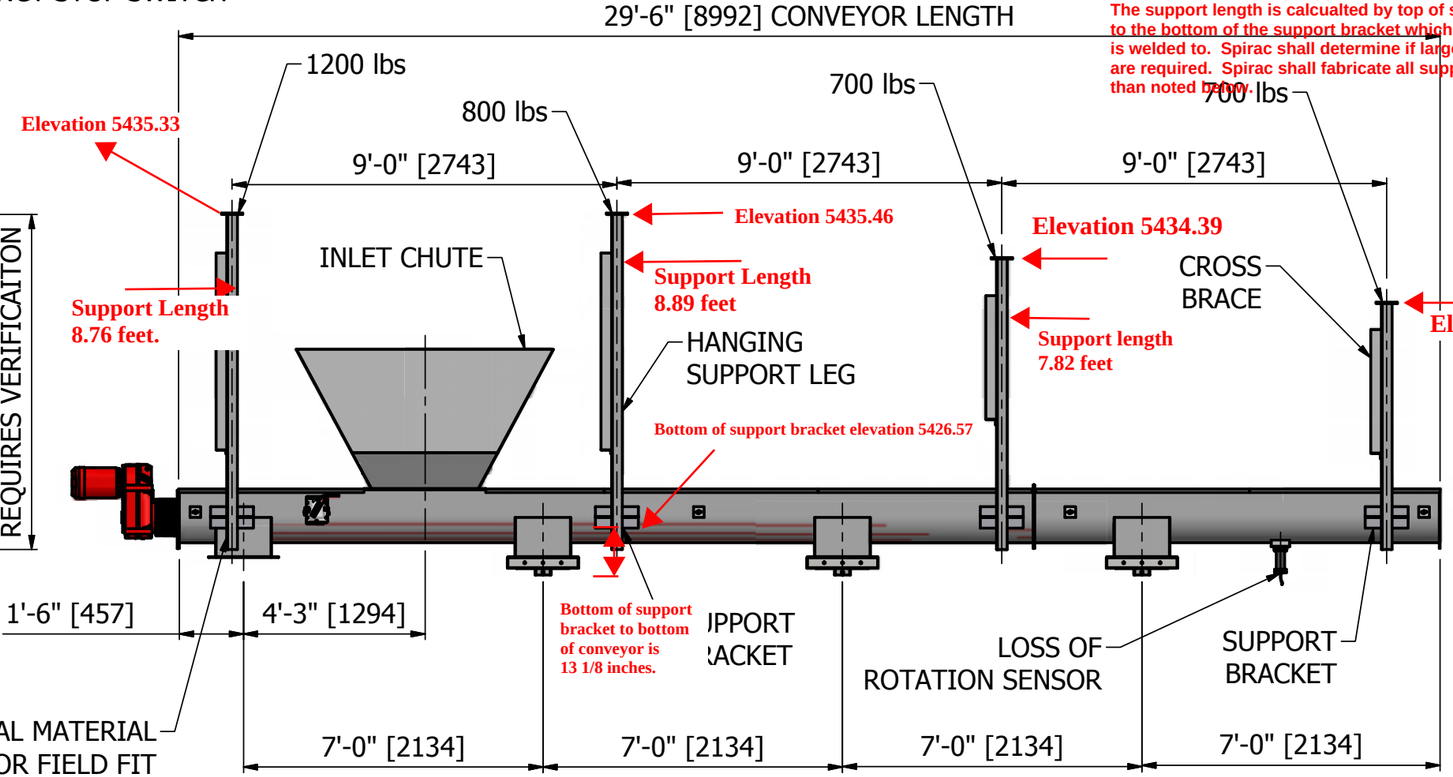


INLET CHUTE



TYPICAL FOOT PLATE





The top of the support foot plate has been established by the metal building shop submittals based on the bottom of beam elevations being supplied by metal building manf. The support length is calcualted by top of support foot plate to the bottom of the support bracket which the support is welded to. Spirac shall determine if larger diameter supports are required. Spirac shall fabricate all supports 8-inches longer than noted below.

NOTES:

ALL LIDS FULLY GASKETED WITH 1" WIDE MATERIAL

ALL HARDWARE STAINLESS STEEL

LOCATE & WELD SUPPORT LEG CROSS BRACE AT INSTALLATION TYP

LOCATE & WELD SUPPORT BRACKET TO SUPPORT LEG AT INSTALLATION

CONVEYOR WEIGHT WITH MATERIAL 3400 LBS

CONVEYOR WEIGHTS SHOWN REPRESENT LEG SET

REV	DATE	DESCRIPTION	BY	CHK
A	3/11/2013	ADDED CONVEYOR WEIGHT	RJL	

SPIRAC (USA) INC.
75 Jackson Street Suite 300
Newnan, GA 30263
ph (770) 632-9833
fax (770) 632-9833

TOLERANCES EXCEPT WHERE OTHERWISE STATED:-

UP TO 120 IN	±1/8 in
120 IN AND OVER	±1/4 in
HOLE CENTERS	±1/16 in
CLEARANCE HOLE DIA	±1/16 in
ALL ANGLES	±1°

DIMENSIONS IN INCHES DO NOT SCALE

741 Fountain HDTWRF CO
General Arrangement
Distribution Conveyor CV-1
U355-SPX/304 SS

DRAWN: RJL	CHECKED:
DATE: 2/15/2013	
SHEET:	SCALE: NTS

DWG. No. GA-741-04 REV. A

FOUNTAIN HDTWRF, CO

SPEC SECTION 14555: SHAFTLESS SCREW CONVEYORS
One (1) U355 Conveyor System

SUBMITTAL
FEBRUARY 2012

SPIRAC Project Name:	Fountain HDTWRF, CO
SPIRAC Project Number:	741
Site Location:	HDTWRF 9001 Birdsall Road Fountain, CO 80817
Purchaser:	Garney Companies, Inc. c/o Weaver Construction Management PO#9103-14555-1 Contact: John Jacob 7911 Shaffer Parkway Littleton, CO 80127 Tel: 303.791.3600 Fax: 303.791.1801
Conveyor Manufacturer:	SPIRAC (USA) INC. Project Manager: Robert Lytten 75 Jackson Street, Suite 300 Newnan, GA 30263 Tel: 770.683.0145 Fax: 770.632.9838
Mfr's Representative:	Ambiente H2O, Inc. Contact: Brian Johnson 1500 W. Hampden Ave. Suite 5-D Sheridan, CO 80110 Tel: 719.580.766400 Fax: 303.380.0664

CONTENTS

SPIRAC (USA) INC
75 Jackson Street, Suite 300, Newnan, GA 30263, USA
Tel: 770 632 9833 Fax: 770 632 9838
Website: www.spirac.com

22 February 2013

Garney Companies, Inc.
c/o Weaver Construction Management
ATTN: John Jacob
7911 Shaffer Parkway
Littleton, CO 80127

Re: SPIRAC Submittal – Fountain CO HTDWRF 14555 Shaftless Screw Conveyors

Mr. Jacob,

Enclosed is SPIRAC's submittal package for the above project, for your review and approval.

As you may know, in the 1980's, SPIRAC invented and pioneered, modern shaftless conveying technology in Sweden. We patented the first shaftless press in 1984, first shaftless vertical in 1989, and remain the industry leader in the shaftless field. SPIRAC shaftless standards are the basis of most world-wide shaftless specifications.

Immediately following this page, we have detailed any areas which require clarification as deviations or exceptions to the specifications.

If during the course of your review, you have a need for additional information on any item, please don't hesitate to contact the undersigned.

We look forward to working with you. Once we are in receipt of your approval to manufacture, we will establish a target completion date and coordinate a delivery time that works with your schedule.

Sincerely,

Robert Lytten
SPIRAC (USA) INC.

SPIRAC (USA) INC
75 Jackson Street, Suite 300, Newnan, Georgia 30263, USA
Tel: 770 632 9833 Fax: 770 632 9838
Website: www.spirac.com

Submittal Clarifications, Deviations, Exceptions, and Recommendations

SPIRAC Project – 741 Fountain, CO. HDTWRF

Fountain HDTWRF 14555 Shaftless Screw Conveyors

SPIRAC has made every effort to comply fully with the above named section. Where there are specific functional differences between SPIRAC's manufacturing methods or construction techniques, we have provided a clear and detailed explanation below. We further understand that with any project, and especially one of this magnitude, there may be trivial and or typographical errors within the base specifications. Where these appear, they may be mentioned below for clarity only, without excessive discussion.

1.5.A.2. Installation Conditions: This section mentions the physical characteristics of the conveyor and installation. The general arrangement is provided based off of drawings BH-6, BH-7, and BH-8.

2.2.B.2 Conveyor Assembly: This section mentions the use of 3/16" thick 304 S.S. material for the inlet chute. The inlet chute submitted is constructed from 11 GA thick 304 S.S. material. This is the typical material that has been used successfully by SPIRAC in numerous applications. SPIRAC requests to use 11 GA thick material as opposed to 3/16" thick material.

2.2.B.7 Conveyor Assembly: This section mentions the use of 3/16" thick 304 S.S. material for the construction of the slide gates. The slide gates submitted is made from 11 GA thick 304 S.S. which is formed and reinforced to provide the rigidity required for this application. This is SPIRAC's typical design and has been used numerous times in similar applications. SPIRAC requests to use 11 GA thick material as opposed to 3/16" thick material.

2.2.B.11 Conveyor Assembly: This section discusses the use of type 316 hardware. SPIRAC requests to use type 304 hardware which is the same type of material used for the conveyor trough, inlet chute, and conveyor supports.

2.3.C.5.a Drive Unit Motor Size: This section indicates the maximum horse power of the drive motor to be 3 H.P. Section 2.1.A.6 requires the conveyor to have the ability to start the conveyor with 100% trough loading. The horse power required to be in compliance with this specification, the drive motor size is 5 H.P.

2.5.A Anchor Bolts: The anchor bolts to be provided by others.

--NOTHING FOLLOWS--

SPIRAC (USA) INC
75 Jackson Street, Suite 300, Newnan, Georgia 30263, USA
Tel: 770 632 9833 Fax: 770 632 9838
Website: www.spirac.com

SPIRAC
CONFORMANCE and STANDARDS CERTIFICATION

SPIRAC guarantees that all known or available documents and performance data related to this project were reviewed. The attached submittal represents a SPIRAC engineered system specifically for this application. To the best of our knowledge this submittal conforms to all criteria set forth for it's intended use unless otherwise noted on an attached cover.

It is the duty of the customer or customer's appointed responsible party to review the SPIRAC submittal and approve the document(s) or to question or to ask SPIRAC to clarify any part of the submittal that appears not to be in conformance with the customers design criteria.

All manufacturing codes and standards named in the customers design criteria are meet or exceeded where applicable. SPIRAC guarantees that the supplied equipment will meet the specified performance data as illustrated within this submittal and SPIRAC will warranty the equipment life as specified.

SPIRAC, INC. LIMITED WARRANTIES AND REMEDIES

a. SPIRAC warrants the goods it supplied against defects in materials and workmanship for a period of twenty four (24) months from the date of final acceptance of the equipment, or within thirty (30) months after delivery to the Purchaser, whichever occurs first. SPIRAC will either repair or replace, at its option, such component provided that written notice of any such defect or deficiency is given to SPIRAC within 14 days after its initial discovery. The obligations of SPIRAC shall also apply with respect to repaired or replaced components for the warranty period then remaining as to the goods supplied, or for a period of 12 months from the date of repair or replacement, whichever period expires first.

b. In the event that the equipment covered by this Warranty was originally purchased by a General Contractor for incorporation into the work, the word "Purchaser" shall mean either the General Contractor or ultimate Owner on whose behalf the equipment was purchased.

c. SPIRAC's warranty and obligations do not cover defects or deficiencies due to or arising out of normal wear and tear; improper or negligent handling, operation, maintenance, overloading or use; defective or improper premises or equipment installation; chemical, electro-chemical or electrical influences; weather or influences of nature; or alteration or repair performed by the Purchaser or third parties without SPIRAC's prior written consent.

d. For any repair covered by this warranty, SPIRAC shall absorb the cost and transportation expenses of the replacement part, the reasonable expenses of disassembly and installation directly required for the repair or replacement, and the expenses of SPIRAC's personnel, if required, for such repair or replacement. The Purchaser shall pay all other repair or replacement expenses. All replaced components become the property of SPIRAC.

e. The Purchaser shall grant SPIRAC a reasonable time and opportunity after written notice for all repairs required under this warranty. If any particular repair cannot be corrected immediately, SPIRAC shall not be deemed to be in default for so long as it actively pursues corrective action. SPIRAC reserves the right to adjust and modify the goods if necessary to meet its warranties.

f. Any action or suit based on any alleged defect or deficiency in the goods supplied shall be barred if not asserted or commenced within 12 months from the date a claim was first made against this warranty by the Purchaser.

g. The Purchaser shall not be entitled to reimbursement for correction of any defect or deficiency caused by it or by any third party.

SPIRAC Incorporated
75 Jackson Street, Suite 300, Newnan, GA 30263 USA
Tel: 770 632 9833 Fax: 770 632 9838
Website: www.spirac.com

h. **THE WARRANTIES AND OBLIGATIONS OF SPIRAC ARE EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND OBLIGATIONS, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED.**

LIMITATION OF LIABILITY

The remedies provided are the exclusive remedies available to the Purchaser in the event that SPIRAC fails to perform any obligation under the contract or the goods supplied cannot be used by the Purchaser in the manner agreed to by SPIRAC under the contract, whether because SPIRAC has failed to give any required instructions, recommendations or advise with respect to the operation or servicing of the goods, or otherwise.

SPIRAC SHALL NOT BE LIABLE TO THE PURCHASER IN ANY MANNER FOR ANY LOSSES OR DAMAGES OF ANY KIND, WHETHER SUCH DAMAGES OR LOSSES ARE GENERAL, DIRECT, IMMEDIATE, SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL, EXEMPLARY, PUNITIVE, OR OTHERWISE.

SPIRAC®

First in spiral conveying technology

SPIRAC shaftless screw conveyors

GENERAL INFORMATION NOT SPECIFIC TO THIS PROJECT

SPIRAC provides customized conveying equipment that meets the solids material handling requirements of industries all over the world. Through innovative design and more than 30 years of experience in leading edge conveying technology, SPIRAC is able to adapt easily to changing industry needs.

SPIRAC's original shaftless screw conveyor technology combines unparalleled low-maintenance and efficient system design.

SPIRAC Shaftless Conveyors

The unique features of the SPIRAC Shaftless Conveyors offer new possibilities in material handling system design. SPIRAC systems are modular, space saving, fully enclosed and reliable. With unlimited combinations of SPIRAC horizontal, inclined, or vertical shaftless conveyors, greater design flexibility is available than ever before.

SPIRAC's design allows the spiral to rotate on the replaceable state-of-the-art wear liner, that becomes the bearing surface; eliminating the need for a central shaft, intermediate bearings and end bearings. The shaftless spiral is the only moving part in the conveyor trough. The elimination of the center shaft allows a much higher fill rate resulting in lower speed operation, more efficient conveying and consequently less wear, noise and power usage. Maintenance is significantly reduced when compared to traditional conveying methods.

Shaftless spiral

At the heart of the system is the spiral. Based on SPIRAC experience, spirals may be made of many different materials and combined in multiple configurations to provide the most efficient results for specific applications. The primary material is a special steel from Sweden, which has mechanical properties that result in the SPIRAC spiral having a very high tensile strength.

No intermediate or end bearings

Eliminating intermediate and end bearings reduces major maintenance work. It also allows efficient and direct transfer into another conveyor – horizontal, inclined or vertical.

- **VIRTUALLY MAINTENANCE FREE**
- **LOW POWER USAGE**
- **LESS DOWN TIME**
- **COST SAVINGS**
- **LESS WEAR**
- **SPACE SAVING**

Liners

SPIRAC's proprietary liner, DURAFLO SPX, is designed specifically to ensure long life. The DURAFLO SPX liner has a built in wear indicator with a snap-in, snap-out feature enabling easy replacement.

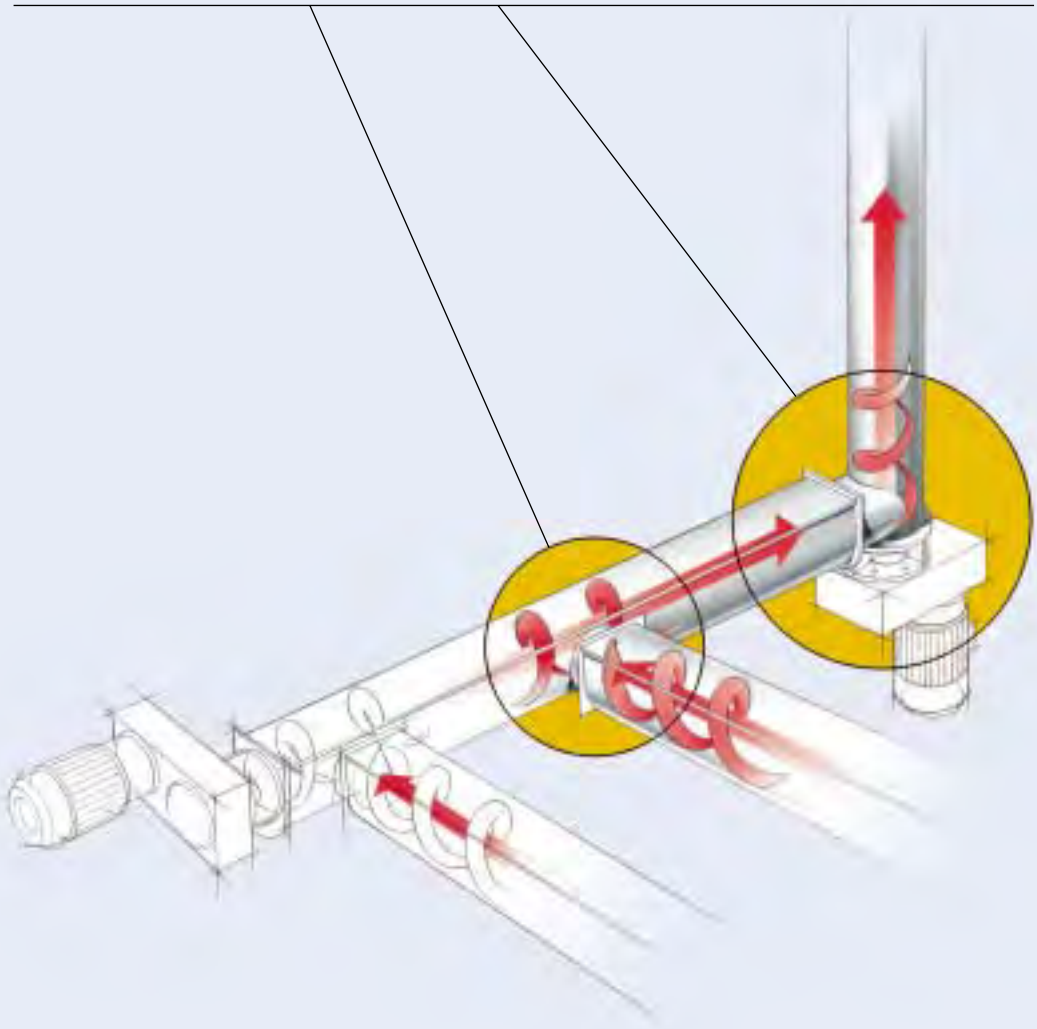
Totally enclosed troughs

SPIRAC conveyors are totally enclosed. There is no spillage of the material being conveyed and odors are completely contained. This provides a clean and safe workplace.

Direct drive

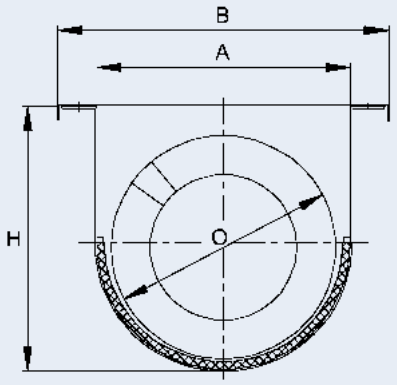
SPIRAC's direct drive design allows a clean and efficient transmission without the maintenance required with belt and chain drives.

A DIRECT TRANSFER INTO A VERTICAL CONVEYOR OR ANOTHER HORIZONTAL CONVEYOR IS A SPACE-SAVING BENEFIT OF SPIRAC SHAFTLESS CONVEYORS. THE ELIMINATION OF END BEARINGS MAKES THIS TRANSFER METHOD VERY EFFICIENT.



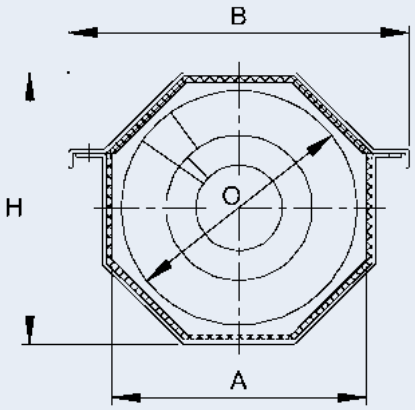
Technical specifications

For application assistance, call SPIRAC for the authorized technical Sales Representative nearest you.



Standard U-trough design sizes (mm)

	A	B	H	O
U200	200	304	205	160
U250	250	354	260	215
U320	320	424	329	280
U355	355	459	364	315
U420	420	545	421	365
U500	500	625	499	440
U620	620	749	609	550



Standard vertical design sizes (mm)

	A	B	H	O
OK200	200	290	207	176
OK250	250	340	257	226
OK320	320	410	327	296
OK355	355	445	362	331
OK420	420	514	431	386
OK500	500	594	511	466
OK620	620	714	631	581

SPIRAC Conveyor specifications

Spiral
- High Tensile Micro Alloyed Steel
- 304 & 316 Stainless Steel
- Bisalloy
- Special coatings available

Liners
- DURAFLO SPX
- Polyethylene
- Bisalloy
- Stainless Steel
- Duplex Stainless Steel

Drive unit
- Direct coupled
- Variable speed option

U Troughs
- Fully enclosed with bolted or quick release lids
- Inspection Ports
- 304 & 316SS, Duplex SS, Mild Steel

Seals
- Gland Packing
- Labyrinth
- Mechanical

Other options
- Supports
- Electronic shear pins
- Automatic controls
- Motion sensors
- Limit switches
- Knife gates

FEBRUARY 2003

SPIRAC REFERENCES

LOCATION	CONSULTING ENGINEER	DESCRIPTION
ADAMS WWTP 273 COLUMBIA STREET SALEM, MA 01970 JOE FIJAL 413-743-8370		(2) U320 CONVEYOR SYSTEM
AKRON WWTP, OHIO	SPIRAC	GRIT FROM PRIMARY GRIT TANKS 4 MODEL U320 SPIRAC CONVEYORS START UP 1990
ALBANY WWTP, GA.	BROWN & CALDWELL	SCREENINGS FROM MECH. BAR SCREEN 1 MODEL U320 SPIRAC CONVEYOR START UP 1994
ALBUQUERQUE WWTP, NM	CAMP, DRESSER & MCKEE	CENTRIFUGE DEWATERED SLUDGE CAKE 6 MODEL U420 SPIRAC CONVEYORS START UP 1996
ALBUQUERQUE WWTP 4201 SECOND STREET SW ALBUQUERQUE, NM 87105	BRADBURY STAMM 3701 PASEO DEL NORTE NE ALBUQUERQUE, NM 87113	U420PX/SS304 CENTRIFUGE SLUDGE START UP JUNE 2001
ALLENTOWN WWTP, PA. JIM VALIK 610-437-7643		BELT FILTER PRESS DIGESTED DEWATERED SLUDGE 4 MODEL U320 SPIRAC CONVEYORS START UP 1987
AMERICAN WATER	HAVENS & EMERSON	BELT FILTER PRESS DEWATERED ALUMINUM HYDROXIDE WATER PLANT SLUDGE 3 MODEL U355 SPIRAC CONVEYORS START UP 1995
AMHERST WWTP #16 445 TONAWANDA CREEK AMHERST, NY 14228	MALCOLM PIRNIE	SCREENINGS CONVEY/DEWATERING 2 MODEL U260 CONV/PRESS 31.5' & 23' LENGTHS START UP NOVEMBER 2002
ANN ARBOUR WWTP, MI BILL THOMPSON 313-994-2811	MCNAMEE, PORTER & SEELEY	SCREENINGS FROM MECH. BAR SCREENS 2 MODEL U320 SPIRAC CONVEYORS START UP 1991
ARLINGTON WWTP,. VA.	CAMP,DRESSER & MCKEE	SCREENINGS FROM MECH BAR SCREENS 3 MODEL U355 SPIRAC CONVEYORS START UP 1994
ARUBA-PARKIETENBOS ALBO ARUBA BARCADERA 122 ORANJESTAD EDWIN DONATA 011-297-582-4700		U 320 & OK320 CONVEYOR SYSTEM
ASTON WWTP, PA.	CATANIA ENGINEERING	BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U320 SPIRAC CONVEYORS START UP 1988
ATLANTA C.S.O.'S GA.		WASTE WATER GRIT CONCENTRATION 3 MODEL SA355 SANDSEPS START UP 1995

BALTIMORE, CITY OF PATAPSCO WWTP BALTIMORE, MD. RICHARD BANKS 410-396-2800		SUBMERGED SLUDGE CONVEYOR START UP DECEMBER 2000
BARE HILL CORRECTIONAL FACILITIES WWTP MALONE, NY RTE 2, BOX 155A CHARITON, IA 50049 CURT DANIELS 515-766-6820	N.Y. STATE OFFICE OF GENERAL SERVICES C.T. MALE ASSOC.	WASTE WATER SCREENINGS 1 MODEL U260, 1 MODEL OK260 VERTICAL, 1 MODEL SP215 SPIROPRESS CONVEYOR W/LONGPAC BAGGING SYSTEM START UP 1996
BARTLETT WWTP, IL. MR BRIDGE PALOMO 630-837-4912/630-837-9043	PAVIA-MARTING ENGINEERS	BELT FILTER PRESS ANAEROBICALLY DIGESTED SLUDGE 2 MODEL U260, I MODEL OK260 VERTICAL, 3 MODEL U320 SPIRAC CONVEYORS START UP 1995
BERNARDS TWP WWTP, NJ	KILLIAM ASSOCIATES	BELT FILTER PRESS DEWATERED SLUDGE 1 MODEL U320 SPIRAC CONVEYOR START UP 1994
BETHLEHEM WWTP 144 SHIMMERSVILLE ROAD BETHLEHEM, PA.	EDM CONSULTANTS 1250 SOUTH BROAD STREET LANSDALE, PA 19446 215-699-4737	2 MODELS SA320 GRIT START UP DECEMBER 2000
BIO RESOURCES MINGO, IA RTE 2, BOX 155A CHARITON, IA 50049 CURT DANIELS 515-766-6820		SWINE SLURRY DEWATERING & COMPACTION 1 MODEL U420 SPIROPRESS START UP 1995
BISSELL POINT WWTP, ST. LOUIS, MO.	SVERDRUP ENGINEERING	WASTE WATER GRIT DISTRIBUTION 3 MODEL U355 SPIRAC DISTRIBUTION CONVEYORS START UP 1996
BLUE WATER FIBER PORT HURON, MI.	RUST ENGINEERING	RECYCLE PAPER MILL SEDIMENT SEPARTOR I MODEL SA260 SANDSEP START UP 1995
BRANDON WWTP ONTARIO		GRIT CONCENTRATION 1 MODEL SA200 SANDSEP START UP
BRECKENRIDGE WWTP, CO.	RICHARD ARBOR ASSOCIATION	CENTRIFUGE DEWATERED SLUDGE 1 MODEL U260 SPIRAC CONVEYOR STARUP 1988
BRECKENRIDGE WWTP, CO.		GRIT CONCENTRATION & ELEVATION 1 MODEL SA260 SANDSEP START UP 1995
BREVARD CO. SO C WWTP 10001 NO. WICKHAM ROAD VIERA, FL 32940 407-639-9198	FRANCIS T. SIENER	(3) X U355/316SS 2@ 32' & 19' LENGTHS BELT FILTER PRESS SLUDGE START UP JULY 2001
BUTTE, SILVER, BOW WWTP, MT.	BLACK & VEATCH	SCREENINGS CONVEYING/DEWATERING 1 MODEL SP215 SPIROPRESS START UP 1996
CAMDEN MORRIS DELAIR WWTP 8900 ZIMMERMAN AVE. PENNSAUKEN, NJ 08110 US WATER 856-488-2041		8 MODEL U320 CONVEYORS 2@ 11.5', 2@ 12', 2@ 29', 2@ 29.5', START UP MAY 2002

CARLTON PLACE WWTP, ONTARIO	J.L. RICHARDS ASSOCIATION	SCREENINGS CONVEYING/DEWATERING 1 MODEL SP215 SPIROPRESS
CARPENTERSVILLE WWTP, CARPENTERSVILLE, IL	BAXTER & WOODMAN, INC. BILL BOONE (T) 847-551-3490 (F) 847-426-0809	BELT FILTER PRESS DEWATERED SLUDGE CONVEYING 1 MODEL U320 SPIRAC CONVEYOR START UP 1996
CENTRAL VALLEY WWTP	BROWM & CALDWELL	GRAVITY BELT THICKENDED SLUDGE 3 MODEL U320 SPIRAC CONVEYORS START UP 1988
CHALFONT WTP, PA.	GANNETT, FLEMING EE+T INC.	ALUMINUM SLUDGE CONVEYING 2 MODEL U320 SPIRAC CONVEYORS START UP 1995
CHINO BASIN MWD RIVERSIDE, CA 909-484-3888	NORTH AMERICAN TREATMENT SYSTEMS	CENTRIFUGE DEWATERED SLUDGE CAKE 3 MODEL U320 CONVEYORS, 1 MODEL OK320 VERTICAL
CHITTENANGO WWTP, NY.	STEARNS & WHEELER	BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U260 SPIRAC CONVEYORS START UP 1988
CITY OF TAMPA 2700 MARITIME BLVD. TAMPA, FL. 33605 CARL PENLY 813-927-3685		PROJECT #5-C-54 HOWARD F. CURREN AWTP CONVEYOR REPLACEMENT JOB #05072 U420 & OK420 CONVEYOR SYSTEM
COBB COUNTY, GA. SOUTH COBB WWTP	BROWN & CALDWELL MAYES, SUDDETH & ETHERIDGE	SCREENINGS CONVEYOR 1 MODEL U260 SPIRAC CONVEYOR START UP 1996
COCOA BEACH WWTP,. FL.		BELT FILTER PRESS DEWATERED SLUDGE 1 MODEL U320 SPIRAC CONVEYOR START UP 1994
COLD SPRINGS WWTP, NV	KENNEDY JENKS	2 MODEL U250 DEWATERED CENTRIFUGE SLUDGE, 30' INCLINE TO 15' TRUCK LOADER W/3 DISCHARGE POINTS
COLUMBIA, S.C.	BLACK & VEATCH	2 MODEL U320 GRIT CONVEYORS 2 SCREENINGS CONVEYORS START UP 1997
CROWN POINT WWTP, CROWN POINT, IN. CHRIS PREVIS 219-662-3255	COMMONWEALTH ENGINEERS	BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U260, 1 MODEL OK260 VERTICAL SPIRAC CONVEYING SYSTEM START UP 1996
CLARK CO BAR SCREEN 5857 EAST FLAMINGO ROAD LAS VEGAS, NV 89122	CAROLLO ENGINEERS MR. WALID KARAM (F) 714-540-4349	4 MODEL U355-PX/SS316L GRIT & SCREENINGS CONVEYOR 41.5', 48;, 25', 17.5' LENGHTS START UP 2002
COLUMBIA FALLS WWTP 2500 SHRUB DRIVE COLUMBIA FALLS, MT 59912 HUGH 406-892-4357	HDR 3075 N. RESERVE MISSOULA, MT 59808 406-541-9758	2 MODEL U320 CONVEYORS 36' & 8' LENGTHS START UP MAY 2001
CONCORD, NH HALL ST WWTP RICHARD ROY 603-230-3858		(5) MODEL U320 CONVEYORS 13', 39', 23' & 2 @ 15' LENGTHS START UP 2003
CONSHOHOCKEN WWTP CONSHOHOCKEN, PA 610-828-0979		1 MODEL U320 CONVEYOR 22.5' LENGTH START UP 2002

DALTON UTILITIES DALTON GEORGIA LESLIE RUSH 706-281-1119	SPIRAC INC & CITY OF DALTON	(1) MODEL SLV 80X20' VERTICAL (3) MODEL U500 HORIZONTAL START UP APRIL 2000
DENTON TEXAS PECAN CREEL WRP EXP.		(1) MODEL U355 CONVEYOR 23' LENGTH START UP 2003
DEPERE WWTP 315 LEONARD DEPERE, WI 54115 906-863-6549		4 MODEL U320, 1 OK320 VERTICAL 45', 27', 15', 81' LENGTHS VERTICAL 11' LENGTH START UP SEPT 2001
DERRY TOWNSHIP WWTP, PA. CET ENGINEERS WAYNE SHUTZ 717-566-3237		BELT FILTER PRESS SLUDGE 1 MODEL U420 SPIRAC CONVEYOR START UP 1994
DOWNERS GROVE WWTP DOWNERS GROVE, IL RALPH SMITH 5003 WALNUT AVENUE DOWNERS GROVE, IL 60515-4044 (T) 630-969-0664 (F) 630-969-4913	BAXTER & WOODMAN	SCREENINGS DEWATERING & CONVEYING 2 MODEL SP280 SPIROPRESS 1 MODEL U320 SPIRAC CONVEYOR START UP 1995
DUFFIN CREEK WWTP, CDN Derrick Godfrey 905.431.8488	GORE & STORRIE LTD.	GRIT & SCREENINGS CONVEYING/DEWATERING 2 MODEL U260 CONVEYORS, 1 MODEL U320 CONVEYOR, 2 MODEL U355 CONVEYORS, 1 MODEL U320 SPIROPRESS START UP 1990
DURHAM PHASE 3 EXP. 16580 SW 85TH STREET TIGARD, OR 97224 ED DIX CLEAN WATER SERVICES 503-547-8150	HDR ENGINEERING 10300 SW GREENBURG, #500 PORTLAND, OR 503-768-3700	7 MODEL U355 HORIZONTAL INCLINE 2@27', 18', 17', 53', 50', & 36' 2 MODEL OK355 VERTICALS, 39' EACH VERTICALS CENTRIFUGE SLUDGE START UP AUGUST 2001
EFFINGHAM WWTP, EFFINGHAM, IL. DON BROWN 217-347-7421	MILANO & GRUNLOCK	BELT FILTER PRESS DEWATERED ALUM SLUDGE 2 MODEL U320 1 MODEL OK320 VERTICAL SPIRAC CONVEYING SYSTEM START UP 1995
ELMIRA WWTP, NY PAUL NICKEL 607-732-5115	C & S ENGINEERS	ALUM SLUDGE CONVEYING 2 MODEL U260 CONVEYORS 1 MODEL OK260 VERTICAL CONVEYOR WITH SWIVEL START UP 1996
EPHRATA WWTP, PA.		WASTEWATER SEPARATED GRIT 1 MODEL U260 SPIRAC CONVEYOR START UP 1989
ELIZABETHTOWN WWTP ELIZABETHTOWN BOROUGH, PA DENNIS BLAIR 717-367-6666	CAMP DRESSER & MCKEE	BELT FILTER PRESS ANAEROBICALLY DIGESTED SLUDGE 2 MODEL U320 SPIRAC CONVEYORS START UP 1994
EL PASO, TEXAS R. BUSTAMANTE WWTP	PARKHILL, SMITH & COOPER CH2M/HILL	BELT FILTER PRESS ANAEROBICALLY DIGESTED SLUGE 3 MODEL U420 SPIRAC CONVEYORS START UP 1990
EL PASO, TEXAS HASKELL ST. WWTP	PARKHILL, SMITH & COOPER	SCREENINGS FROM 3 MECH. SCREENS 1 MODEL U320 SPIROPRESS 1 MODEL U320 SPIRAC CONVEYOR START UP 1993

EL PASO, TEXAS HASKELL ST. WWTP PETE CHAVOL 915-532-3506	PARKHILL, SMITH & COOPER	SCREENINGS FROM 3 MECH. SCREENS 1 MODEL U320 SPIROPRESS I MODEL U320 SPIRAC CONVEYOR START UP 1993
EXXON BATON ROUGE CHEMICAL PLANT PO BOX 241 BATON ROUGE, LA 70821-0241 BRUCE GARDNER 225-977-7021	SPIRAC	SA320/SS304 CHEMICAL HEAVY REJECTS (GRIT CLASSIFIER) START UP 2001
FIELD TRAILS MINGO, IA		SWINE SLURRY DEWATERING & COMPACTION 1 MODEL U420 SPIROPRESS START UP 1995
FISHERS WWTP, IN.	COMMONWEALTH ENGINEER	BELT FILTER DEWATERED SLUDGE 2 MODEL U320 SPIRAC CONVEYORS START UP 1994
FORD MOTOR CO. LOUISVILLE, KY. 800-392-3673	HUBBEL, ROTH & CLARK	METAL HYDROXIDE SLUDGE FROM PLATE & FRAME PRESS 1 MODEL TWIN U355 SPIRAC DISTRIBUTION CONVEYOR START UP 1994
FOREST PARK WTP EXP. BOROUGH OF CHALFONT, PA. 144 PARK AVENUE CHALFONT, PA 18914	GANNETT FLEMING HARRISBURG, PA	U355 CONVEYOR SYSTEM
FORT LAUDERDALE PLANT, FL.		DEWATERED SLUDGE, COMPOSTING SAWDUST & COMPOST 1 MODEL U500 TRIPLE 1 MODEL U500 TWIN O500 (AIR LOCK) 5 MODEL U500 4 MODEL U420 4 MODEL U355 TWINS SPIRAC CONVEYORS START UP 1986
FOX LAKE CENTRIFUGE IMP 200 INDUSTRIAL DRIVE FOX LAKE, IL 60020	TROTTER & ASSOCIATES 16 NORTH FIRST AVENIE ST. CHARLES, IL 60174 630-587-0470	MODEL U355PX/SS304 SLUDGE START UP OCTOBER 2000
FOX RIVER WPCC BROOKFIELD, WI	STAND ASSOCIATES ENGINEERS	WASTE WATER SCREENINGS 2 MODEL U260 SPIROPRESS 1 MODEL OK320 CONVEYORS START UP 1997
FRISCO SANITARY 111 SO. SUMMITT BLVD. FRISCO, CO 80443 970-668-1018	BLACK & VEATCH CORP. AURORA, CO.	(3) U420 X 304L CENTRIFUGE SLUDGE 2@20', 1 @38' LONG START UP FEBRUARY 2001
GEORGETOWN WWTP, ONTARIO	GORE & STORRIE	SCREENINGS FROM MECH. BAR SCREEN 1 MODEL U260 SPIRAC CONVEYOR
GEORGIA KRAFT, MACON, GA.		DEWATERED SLUDGE & BARK HANDLING TO INCINERATOR 2 MODEL U355 TWINS 3 MODEL U355 SPIRAC CONVEYORS START UP 1983
GRAND ISLAND WWTP, NE	CH2M/HILL	CENTRIFUGE DEWATERED SLUDGE 3 MODEL U320 SPIRAC CONVEYORS START UP 1995

GRAVENHURST WWTP, ONTARIO	GORE & STORRIE	DEWATERED SLUDGE CAKE 1 MODEL U320 CONVEYOR START UP
GREEN CREEK WWTP, OTTAWA, ONT.	GORE & STORRIE	PRE SCREENINGS CONVEYING 3 MODEL U600 SPIRAC CONVEYORS START UP 1991
HAIKEY CREEK TULSA, OK MIKE BOATNER 918-369-5961	GREELY & HANSON	BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U420 1 MODEL OK420 SLUDGE/LIME MIX 1 MODEL U420 SWIVEL SPIRAC CONVEYORS START UP 1996
HARRIS COUNTY, TEXAS	TURNER, COLLIE & BRADEN	WASTEWATER SCREENINGS 1 MODEL U260 SPIROPRESS START UP 1997
HASKELL STREET WWTP PETE CHAVOL 915-532-3506		SCREENINGS FROM BAR SCREEN 1 MODEL U320/SP280 SPIROPRESS 1 MODEL U320 CONVEYOR START UP 1993
HEINZ ORE-IDA 175 NE 6TH AVENUE ONTARIO, OR 97914 TOM HENSCHEID 541-889-0521	SPIRAC	U355-PX/SS304 OK355-PX/SS304 INDUSTRIAL WASTEWATER SLUDGE START UP 2001
JAMES RIVER ASHLAND, WI		PAPER RECYCLE MATERIAL DEWATERING/COMPACTING 1 MODEL U420 SPIROPRESS START UP 1995
JAMES RIVER ASHLAND, WI		PAPER FIBER SLUDGE CONVEYING 2 MODEL U320 SPIRAC CONVEYORS START UP 1996
JASPER WWTP, IN.	COMMONWEALTH ENGINEERING	DEWATERED SLUDGE CAKE 2 MODEL U320 SPIRAC CONVEYORS START UP 1990
JEFFERSON SMURFIT CORP NORTH 8TH STREET FERNANDINA BEACH, FL 32034 904-277-5758 ALAN DESHAZER	SPIRAC	CS-300 CHANNEL SCREEN PULP AND PAPER START UP JULY 2001
JOHNSON CITY WWTP 857 RIVERVIEW DR. JOHNSON CITY, TN 37605 STEVE HARSH 423-975-2636		2 MODEL U320 CONVEYORS 12.5' & 18' LENGHTS START UP MARCH 2002
KOKOMO WWTP, IN. JANE BAIRD 317-457-5509	R.Q.A.W. CONSULTING ENGINEERS	BELT FILTER PRESS DEWATERED SLUDGE CAKE 3 MODEL U355 1 MODEL OK355 VERTICAL SYSTEM 1 MODEL U500 TWIN SPIRAC CONVEYORS START UP 1995
LABBATT'S BREWERY MONTREAL QUEBEC		RECYCLED BOTTLE LABEL DEWATERING 6 MODEL U320 SPIROPRESSES
LAFAYETTE SOUTH WWTP	CAMP, DRESSER & MCKEE	WASTEWATER SCREENINGS 2 MODEL U260 SPIROPRESSES START UP 1997

LANCASTER AREA SEWER AUTHORITY LANCASTER, PA.		DEWATERED SLUDGE CAKE 3 MODEL U320 2 MODEL U420 SPIRAC CONVEYORS START UP 1996
LANCASTER COUNTY WWTP, PA.		BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U420 2 MODEL U500 1 MODEL U500 TWIN SPIRAC CONVEYORS START UP 1996
LANDIS SEWER AUTHORITY VINELAND WWTP, NJ.		SCREENINGS FROM MECH SCREENS 1 MODEL U260 SPIRAC CONVEYOR GRIT/GREASE CONVEYOR 1 MODEL U 260 SPIRAC CONVEYOR START UP 1996
LAREDO NORTHSIDE 8803 CHRIS LANE LAREDO, TX 78041	NAISMITH ENG. INC. 4501 GOLLIHAR ROAD CORPUS CHRISTI, TX 361-814-9900	2 MODEL U260 CONVEYORS 25' & 6' LENGTHS START UP 2001
LARAMIE, WY.	WESTERN RESEARCH INSTITUTE/P.G.I.	PRESSURIZED HOPPER CONVEYING SAWDUST 1 MODEL O200 SPIRAC CONVEYOR START UP 1996
LEESBERG WWTP, VA.	CH2M/HILL	SCREENINGS FROM 2 MECH SCREENS 2 MODEL U260 SPIRAC CONVEYORS START UP 1995
LEWISTOWN WWTP, PA.		SCREENINGS FROM MECH SCREEN 1 MODEL U320 SPIRAC CONVEYOR START UP 1996
LOS ANGELES, CA. TERMINAL ISLAND WWTP	JAMES MONTGOMERY ENGINEERS(STRR DIVISION)	CENTRIFUGE DEWATERED SLUDGE CAKE 2 MODEL U355 SPIRAC CONVEYOR START UP 1993
MACMILLAN BLOEDEL PKG. HENDERSON, KY ROBERT OUSLEY 502-831-6002		
MANCHESTER, NH 300 WINSTON ST MANCHESTER, NH 03103		U355 & U500 CONVEYOR SYSTEM
METRO TORONTO, ONT. DUFFIN CREEK WWTP. 901 MCKAY ROAD PICKERING, ONT., CN L1W3A3 BOB RANAGE, CHIEF MAINT. OP. 905-683-9127	PROCTOR & REDFERN	SCREENINGS FROM MECH SCREENS, CONVEYING/DEWATERING 4 MODEL U355 CONVEYORS 2 MODEL U320 SPIROPRESS DEWATERED GRIT 2 MODEL U260 CONVEYORS START UP 1992
METRO TORONTO, ONT. HIGHLAND CREEK WWTP. 51 BEACH GROVE DRIVE WESTHILL, ONT., CN M1E3ES MARTIN SHIGEISHI 416-392-4762	PROCTOR & REDFERN	SCREENINGS FROM MECH SCREENS, CONVEYING/DEWATERING 3 MODEL U355 CONVEYORS 2 MODEL U320 SPIROPRESS START UP 1994 SUBMERGED GRIT CONVEYORS 5 MODEL U280 SPIRAC CONVEYORS W/ UNDERWATER HYDRAULIC DRIVES START UP 1994
MILLVILLE WWTP, NJ.	SCHOOR, DEPALMA & CANGER	DEWATERED SLUDGE CAKE 3 MODEL U355 CONVEYORS START UP 1993

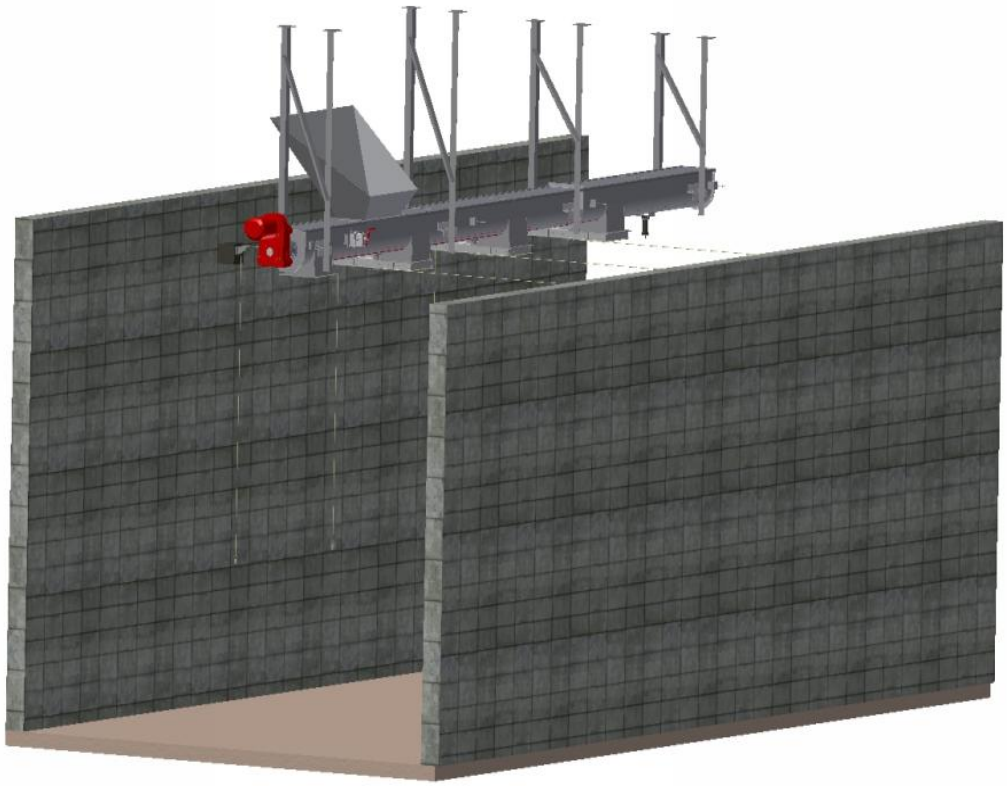
MINGO COUNTY RTE 10 NAUGATUCK, WV 25685 740-245-5316		1 U320/304SS 23' LENGTH
MISHAWAKA WWTP, BIOSOLIDS FACILITY MISHAWAKA, IN TIM BRILL 219-258-1655	GREELEY & HANSEN CHICAGO, IL.	BELT FILTER PRESS DEWATERED SLUDGE CAKE 2 MODEL U355 1 MODEL OK355 VERTICAL SPIRAC CONVEYORS START UP 1995
MONROE WWTP, MI.	MCNAMEE, PORTER & SEELEY	DEWATERED SLUDGE STORAGE HOPPERS 20 SPIRAC CONVEYORS START UP 1992
MONCTON, ONT, CDN	TOUCJIE ENGINEERING	DEWATERED SLUDGE CAKE 1 MODEL U320 SPIRAC CONVEYOR START UP 1991
MONTPELIER WWTP 949 DOG RIVER ROAD MONTPELIER, VT 05602	DUFRESNE-HENRY ENGINEERS NORTH SPRINGFIELD, VT 802-886-2261	U355 PX/304SS SLUDGE START UP APRIL 2001
MURFREESBORO, TN STAN WALLACE 615-848-3225		4 MODEL U320 CONVEYORS 107', 93', 88', 74' LENGHTS START UP 2000
NAUGATUCK - VEOLIA WATER NO. AMERICA, 500 CHERRY STREET, NAUGATUCK, CT 06770	WRIGHT PIERCE, JENNIFER MUIR 860.343.8297	25 CONVEYORS TOTAL DEWATERING AND SLUDGE RECEIVING, START UP 2007
NEBRASKA CITY WWTP, NE.		CENTRIFUGE DEWATERED SLUDGE CAKE 1 MODEL U260 SPIRAC CONVEYOR START UP 1996
NEW YORK ORGANIC FERTLISER CO., NY 1108 OAK POINT AVENUE BRONX, NY 10474 (T) 718-991-7417 (F) 718-991-7426	TIGER & BOND	CENTRIFUGE DEWATERED SLUDGE CAKE 12 MODEL U500 TWIN (3 TRUCK EMPTYING BINS) 6 MODEL U500 CONVEYORS 6 MODEL U355 TWINS
LOCKSLEY LEWIS- EXT. 239 MIKE TRACY EXT. 273 RODERICK WEBB PURCHASING		(6 DAY HOPPERS FEEDING 6 DRIERS) 6 MODEL U355 CONVEYORS START UP 1993
NIAGARA, ONTARIO, CDN.	PROCTOR & REDFERN	BELT FILTER PRESS SLUDGE 2 MODEL U260 SPIRAC CONVEYORS START UP 1998
NORTH END WWTP TACOMA, WA	PARMETRIX	WASTEWATER GRIT CONCENTRATION 2 MODEL SA260 SANDSEP START UP 1995
NORWALK, CT.	MALCOLM PIRNIE, INC.	2 MODEL U355 GRIT CONVEYORS 2 MODEL U320 SCREENINGS CONVEYORS 2 MODEL U320 SPIROPRESS START UP 1998
OTTAWA GREENCREEK ROBERT PICCARD CENTER, CITY OF OTTAWA STEVE MOORE 613-580-2424		SUBMERGED GRIT CONVEYOR
OJAI VALLEY SANITATION DISTRICT WWTP, CA.		BELT FILTER PRESS DEWATERED SLUDGE 2 MODEL U320 SPIRAC CONVEYORS START UP 1996

PAWLEY'S ISLAND GEORGETOWN CO. W&S 456 CLEARWATER DRIVE PAWLEY'S ISLAND, SC 29585	JORDAN JONES & GOULDING 145 KING STREET CHARLESTON, SC 29401 843-722-0300	U320/SP280 SCREENINGS PRESS START UP JULY 2001
PENTICON, BC. CDN	STANLEY ASSOC.	BELT FILTER PRESS SLUDGE 2 MODEL U320 SPIRAC CONVEYORS START UP 1990
PETERSBERG WWTP, ALASKA	URS ENGINEERS	SCREENINGS FROM MECH SCREEN 1 MODEL U260 SPIRAC CONVEYOR START UP 1989
PINE CITY FIBER CO. JACKSON, AL	RUST ENGINEERING	RECYCLE PAPER MILL SEDIMENT SEPARATOR 1 MODEL SA260 SANDSEP START UP 1994
PORT ST. LUCIE 10700 NW GLADES CUTOFF ROAD PORT ST. LUCIE, FL 34987		U320 & U500 CONVEYOR SYSTEM
POST FALLS WWTP, ID.	KIMBALL ENGINEERING	SCREENINGS FROM 2 MECH SCREENS 1 MODEL U260 SPIRAC CONVEYOR START UP 1996
POTTSVILLE WWTF UPGRADE & EXPANSION TRAIN 1 ROUTE 61 POTTSVILLE, PA		U355-SPX/304SS CONVEYOR SYSTEM
PULP & PAPER RESEARCH		PULP STOCK DEWATERING 1 MODEL U320 SPIROPRESS START UP 1992
ROCK RIVER WATER RECLAIMATION DISTRICT ROCKFORD, IL. TERRY HEALLESS, P.E. 815-397-9700	ROCK RIVER WRD ENGINEERING DEPT.	SCREENINGS FROM 2 MECH. BAR SCREENS, COMPACT & DEWATERER 1 MODEL U260 SPIROPRESS START UP 1996
SAN ANGELO WWTP, TX. JACK NALEPKA	PARKHILL, SMITH & COOPER	WASTEWATER PLANT GRIT & SCREENINGS 1 MODEL U320 SPIRAC CONVEYOR START UP 1994
SAN JOSE WWTP. SANTA CLARA, CA.	CH2M/HILL	SCREENINGS FROM MECH BAR SCREENS 1 MODEL U500 SPIRAC CONVEYOR START UP 1996
SARASOTA WTP, FL. SARASOTA CITY OF PUBLIC WORKS UTILITIES ALEX HERNANDEZ 941-365-2200 EXT. 6241		DEWATERED SLUDGE & SAWDUST COMPOST 2 MODEL U500 TWINS 4 MODEL U500 5 MODEL U355 SPIRAC CONVEYORS START UP 1985
SCHENECTADY WWTP, NY.		CENTRIFUGE DEWATERED SLUDGE CAKE 1 MODEL U260 CONVEYOR START UP 1996
SCOTT PAPER, MOBILE, AL		DEWATERED FIBER SLUDGE 3 MODEL U500 TWINS 1 MODEL U500 CROSS SPIRAC CONVEYORS START UP 1984

SEIDEL TANNING CO.		LEATHER TANNARY, RECYCLE WASTE SOLIDS DEWATERING/COMPACTION 1 MODEL U260 SPIROPRESS START UP 1994
SHERBROOKE WWTP SHERBROOKE, QUEBEC, CAN MICHELE DEMERS 818-566-1150	CONSULTANTS CESIR INC.	LIME SLUDGE FROM STABILIZATION PROCESS 2 MODEL U720 2 MODEL U355 TWINS 8 MODEL U320 2 SPIRAC SLUKA LIME/SLUDGE MIXERS START UP 1994
SMITH FALL WWTP, ONT	GORE & STORRIE	SCREENINGS DEWATERING 1 MODEL U320 SPIROPRESS START UP 1993
SOUTHERLY WWTP 6977 SOUTH HIGH STREET LOCKBOURNE, OH 43137 DEAN POSEKANY 614-645-3248	MALCOLM PIRNIE	NEW HEADWORKS SCREEN & GRIT FACILITIES U320 CONVEYOR SYSTEM
SPRINGSBORO, OH 275 WEST MILL STREET SPRINGSBORO, OH TERRY MORRIS 937-748-9453	U.R.S.	U320 & OK320 CONVEYOR SYSTEM
SPRING CREEK MONTGOMERY CO., TX	JONES & CARTER, INC.	WASTEWATER SCREENINGS 1 MODEL U260 SPIROPRESS START UP 1997
STURGEONS FALLS WWTP	DICK ENGINEERING	GRIT CONCENTRATION & DEWATERING 1 MODEL SA260 SANDSEP START UP 1993
SUMMITT COUNTY, CO. DILLON WWTP	BLACK & VEACH	CENTRIFUGE DEWATERED SLUDGE CAKE 2 MODEL U320 SPIRAC CONVEYORS START UP 1992
STIFFELS LABS WWTP	STEARNS & WHEELER	BELT FILTER PRESS DURHAM, NY DEWATERED SLUDGE 1 MODEL U260 SPIRAC CONVEYOR START UP 1990
SQUAMISH WWTP, WA TACOMA, WA	PARAMETRIX	WASTE WATER GRIT CONCENTRATION 1 MODEL SA260 SANDSEP START UP 1996
TEMECULA VALLEY 42565 AVENIDA ALVARADO TEMECULA, CA	G.L. OWENS & ASSOCIATES	1 MODEL U260/SP215 24.5 LENGTH START UP DECEMBER 2002
TENN RIVER PULP		SCAVENGER REJECTS 2 MODEL U500 WITH PERFORATED TROUGHS START UP 1986
TROPHY CLUB, TX 1499 INDIAN CREEK DRIVE		2 U320 CONVEYORS 13', & 19' LENGTHS START UP 2003
UPPER MILL CREEK BUTLER COUNTY, OH 6055 CENTRE PARK DRIVE WEST CHESTER, OH 45069		U355/OK355 CONVEYOR SYSTEM
US GYPSUM CO 4500 ARDINE STREET SOUTH GATE, CA 90280 RICHARD FORBES 323-560-4660	SPIRAC	SA260/SS304 PULP/PAPER HEAVY REJECTS (GRIT CLASSIFIER) START UP 2001

VILLAS, NJ TWP. WWTP	WALKER, PREVITIS, HOLMES & ASSOCIATES	CENTRIFUGE DEWATERED LOWER SLUDGE CAKE 5 MODEL U320 SPIRAC CONVEYORS START UP 1996
WASHINGTON, DC BLUE PLAINS WWTP 5000 OVERLOOK WASHINGTON, DC	HAZEN & SAWYER PBS	30 CONVEYORS & PRESSES TOTAL: MODELS U355, U420, U500, U620 START UP 2006
WEYERHAUSER PAPER CO. PLYMOUTH, NC DALTON WATERS (T) 919-793-8809 (F) 919-793-7223	RUST ENGINEERING	RECYCLE MILL PULP FEEDSTOCK 2 MODEL U700 SPIRAC CONVEYORS START UP 1995
WILLOWBROOK WWTP HOUSTON, TX.		SCREENINGS DEWATERING 1 MODEL U260 SPIROPRESS START UP 1996
WINDSOR WWTP, CA.		SCREENINGS CONVEYING 1 MODEL U260 SPIRAC CONVEYOR START UP 1996
WINNIPEG (CITY OF) WWTP	GORE & STORRIE	DEWATERED SLUDGE CAKE STORAGE "LIVE BOTTOM HOPPERS" 1 MODEL U420 SPIRAC TWIN CONVEYOR START UP 1990

SPIRAC Project Number	**741**
SPIRAC Project Name	**Fountain CO HDTWRF**
Customer Specification	**14555**
Location	**Fountain CO**



INSTALLATION, OPERATION & MAINTENANCE MANUAL

2.0 IOM INDEX

2.1 INTRODUCTION

2.1.1 GENERAL

We welcome you as a user of SPIRAC conveyors. Your conveyor is a product of careful engineering and skilled workmanship. We believe you have the best conveyor possible for the service intended. With reasonable care and preventive maintenance it will give you long, efficient, trouble-free service.

This manual is furnished to acquaint you with some of the practical ways to install, operate and maintain this conveyor. Read it completely before doing any work on your unit and keep it handy for future reference.

All SPIRAC conveyors are built to convey different types of materials that may be wet, half fluid, sludgy, uneven, hygienically demanding, etc. However, every conveyor is custom built to give maximum efficiency for the specified material being conveyed. It is not acceptable to convey any product other than that noted in the Specification Sheets.

ENVIRONMENTAL CONDITIONS: The mechanics and exterior of a SPIRAC conveyor are rated for indoor or outdoor usage. The only limitations are:

Conveyed material high temperature cannot exceed 220 degree F for the Duraflo type SPX UHMW-PE liner. Conveyed material low temperature cannot exceed a.) Freezing point of material if control philosophy dictates that it is allowed to stand in the conveyor; b.) No practical limit if the control philosophy dictates that it be purged from the conveyor after each shut down (unless the amount of conveyor exposed to low temps allows material freezing while being conveyed in which case heat tape can be applied to the trough bottom.)

Limits for the gear reducer can be found within the OM manual behind tab 9 and limits for the motor can be found behind tab 10.

Any modification, change or rebuilding of the conveyor must be approved in writing by SPIRAC so that machine damage and personal injury are avoided and that documentation is relevant.

SPIRAC assumes no responsibility for injuries that result from unprofessional conduct.

In the event of any queries please contact your nearest SPIRAC representative.

2.1.2 PRODUCT IDENTIFICATION

There is one identification plate (ID) on each conveyor. *Figure 2.1.2a* shows an example of a typical ID plate.

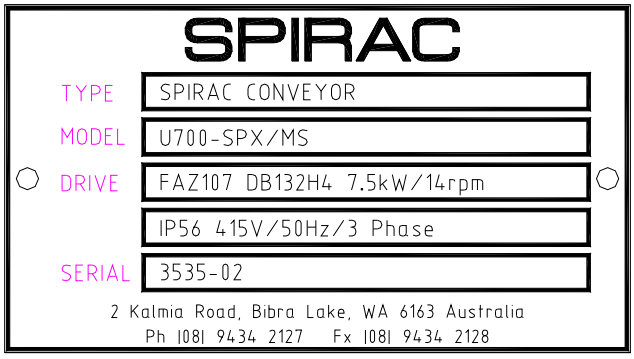


Figure 2.1.2a

Permanent records for this conveyor are kept by Serial Number and it must, therefore, be used with all correspondence and spare parts orders. The last sequence of numbers is specific to that conveyor and is utilised on orders of more than one conveyor. This sequence of numbers is also the end users equipment tag numbers.

2.1.3 STATEMENT OF OPERATION CONTROL

SPIRAC conveyors are a material handling device only. They do not process the material in any way, except in moving materials from point A to point B (or to multiple end points).

Control Philosophy

Control philosophy is a written narrative of the sequence and methodology of electrically controlling the conveyor to do the intended work. The philosophy should create safe working conditions for both the operator and the equipment. The control philosophy is dictated by the application with input from the owner or owners consulting authority and should be approved by SPIRAC. When the supplier of the controls is by others, the control philosophy can be found in an O&M supplied by them. When the supplier of the controls is SPIRAC, the control philosophy is as follows:

Conveyor Mounted Components

Some electrical conveyor mounted components may be supplied by SPIRAC, and function in concert with, or independent of a control panel. The most common conveyor mounted control components are as follows:

Emergency Stop

SPIRAC Conveyors are typically provided with an emergency stop button, switch or emergency stop mechanism with operator accessible pull-cable. When actuated, it shall immediately stop the conveyor drive system. It is generally recommended that actuation of the emergency stop also stop any mechanical device feeding the conveyor.

Loss of Rotation (optional)

SPIRAC Conveyors are often provided with a Loss of Rotation (LOR) sensing device. No operator interface is required for normal functioning, and details may be found within the Operation and Maintenance Manual provided with the equipment. Should a failure of the spiral or drive system result in conveyor stoppage, this device provides an output to disable the drive system and provide visual indication to alert operations. It is generally recommended that the LOR output also be connected to and stop any mechanical device feeding the conveyor.

2.1.4 PRODUCT DESCRIPTION

The conveyors' parts can vary in appearance due to the fact that all SPIRAC conveyors are custom built. The figures below show the principal parts of the conveyor. Drawings of each particular conveyor can be found in the drawings section, and a more detailed exploded view may be found in section 2.8 of this manual.

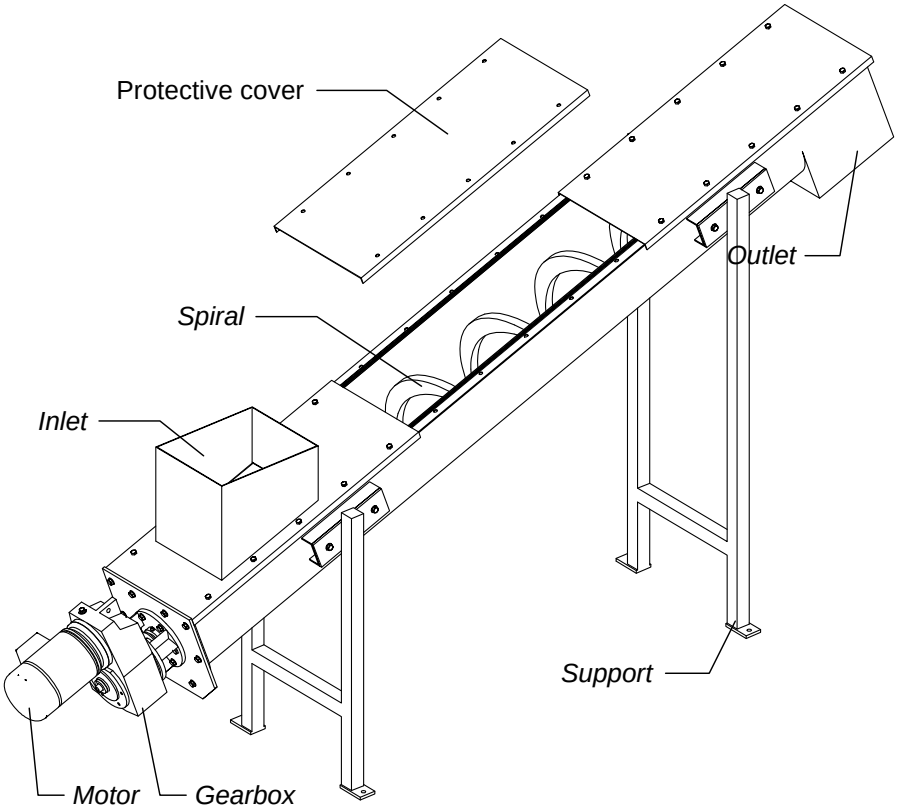


Figure 2.1.3a Principal Parts of a Horizontal or Lightly Inclined Spiral Conveyor

The material is fed in/out via one or more inlets/outlets. These can be fit with covers or knife gates if so required. The inlets/outlets can be mounted to face any direction, details of which can be found in *the drawings.*

The conveyor moves the material with a rotating steel spiral. The spiral's inclination and diameter are relevant to the material being conveyed. The steel spiral has only one bearing, at the drive end. The spiral is a helix without a centre shaft. This gives the conveyor more space for and less sensitivity to the material being conveyed.

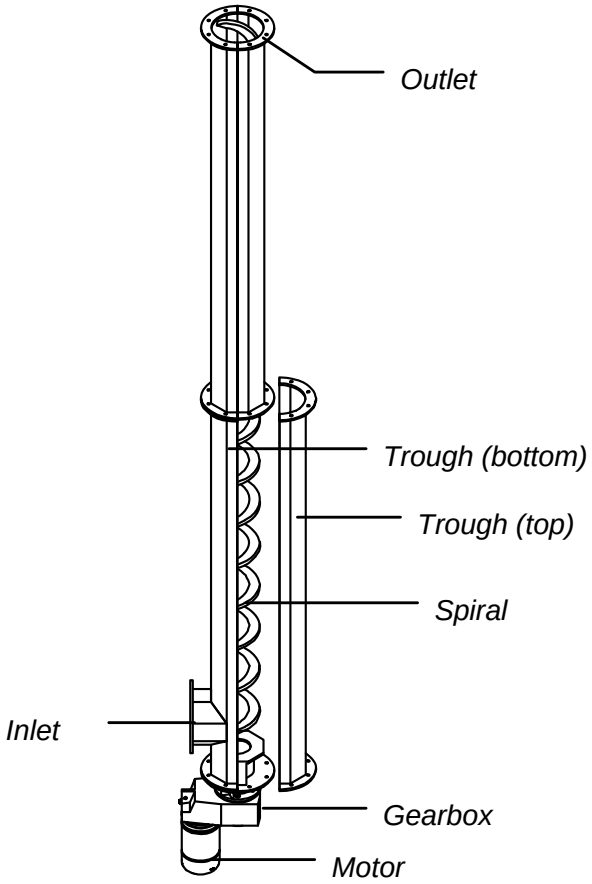


Figure 2.1.3b Principal Parts of a Steeply Inclined or Vertical Conveyor

The conveyor can either be “pushing” or “pulling”, with relation to the location of the drive. A pushing drive enables the conveyor to work best with materials that tend to snag.

Because the spiral has no centre shaft it is always in contact with the trough when it rotates. The trough is therefore protected by a replaceable liner. The liners are available in several different materials (plastic, steel, etc.) depending on the material being conveyed.

To reduce wear the conveyor should be driven as full as possible.

2.2 INSTALLATION

IMPORTANT NOTE: To prevent machine damage and personal injury, these instructions must be carried out in the order presented.

2.2.1 GENERAL

Immediately upon receipt of equipment, check conveyor(s) for shortages and damage. Prompt reporting to the carriers agent, with notations on the freight bill, will expedite satisfactory adjustment by the carrier.

> Note: Conveyors are normally shipped from the factory within open sided crates. Spirals, motors, gearboxes, and peripheral equipment may be attached to the conveyor(s) or packed separately for shipping. When packed separately, fasteners will be included.
>
> Note: For long and/or short term storage keep crate blocked and off the ground if at all possible, tarp completely and securely (with special attention to the motor and SEW) so equipment will not be exposed to rain or other weather conditions, no lubrication required during storage period.

Before attempting installation, obtain a General Arrangement (GA prefix) drawing (set) from SPIRAC. Do not attempt installation without these as a reference to proper orientation and location of equipment. Before the conveyor is installed, verify that the critical dimensions on the GA accurately reflect the field conditions. Be sure to check that inlets and outlets (including drains) to and from the conveyor, are at the proper angle and elevation to suit the conveyors inlets/outlets.

The foundation must be substantial enough to support the conveyor and absorb operational vibrations (SPIRAC recommends fabricated foundations weigh at least 5 times the weight of the conveyor). The foundation must form a permanent and rigid base for the conveyor supports in order to maintain alignment of the conveyor trough.

2.2.2 ASSEMBLING THE TROUGH

Should the conveyor troughs be delivered in multiple sections, these should be assembled first. If the trough is already assembled then continue to *Section 2.2.3.*

1. Lay out the trough sections in a straight line on a flat surface.
2. Check that the trough-sections are positioned in the correct order. The trough-ends are marked to show the order and direction in which they should be assembled.
3. Make sure that the sealing strip or gasket is placed between the trough-sections.
4. Fix the trough-sections together with the bolts, nuts and washers provided.

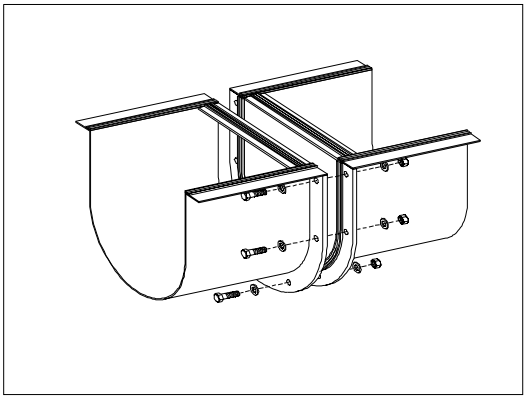


Figure 2.2.2a

IMPORTANT NOTE: To prevent machine damage and personal injury, these instructions must be carried out in the order presented.

2.2.3 CONNECTION OF SPIRALS

Should the spiral be delivered in multiple sections, they must be welded together at this time (before installing into the trough). Additionally, sometimes the spirals are delivered longer than required and must be cut to the length specified in the drawing. Should this be necessary, the spiral should be cut at right angles to its axis. After this the edges should be ground and angles cut where needed. If the spiral does not need welding or cutting go on to *Section 2.2.4.* If welding is required, please follow the guidance found in *Section 2.8* before proceeding.

2.2.4 MOUNTING THE DRIVE ASSEMBLY

Should the drive assembly require attachment, it is delivered fully lubricated and ready to be attached. If the conveyor is to work in a raised position it is better to mount the drive unit with the conveyor on the ground. **Note: If a motor adaptor is received separately from the gearbox, sealant is required to be applied to both sides of gasket between gearbox and adaptor for the motor.**

1. Remove the transport lock from the spirals' drive shaft.
2. Remove the tape holding the key to the drive shaft.
3. If the drive shaft is not stainless steel it is treated with rust inhibitor. Use degreaser to remove this, thoroughly cleaning the shaft surface.
4. Lightly lubricate, then wipe the shaft with a clean dry cloth.
5. If the motor is already installed onto the gearbox, remove the cover from the motors cooling fan so that the drive shaft can be turned using the fan.
6. Turn the drive shaft so that the key-way comes to the right position for the spirals' drive shaft and then gently drive the gearbox onto the drive shaft.
7. Bolt the gearbox to the bell housing flange with the bolts, nuts and washers provided.

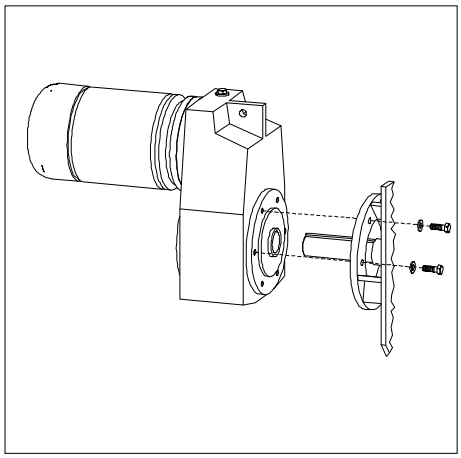


Figure 2.2.4a Mounting the Drive Assembly

NOTE: There are no "extra" or "blind" holes on the Drive Plate or bell housing.

IMPORTANT NOTE: To prevent machine damage and personal injury, these instructions must be carried out in the order presented.

8. Fasten the locking bolt, spring washer and stepped spacer to the spirals drive shaft in order to fasten this in the gearboxes drive bore (Fig 2.2.4b). When the spiral's drive shaft is firmly positioned in the drive bore the locking bolt should be sufficiently tightened.

   NOTE: The spiral must be pushed back towards the drive so that the locking bolt can be threaded into the drive shaft.

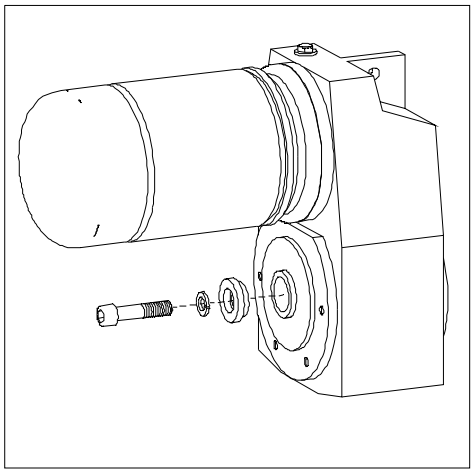


Figure 2.2.4b - Fastening the Driveshaft

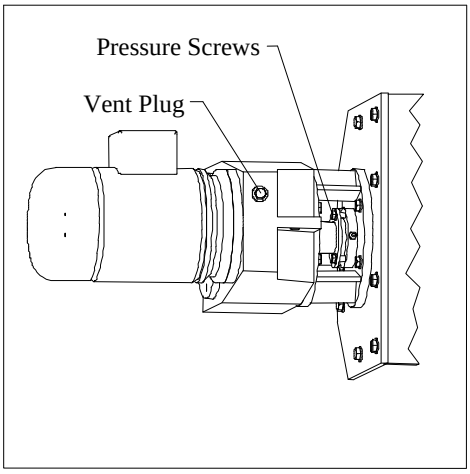


Figure 2.2.4c-Tightening the Pressure Screws

9. Tighten the pressure screws until the gap between the packing box and the gland is only about 7mm wide. Tighten the screws alternately and check the gap is even after the screws are tightened (see Fig 2.2.4c).
10. Fill the packing box with grease (see Sect. 2.4.3).
11. Replace the cooling fan cover to the motor.
12. Ensure that the top-most screw on the gearbox has been used for attachment of the vent plug. If not, make the necessary corrections before proceeding. The vent is shipped with a rubber O ring to prevent oil leakage. REMOVE the vent O ring and discard it. The vent will not operate correctly with it on and may result in seal leakage.
13. Although typically filled at the factory, check level of oil in the gearbox (see gear reducer section for proper details).

2.2.5 TYPICAL ANCILLIARY EQUIPMENT

A. Loss of Rotation Sensor

When required, a probe may be mounted on the lid of the conveyor, at a point furthest from the drive end. In the event that four pre-drilled holes have not been provided, the base of the LOR may be used as a template.

NOTE: The four mounting holes are the only penetrations required. The typical probe senses magnetically, and is unaffected by the stainless steel lid. NO HOLE IS REQUIRED FOR THE PROBE TO "SEE" THROUGH THE LID.

B. Emergency Stop

Should one or more Emergency Stop Switches be required, a mounting plate is provided on one of the support legs. Additionally, provisions have been made for the installation of stainless steel eyebolts at each support along the length of the conveyor. As a general rule, eyebolts guiding the cable are 3/8", and the final eyebolt at the end of the cable's run is a larger ½".

2.2.6 CONNECTION TO SUPPORT STRUCTURE

All conveyors are fitted with support brackets welded to each side of the conveyor trough. These brackets are pre-slotted and positioned in the factory prior to shipment.

NOTE - If the conveyor requires mounting of knife-gates, or other ancilliary equipment, do this before the conveyor is raised to an "over-head" position.

When installing the conveyor:

1. Do not stand beneath the trough while it is being lifted or mounted.
2. Lift and fully support the conveyor into it's operating position, then fasten the supports to the support brackets (numbered for identification) using the hardware provided.
3. Anchor the conveyor to the floor to withstand any working loads.

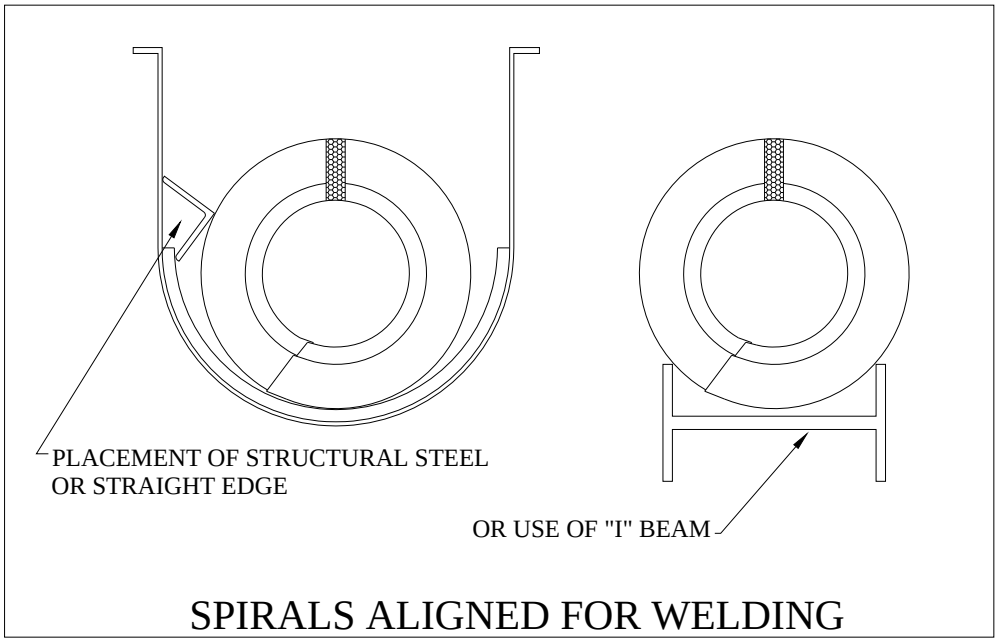
2.2.7 ELECTRICAL

Conveyor component manufacturers generally do not provide electrical equipment to control the conveyors. In the event that the purchased conveyor includes a Control Panel, Control Station(s), or other eletrical devices, refer to the specific section of the Operation and Maintenance Manual for their safe and proper installation and use.

2.2.8 WELDING

For all welding operations, and especially when welding stainless or special alloy steels, it is imperative that only qualified personnel using appropriate materials and equipment are utilized. This equipment consists of moving parts under great loads. Poorly assembled or welded components increase the risk of personal injury and premature wear or failure of components.

- Unbolt the protective cover from the trough.
- Lay the spiral-sections in line with each other in the trough. The ends of the spiral sections are marked with numbers to show the order in which they should be assembled.
- Grind the surfaces to prepare for a symmetrical, full penetration, x-weld.
- Make sure that the part of the spiral to be welded is facing upward. If welding is done against the bottom of the trough, the liner will be damaged.
- Suitable protection must be provided for the liner and 'U' trough in the welding vicinity to prevent splatter or burning eg: with a fire resistant blanket.
- Centre the spiral sections in the trough using heavy wooden blocks or steel profiles. Check eg: with a tri-square, that the spiral sections are in line before they are welded together. If the spiral is welded outside the trough, a structural "I" beam provides an ideal welding surface/jig.

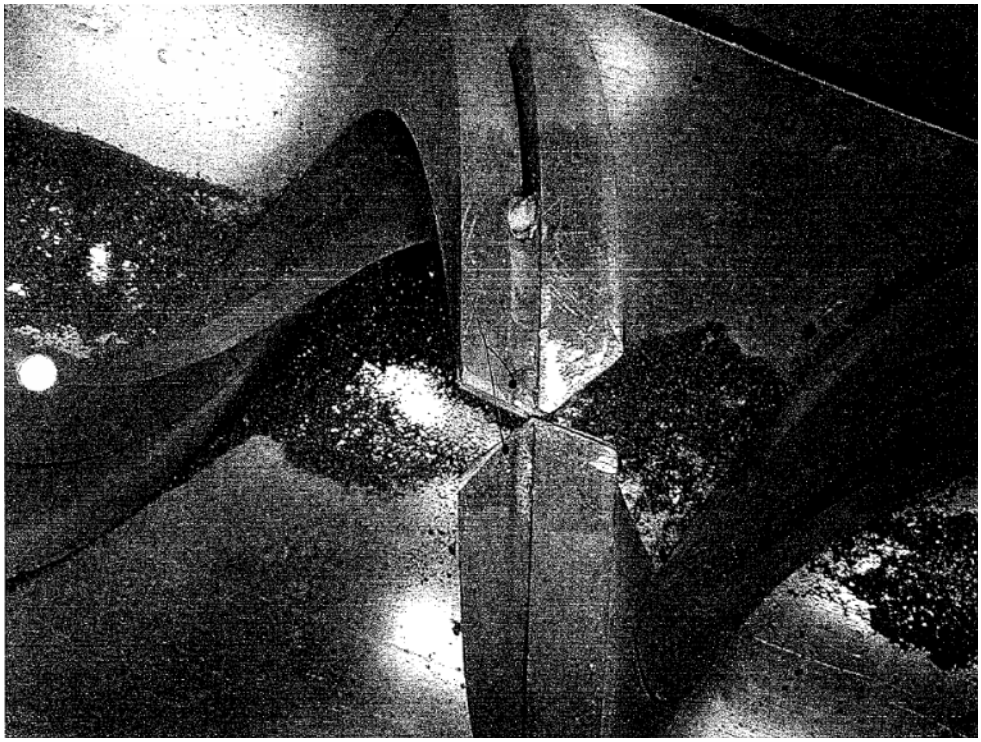


SPIRALS ALIGNED FOR WELDING

2.2.8 WELDING (cont'd)

- Alternate welds on the two sides of the joint.
- Grind the weld *carefully* to remove all sharp edges and unevenness.
- Prime the finished surface or passivate if the spiral is stainless steel.
- Replace the trough's protective cover.

ELECTRODE TYPES	
7018	For spirals of HTMAS Special Steel (the electrode dimension should be at least 2mm to avoid overheating).
308 L16	For stainless steel.
316 L16	For acid resistant stainless steel to mild steel (or to HTMAS).
309 L	For stainless to mild steel (or to HTMAS).



2.3 OPERATION

2.3.0 OPERATION – NORMAL

Normal operation of the SPIRAC conveyor or conveyor system shall be either manual or automatic depending on the control philosophy of the supplier of the conveyor controls. Operators shall refer to the controls section and written plant procedures specific to their application for daily operational tasks.

Only persons completely familiar with the safety aspects (as detailed in *Sect. 7.0*) should be permitted to operate the conveyor. The operator should thoroughly understand these instructions before attempting to use the conveyor. Failure to follow these precautions may result in serious personal injury or damage to equipment.

Normal operations shall commence after all pre-commissioning checks have been performed by a SPIRAC Technician or personnel authorized by SPIRAC. In some cases by contractual option an owner may elect to assume this responsibility.

2.3.1 PRECOMMISSIONING CHECKS – INITIAL START UP

Before the initial start-up of the conveyor, make the following inspections ;

1. Check to make sure the gearbox is securely fastened to the conveyor drive plate.
2. Check the gearbox to insure the vent plug is located in the top surface of the gearbox. The vent is shipped with a rubber O ring to prevent oil leakage. REMOVE the vent O ring and discard it. The vent will not operate correctly with it on and may result in seal leakage.
3. Check all connections to the motor and starting device with the wiring diagram. Check the voltage, phase and frequency on motor nameplate.

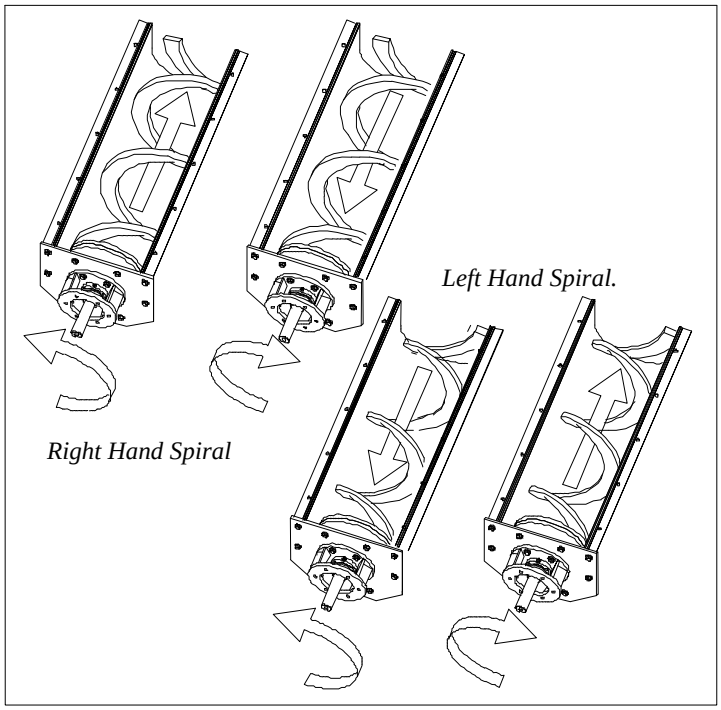


Figure 2.3.1a - Direction of Rotation

3. Remove motor cooling fan cowling and rotate spiral via fan to ensure that it rotates freely. At the same time check spiral rotation and that material will flow towards outlet.
4. Check gland packing box adjustment, lubrication and piping (if supplied).
5. Check gearbox lubrication level.
6. Make sure all covers, guards and safety equipment are properly installed.

2.3.2 CHECK-LIST – INITIAL OPERATION

The following should be used upon initial start-up and after extended shut-down periods.

1. Operate conveyor empty for 1-2 hours, making a continuous check for heating of gearbox bearings and noisy operation.
2. Check that the discharge of the conveyor is clear before feeding any material.
3. Increase feed rate gradually until rated capacity is attained.
4. Stop and start conveyor several times, and allow to operate for several hours.
5. Shut off conveyor and lock out power supply. Remove covers and check coupling bolts for tightness.
6. Replace covers.
7. Ensure material is “flowing” in the correct direction. (correct motor rotation)
8. Make certain that the conveyor controls (e.g. motion sensor, knife gates) are interlocked correctly and functional.

2.3.3 SHUT-DOWN - NORMAL OR EXTENDED

If the conveyor is to be inoperative for any period of time, it is advisable to permit it to operate for a period of time after the feed has been cut-off in order to discharge as much material as possible from the trough. The trough should be cleaned completely after the conveyor is shut down and the power locked out.

Conveyors that are shut down during freezing conditions should be protected by one of the following methods ;

- Empty the trough completely.
- Insulate the conveyor to prevent the material from freezing.

2.3.4 SHUT DOWN – EMERGENCY, INSTRUCTIONS

Provided on conveyors are two possible *automatic* shut down faults.

- Motor overload
- Underspeed (or loss of rotation sensor) on spiral

If one or both of these devises faults the controls should immediately shut down the conveyor and the operator should check the faulted devise and the conveyor for obstructions or other problems. There is additional troubleshooting information in section six of this manual.

Additionally, provided on conveyors are *manual* emergency stops (or e stops). Should the operator see an obstruction or otherwise dangerous situation, he can immediately shut down the conveyor using the manual emergency stop. There is more information on this safety devise in section 10 of this manual if it applies to your particular conveyor.

If the conveyor is to be inoperative for any period of time the trough should be cleaned completely after the conveyor is shut down and the power locked out. Conveyors that are shut down during freezing conditions should be protected by one of the following methods:

1. Empty the trough completely.
2. Insulate the conveyor to prevent the materials from freezing.

2.4 MAINTENANCE

2.4.1 GENERAL

Generally it is necessary to establish routine periodic inspections of the entire conveyor to ensure continuous maximum operating performance. Practice good house keeping. Keep the area around the conveyor and drive assembly clean and free of obstacles to provide easy access and to avoid interference with the function of the conveyor or drive.

Always –

1. Follow your companies established procedures for isolation of equipment.

Or-

2. Lock-out power to motor before doing any maintenance work preferably with a padlock on control panel or isolator.
3. Do not remove padlock from control, nor operate conveyor, until covers and guards are securely in place.

2.4.2 PACKING GLAND ADJUSTMENT

Packing gland bolts should be evenly adjusted so they are little more than finger tight. Over tightening of the packing gland may result in premature packing failure and possible damage to the shaft and gland.

When packing is new, frequent minor adjustments during the first few hours (if material being conveyed is very fluid) of operation are recommended in order to compress and seal the packing.

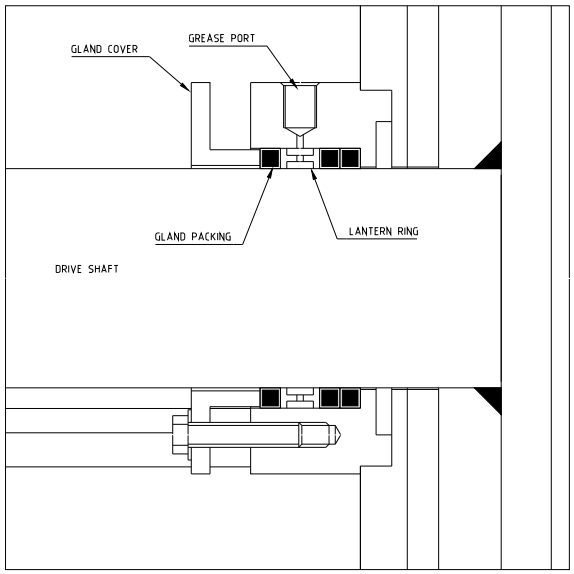


Figure 2.4.2a - Packing Box Arrangement

2.4.3 LUBRICATION

Please refer to the Lubrication Check Sheets located in the Drive System Section, for the reducer requirements. For grease to the labyrinth seal and gland see table 2.4.5.

2.4.4 SURFACE COATING

This section describes how the conveyors surfaces should be treated, if made of stainless steel or not.

Operation in sewage treatment plant or damp environments exposes the conveyor to air that may contain chemically or biologically corrosive particles. In these cases painted, galvanised and stainless steel surfaces can be damaged. It is therefore important that personnel follow the operating instructions and remedy any corrosion or damage to coatings as soon as they occur.

Standard Procedure for Surface Repair

- *Painted*

  In the standard manufacturing procedure the conveyors trough and protective cover are sandblasted to Class 2-½ as per AS1627.4 and then prime coated with a two component red oxide zinc phosphate epoxy polyamide to give a dry film thickness (DFT) of no less than 75µm. The final coat shall be a two component epoxy polyamide to give a DFT of no less than 175µm. The coating shall be sufficiently cured for re-coating within 24 hours at 25°C.

  Final colour to be Blue Grey N53 (or as specified by client) as shown in AS2700.

  To ensure long equipment life it is important that the coated surfaces are maintained to prevent rust that can cause serious damage in a short space of time.

  Rust may be ground back to bare metal and the surface carefully cleaned before it is covered by the above or an equivalent rust protective coating.

- *Hot Dip Galvanised.*

  The only component on a SPIRAC conveyor regularly HDG is the bell housing. It is HDG to AS1650 and AS1214. In special cases as required by the client other components may be HDG.

  Rust may be ground back to bare metal and the surface carefully cleaned before application of a suitable “Cold Galvanising” agent.

- *Stainless Steel.*

  The grades used are usually 304, 304L, 316, 316L or 316SS. These materials do not need any special treatment but the following should be observed.

  Grinding or welding carbon steel in close vicinity of the conveyor must be avoided. Showering sparks onto the stainless steel can cause a rust brown discolouration.

  All stainless steel surfaces must be handled so that the corrosive resistance is not impaired. As a minimum the stainless steel should not come into contact with steel of other qualities during transportation or assembly. Wood, cloth or plastic should be used to pad the stainless steel when lifting or transporting the conveyor.

  The heat input during welding leads to the formation of chromium oxides on the steel surface. The underlying material is depleted of chromium, increasing the risk for corrosion. Passivating removes the oxides, scale and slag. The surface is cleaned to bare metal and a thin protective layer, or “passive” layer, is built up. This restore optimal corrosion resistance and ensures that the weld will have the longest possible life.

2.4.5 MAINTENANCE TIME TABLE

Times shown are PER CONVEYOR to perform task and **ONE PERSON** would be required for each task.

PREVENTIVE MAINTENANCE	
PERIOD	**ACTIVITY**
Daily**	Stop conveyor system, and LOCK OUT – TAG OUT power. Open the inspection LID at the top near the drive end and check for "ragging" of screenings around the spiral and coupling disc. Remove any screenings ragged or compacted here. If the ragging appears to be severe enough on a consistent basis the frequency of checks may need adjustment to suit. Additionally, frequency should be considered according to plant flow peaks during/after storm events. (.50-1.0 hrs - Operator)
Weekly	Check bell housing packing box temperature with a thermometer, not by hand. If over 140 degrees F it may be due to lack of grease. Add grease if required. (.25 hrs- Millwright)
	Check conveyor for any unusual vibration or noise. Locate and rectify. (.25 hrs - Millwright)
Monthly	Clean the conveyor inside and out w/brush & water only. This is usual if the conveyor has been standing idle for long periods. (1.0-4.0 hrs - Operator) Do not hose down motors. See drive/motor section for cleaning instruction.
	Check liner for wear. If yellow backing is showing through replace damaged section.(.5 hr Operator)
	Check gland packing box. Adjust if necessary. (.25-0.5 hr - Millwright)
	Check the spiral for any excessive wear or unusual damage. A maximum of 20% of the spirals original dimension can be worn away before it requires replacement. If the spiral is extremely long (>15m) it should be replaced before this level is reached. (1.0-4.0 hr- Millwright)
Half Yearly	Check all fasteners (supports, trough connections etc.). (2.0-4.0 hrs - Millwright)
	Check all trough welds. (1.0-4.0 hrs - Millwright)
	Check the oil level in the gearbox and its color. If the oil is heavily emulsified (cream-like) there is water in the oil. Rectify and replace. (0.25-0.5 hrs - Millwright)
	Check the control system, ie emergency stops, sequential control etc. (0.25-0.5 hr- Mr. Sparky)

This applies ONLY to **PULLING drives in a SCREENINGS application. Daily frequency may be modified to reflect experience or flowrates. Alternately plant mgmt may require this duty to be performed by operators.

IMPORTANT WARRANTY CLAIM INFORMATION

Some customer product may qualify the liner and/or spiral for an extended wear warranty at time of sale.

The following checks, outlined in Table W3M and recommended for all installations, are a required part of any extended coverage. Checks must be performed, documented, and reported as shown, and do NOT take the place of, but are IN ADDITION TO those checks outlined above.

Definitions:

LINER EXCESSIVE WEAR: The appearance of the bottom indicator layer (second color) along more than 30% of the conveyor length during the first three years of service.

SPIRAL EXCESSIVE WEAR: Loss of more than 50% of the height of the main outer spiral section over 30% of the total length of the spiral.

TABLE W3M: WARRANTY MAINTENANCE – EVERY 12 MONTHS	
ITEM	**DESCRIPTION**
1 – Liner	Measure and record any visible liner wear indicator (second color – bottom layer of liner) at all points along the conveyor length. (Time required varies depending on conveyor length.)
	Calculate percent of wear indicated (distance of wear indicated / conveyor length = percent wear). Liner wear % = < 30% of conveyor total length within 3 years is acceptable. At first sign of the wear indicator layer - spare liner material should be purchased for future replacement.
2 - Spiral	Visually check the Spiral for overall operation and condition.
	Measure and record the spiral diameter intermittent points along the conveyor length.
	Check your G.A. drawings within this O&M to obtain the original outer spiral dimension. (The outer spiral height should be the third number in the spiral numbering system. example - if your spiral is 280/330- 60x25+30x12, then your outer spiral is 60mm high. Calculate percent of *spiral height wear* by (original outer ht – measured ht = differential ht, then differential ht / original ht = percent ht wear). To calculate *spiral length wear* (distance of excessive spiral wear indicated / conveyor length = percent excessive spiral wear). Spiral screw excessive wear = < more than 50% of the height of the main outer screw section and = < 30% of the total length of the screw is acceptable. At first sign of excessive spiral wear: spirals should be purchased for future replacement.

2.4.6 MAINTENANCE TOOLS/EQUIPMENT/CLEANING:

Special tools are *not* required for SPIRAC maintenance, however the following are available:

A. Spiral lifting tool
B. Liner Removal tool

Cleaning Agent: Water only.

2.4.7 LUBRICANT CHECK SHEET

Part to be lubricated:	**GEARBOX**
Recommended lubricant	Mobil 600XP220, Shell 220, Texaco MEROPA 220,Exxon EP220, Tribol 1100 ISO220
Oil Volume	Ref. Tech Data in Tab 9 (dependant on Mounting position)
Change Frequency	10,000 hrs or 2 yrs whichever comes first
One Year Supply	Refer to SEW data in Tab 9
Part to be lubricated (see figure 5.1b in this manual):	**Bell Housing Gland Packing – Klinger K25**
Recommended lubricant	Mobilux EP2 Multi Purpose Extreme Pressure, Shell Alvania EP2, Beacon EP2, Sunaplex 992EP, Multifak EP
Filling Method	Grease gun
Recommended Frequency of service	Every six months
One Year Supply	1 canister of Lubriplate 930AA**

**SPIRAC suggests this product, however, loose equivalents are Unirex EP2, Perlube EP2, Premium Lith EP2, Mobillith AW2, Shell Alvania EP2

2.5 SERVICE

2.5.1 REPLACING THE GLAND PACKING

1. Empty conveyor of all material.
   Unscrew the gland cover screws and slide the cover back along the drive shaft.

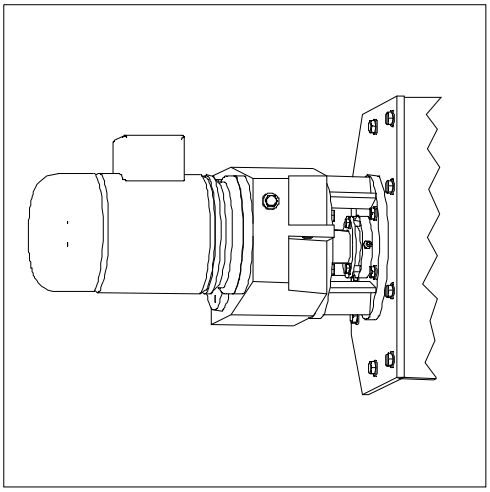


Figure 2.5.1a - Gland Cover Screws

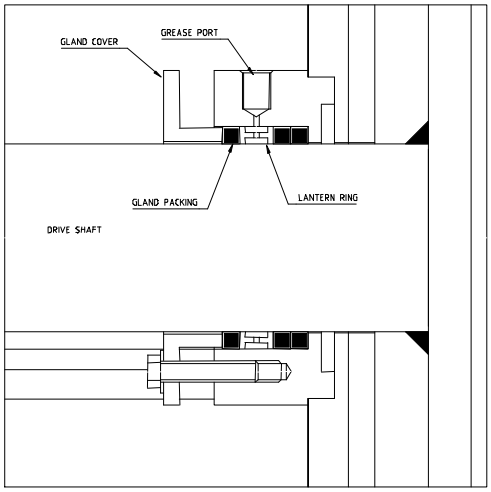


Figure 2.5.1b - Packing Box Assembly

2. Remove the packing and clean the packing box seats.
3. Cut the new packing with an angle (45 Degrees). Put tape around the packing before it is cut to prevent the ends from fraying.
4. Push the new packing into the packing box seat cut ends first.
5. Repeat this process for the other packs. Check that each is in place before the next is put in. The packs should be rotated by 90^{o} to each other so that the joins are in different places.
6. Replace the gland cover and tighten the screws so that the packing is properly formed in the packing box seats.
7. Lubricate as per the Maintenance time table 2.4.5.
8. Test run the conveyor with material and make adjustments as necessary to seal the packing and minimize leakage.

2.5.2 REPLACING THE LINERS

Depending on what is to be conveyed the conveyor can be lined with different materials. There are three different types of liners -

- Plastic or UHMW Polyethylene
- Steel Bar or Steel Bar on Plate
- Steel Plate

Technical data concerning the liners steel and plastic qualities is specified on the drawings.

Liners can often be replaced without the spiral being totally removed. However servicing is easier without the spiral in the trough.

Replacing the Plastic Liner -

The new plastic liners are either delivered ready shaped or flat. The shaped liners should not be removed from their packaging until immediately before they are to be fitted. Once the liner has been removed from its packaging it takes only one hour for it to become flat and needs reshaping.

1. Empty the conveyor of material. Unfasten the lid and remove or push back from the trough (see Fig 2.5.2a)..
2. Unfasten the nuts on the coupling disc bolts holding the spiral to the coupling disc.
3. Remove the spiral from the trough or lift it to increase accessibility (see Fig 2.5.2b).

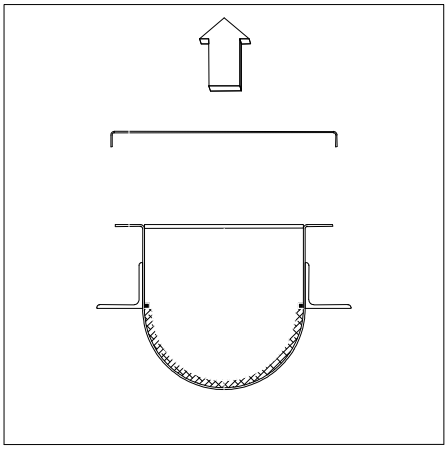


Figure 2.5.2a - Taking off the Cover

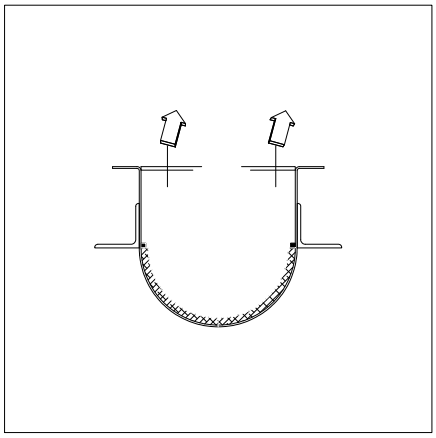


Figure 2.5.2b - Lifting the Spiral

4. Insert a heavy duty screw driver or lever down between the trough and the plastic liner so that it releases from its steel block retainers (see fig 2.5.2c).
5. Take hold of the liner and pull it out (see fig 2.5.2d).

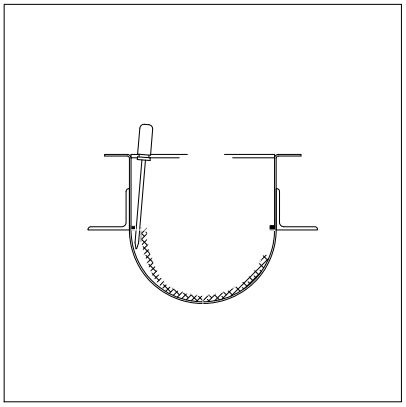


Figure 2.5.2c - Levering Out the Liner

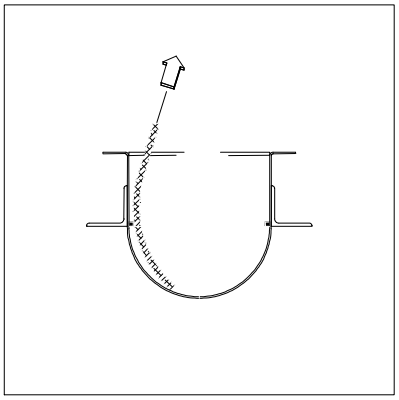


Figure 2.5.2d - Pulling Out the Liner

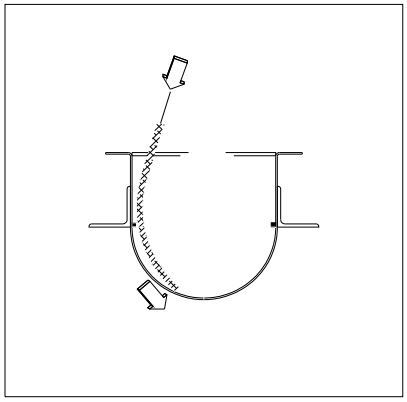


Figure 2.5.2e

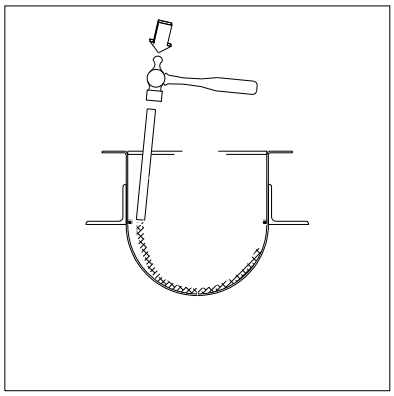


Figure 2.5.2f

6. Push the new liner under the spiral, making sure the wear indicator strip is at the bottom. It is important to secure the liner under the retainer blocks on each side of the trough (Figure 2.5.2e & 2.5.2f).
7. Replace the bolts holding the spiral to the coupling disc.
8. Replace the lid to the trough (Figure 2.5.2g).

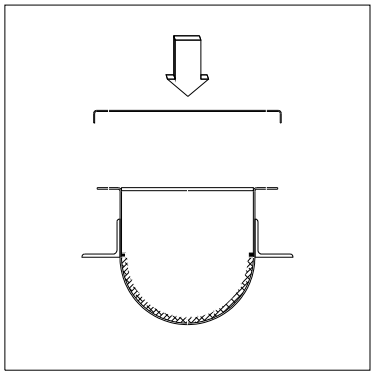


Figure 2.5.2g Replacing the Liner

Replacing the Steel Bar, Bar on Plate, and Steel Plate Liner -

This section describes the replacement of both steel bar and steel plate liners. Should the installation be “steel bar on plate”, replacement follows the “steel plate” steps.

The majority of the steps are common to both procedures. Where the steps differ, this is noted in the text. This procedure requires welding. See *Section 2.2.8* “Welding” before commencing to weld.

1. Unfasten the lid and remove or push back from the trough.
2. Unfasten the nuts on the coupling disc bolts holding the spiral to the coupling disc.
3. Remove the spiral from the trough or lift it to increase accessibility(fig 2.5.2h).

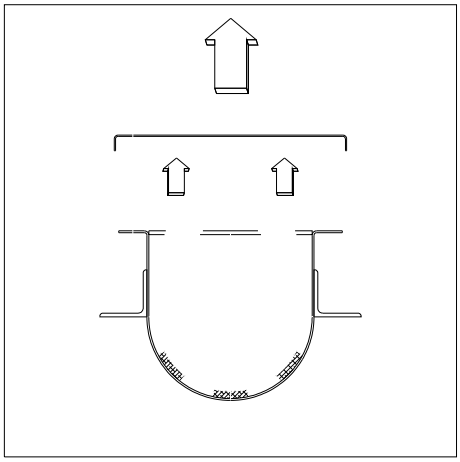


Figure 2.5.2h - Taking off the Cover, Removing the Spiral

4. Use a grinder to grind away the welds from both sides of the steel bars and remove the bars from the trough.

Note – For Plate, there are welds only along the top edges on (typc) 16" centers.

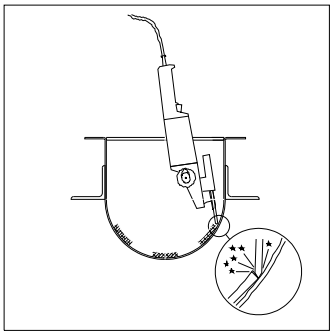


Figure 2.5.2j

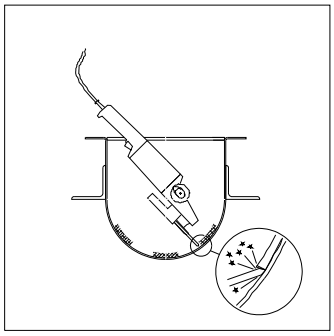


Figure 2.5.2k

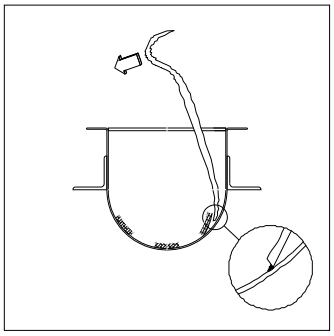


Figure 2.5.2l

5. Grind clean the surfaces where the steel bars or plate were positioned.
6. Degrease the surfaces (with acetone or a similar solvent) to prepare for the new steel bars or plate.
7. Take a new steel bar and fasten it in the position of the old one.

Note: - For Plate, install the preformed plate (or bar on plate), centered within the shape of the trough, and skip to the note on step 9.

8. Check that the bars are all in line.
9. Put welds (Z20/500) along the length of the bar. The welds should alternate from the left to the right hand side of the bar. Make sure the ends of the bars are welded to the trough (fig 2.5.2m).

Note: The welds for the steel plate liner should be placed opposite each other along the length of the trough on (typ) 16" centers.

10. Repeat this procedure for the other steel bar liners.
11. Replace the spiral to the trough and fasten it to the coupling disc.
12. Replace the protective cover to the trough (fig. 2.5.2n).

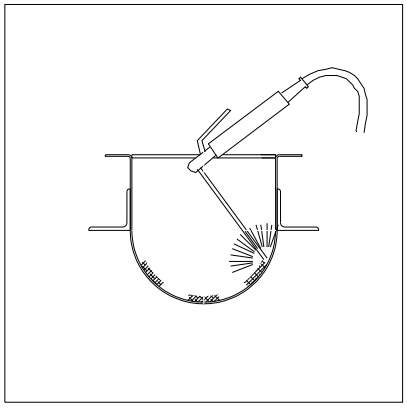


Figure 2.5.2m

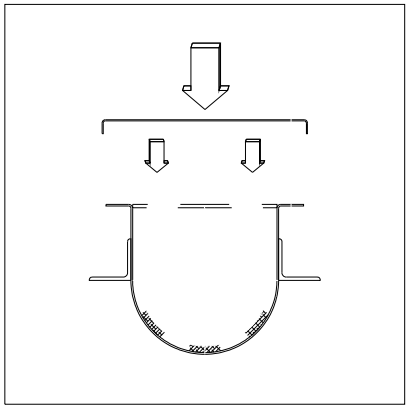


Figure 2.5.2n

2.5.3 REPLACING THE SPIRAL

There should be no welded joints in the spiral closer than 4 spiral-turns to the spirals coupling disc.

1. Undo the bolts holding the protective cover and remove it from the trough.
2. Check the new spiral has the dimensions given on the drawing and check against the existing spiral.
3. Un-bolt the spirals coupling disc from the drive shafts coupling disc.

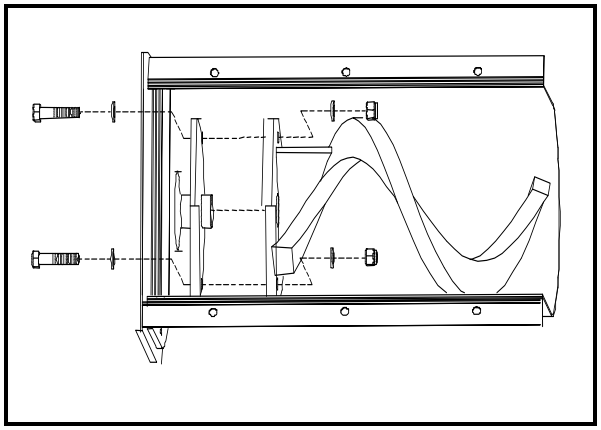


Figure 2.5.3a - Removing the Spiral

4. Lift the spiral from the trough. Depending on the local facilities the spiral can be removed in several ways. The spiral can be either lifted, pushed out through the troughs opening or cut into sections etc.
5. Place the new spiral in the trough. If the new spiral has been shipped in pcs for ease of shipping, crating, and installation refer to 2.2.3 & 2.2.8 for instructions on welding the spiral together.
6. Fasten the coupling discs together (use new locking nuts each time).
7. Replace the protective cover to the trough.

2.5.4REPLACING THE DRIVE SHAFT

1. Undo the bolts holding the protective cover and remove it from the trough.
2. Un-bolt the spirals coupling disc from the drive shafts coupling disc.
3. Remove the spiral from the trough or move it forward enough so that the drive shaft can be removed via the trough.
4. Unscrew the locking bolt, spring washer and stepped spacer from the drive shaft, located at the rear of the gearbox (see fig. 2.5.4a).
5. Remove the gland cover screws from the packing box (see Fig 2.5.4b).

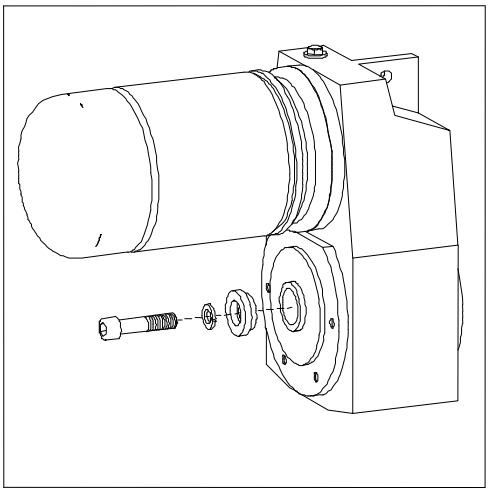


Figure 2.5.4a - Remove the Locking Bolt, Spring Washer and Stepped Spacer

6. Use an extractor tool to push the drive shaft into the trough. Remove the key from the gearbox keyway before the drive shaft goes through the packing box.

   Attn - The end of the drive shaft must be protected so that the threads are not damaged. A screw can be threaded into the end of the shaft before this is placed under pressure

7. Remove the old drive shaft from the trough and lift in the new one .

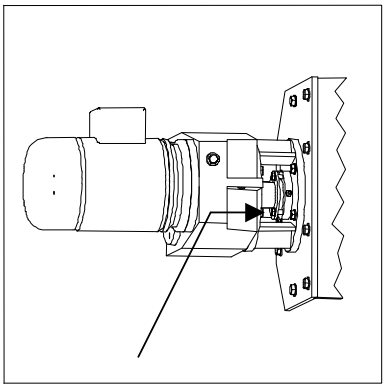


Figure 2.5.4b - Gland Cover Screws

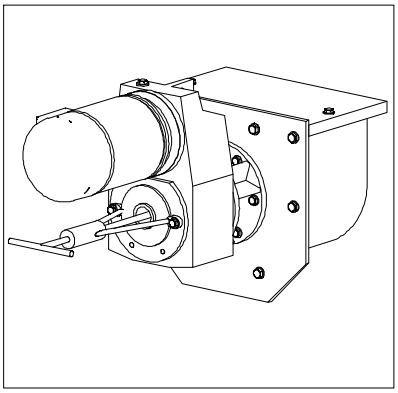


Figure 2.5.4c - Using an Extractor Tool

REPLACING THE DRIVE SHAFT cont…..

8. Turn the gearbox hollow shaft so that the key way is in the correct position in relation to the spirals drive shaft. Push the new drive shaft in so that it takes the place of the old shaft. Place the key in the key way before the drive shaft goes into the gearboxes hollow shaft.
9. Screw the locking bolt, spring washer and stepped spacer into the new drive shaft.

Attn - The spiral must be pushed towards the drive end in order for the locking bolt to thread into the drive shaft.

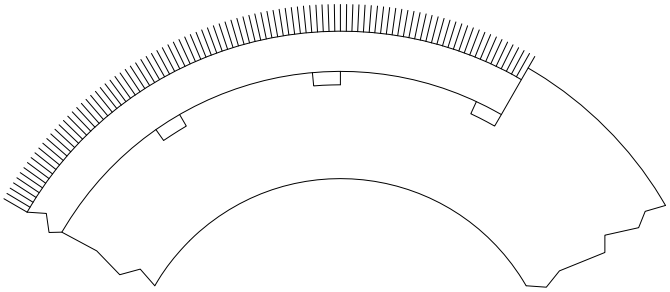
10. Tighten the gland cover screws so that only a 7mm (approx) gap remains between the packing box seat and the gland. Tighten the screws alternately and check the remaining gap after each turn.
11. Fasten the coupling discs together (use locking nuts).
12. Replace the protective cover to the trough.
13. Lubricate packing box as per Lubrication Check Sheet.
14. Test run conveyor with material and make adjustments as necessary to seal the packing and minimize leakage.

2.5.5 REPLACING THE SPIRAL BRUSH

This section applies only when brush is installed onto a spiral over a drain section or across a perforated portion of a trough. This procedure involves welding. See section 2.2.8 "Welding instructions" before commencing to weld.

Remove the spiral from the trough or adequately protect the liner. See section 2.5.3 “Replacing the Spiral”..

- Grind away the welds holding the spiral brush.
- Remove the old spiral brush.
- Form the new spiral brush around the spiral. The new brush should stick out from the spiral by about 5 mm.



Mounting the spiral brush.

- Weld the new spiral brush to the same side as the previous brush.

2.5.6 GENERAL CORRECTIVE MAINTENANCE

Between regular maintenance inspections, be alert for signs of motor or Conveyor trouble. Common symptoms are listed below. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUTDOWN.

Troubleshooting shall be done with the power supply disconnected and locked off, except for those checks which cannot be performed without voltage.

Always make sure there is no one near the conveyor when the power supply is turned on. Use the following table as an aid to troubleshooting. It is assumed the conveyor and installation have formerly functioned satisfactorily.

2.5.7 TROUBLESHOOTING CHART

E: Electrician M: Millwright or Mechanic O: Operator

PROBLEM	CAUSE	REMEDY/MIN. HRS*
Conveyor Fails to Start	Blown Fuse	**E:**Determine and correct cause of failure and replace fuse, .5 hrs
	Motor protection device activated	**E:**Reset protective device. Identify and correct cause for failure, .2 hrs
	Motor protection device faulty or will not reset	**E:**Check protection device for faults, .5 hrs
	Motor not connected for proper voltage	**E:**Check connection diagram in conduit box cover and correct the wiring., 1hr
Conveyor starts but motor protection device trips immediately	Spiral jam from foreign object entering trough.	**M:**Remove object and restart, 1 hr +
	Gearbox seizure due to no oil	**M:** Remove gearbox and service, 8 hrs
	Settings on motor protection incorrect	**E:** Check and re-set, .5 hr
	Motor improperly connected	**E:** Check connection diagram in conduit box cover and correct the wiring, 1hr
Excessive vibration	Loose drive station	**M:** Check and re-tighten fixing bolts, .5 hr
	Unstable ground conditions	**M:** Rectify, 1 hr
	Loose support/trough connections	**M:** Check and re-tighten, .5 hr
Conveyor output is too low	Worn spiral screw	**M:** Replace spiral, 16 hrs
	Material being conveyed is not as originally specified	**O:** Contact SPIRAC, unknown

TROUBLESHOOTING CHART cont. . . . . .

PROBLEM	CAUSE	REMEDY
Motor overheats	Motor not connected for proper supply voltage	**E:** Check connection diagram on conduit box cover and correct wiring, 1 hr
	Insufficient cooling air volume due to obstructed air flow	**E:** Provide clearance around fan area, 1 hr
	Motor allowable duty cycle is exceeded. Too many starts per hour	**E:** The problem may not be solved by a larger unit. Review with manufacturer, 4 hrs
	Single phasing due to break or loose connection in supply line or blown fuse	**E:** Repair supply line. Replace fuse, 4 hrs
Spiral screw jamming	Excess material causing spiral to rise and interfering with lids/cross bars	**M:** Reduce material inflow. Replace worn anti-lift bars where installed, 2 hrs
	Foreign object in conveyor	**M:** Remove object, 1 hr
	Liner has come loose and wedged itself inside the spiral	**M:** Remove and replace liner, 2 hrs
	Incorrect alignment of screw when welding causing eccentric rotation	**M:** Confirm and replace/re-weld, 5 hrs
Conveyor runs in wrong direction	Electrical cable leads wired incorrectly	**E:** Reconnect two phase wires, .5 hr

- **NOTE: HOURS ESTIMATED ARE MINIMUMS. UNKNOWN SITE AND APPLICATION VARIABLES PROHIBIT ESTIMATING MAXIMUM HOURS.**

2.6 SAFETY

2.6.1 GENERAL

The following instructions should always be observed when handling or working with the conveyor -

1. Always isolate the conveyor main power source and ensure that the conveyor cannot be started before commencing any servicing work.
2. Take care to avoid compression injuries when removing or replacing the spiral. Note that the spiral can slide out of the trough when the conveyor is inclined.
3. Never put arms, legs or any loose objects into the conveyor if the main power source has not been isolated and/or locked off.
4. The protective cover should not be removed while the conveyor is in operation.
5. Make sure that no one is working on the conveyor before it is started.
6. Personnel working frequently in these areas where conveyors have remote control or automatic start/stop, must be informed of the operation.
7. Personnel working with the conveyor should use protective clothing if hazardous materials are being conveyed.
8. Personnel should never use the conveyor as a walkway to go to other areas.
9. All persons working on a conveyor or conveyor system should follow company procedures for safe working on mechanical and electrical equipment.

2.6.2 NOISE

The equivalent continual A-wave noise level during normal operation is <70dB.

In cases where the equivalent continual A-wave noise level exceeds 70 dB, ear protection must be worn.

2.6.3 STORAGE INSTRUCTION

SHORT TERM AND LONG TERM

1. Keep crate blocked if at all possible and off the ground.
2. Tarp completely and securely so equipment will not be exposed to rain or other weather conditions.
3. No lubrication required during storage period.

2.7 SPARE PARTS

2.7.1 Conveyor Parts Description

On the following 2 pages are a general depiction of a U-Conveyor and an OK-Conveyor.

The list of spare parts for each, gives the correct names for the parts of the conveyor and therefore eases the ordering of spare parts.

The dimensions and technical data for your conveyor are specified in the drawings section. Make sure you have the drawing available when ordering parts by telephone.

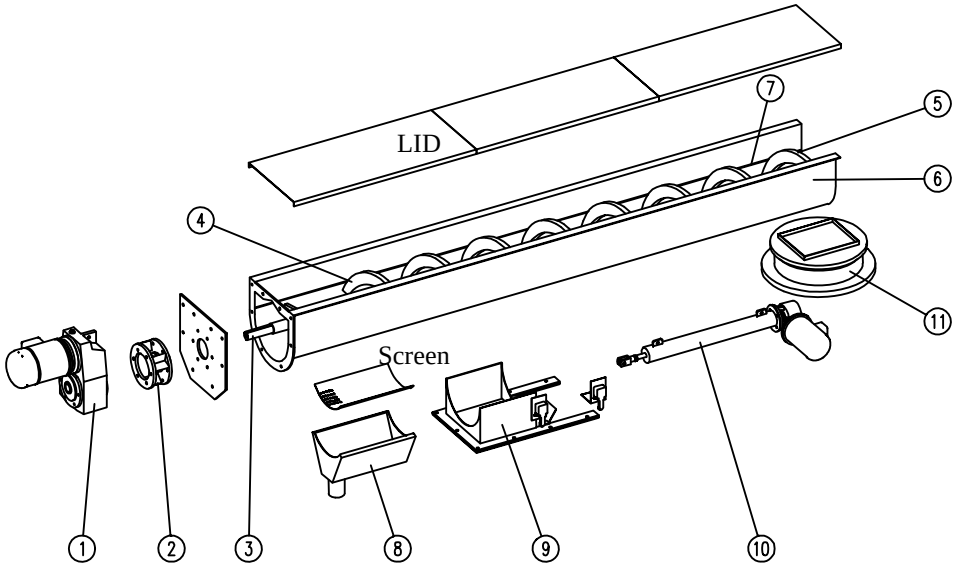


Figure 2.8-1. U-Conveyor Parts

Conveyor Standard Parts		Accessories	
1	Motor and gearbox	8	Draining section with screen
2	Bell Housing	9	Slidegate (Knifetype)
3	Drive shaft and coupling disc	10	Electronic linear actuator / pnuematic cylinder
4	Spiral and coupling disc	11	Longopac holder with adapter
5	Spiral		
6	Trough		
7	Liner		

The dimensions and technical data for your conveyor are specified in the drawing section. Make sure you have the drawing available when ordering parts by telephone.

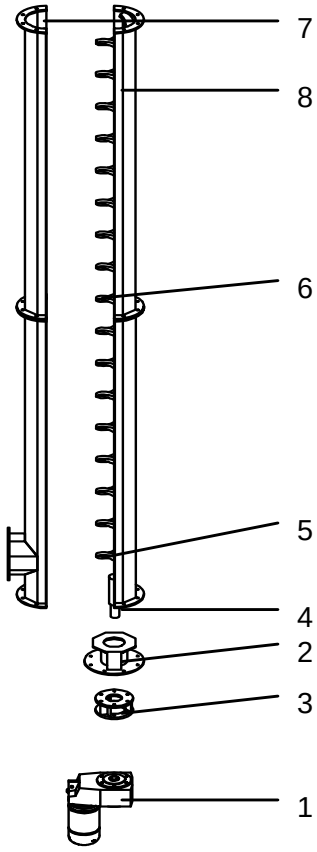


Figure 2.8-2. OK-Conveyor Parts

Conveyor Standard Parts	
1	Motor and gearbox
2	Drive End Plate
3	Bell-Housing and Packing Box
4	Drive shaft and coupling disc
5	Spiral coupling disc
6	Spiral
7	Liner
8	Trough

2.7.2 Recommended Spare Parts

SPIRAC does not have any recommendations for spare parts or require any special tools or special testing equipment. SPIRAC has endeavoured to provide you with equipment that will give you continued and long lasting service.

All parts are available from SPIRAC by calling the SPIRAC representative listed below or your nearest SPIRAC office and giving a part description from Section 8.0 or referring to your General Arrangement drawing included in the O/M.

PREDICTED LIFE OF PARTS SUBJECT TO WEAR:

Every application is somewhat different, so life of parts vary. A well maintained system cleaned at regular intervals will give better service. Refer to Tab 4 for maintenance time table and further instructions.

1. Liners, it can be expected that liners can last 5 yrs or longer, depending on hrs of service per day and other factors. Vertical liners can last up to two times as long as horizontal liners. If yellow backing is showing through replace damaged section.
2. Spiral, depending on service factors, 3 to 7 yrs. A maximum of 20% of the spirals original dimension can be worn away before it requires replacement.
3. Trough, should last indefinitely if the liners are changed before the spiral is allowed to reach the trough. Should liners fail to be replaced in a timely manner and damage trough, replace immediately.
4. Drive unit components, should last 10 yrs plus if regular maintenance is observed as indicated in tab 4 monitoring oil level and quality regularly.
5. Gland packing, 5 yrs if greased and maintained. See page 15 for preventative maintenance information.
6. Motion probe, approximately 10 yrs. Keeping probe clean/dust free.

2.7.3 Supplier Contact

SPIRAC ENGINEERING has Sales Offices throughout the world. Your local office is:

SPIRAC (USA) INC.
75 Jackson Street, Suite 300
Newnan, GA 30263
Tel: 770-632-9833 Fax: 770-632-9838

Please refer to the Supplier Index for additional Vendor Contact Information.

SPIRAC Shaftless Screw Conveyors

Section 3

1. **SCOPE** This section covers the shaftless screw conveying equipment, as fabricated by SPIRAC (USA) INC of Newnan, Georgia.

2. **GENERAL**

2.1 Equipment is furnished complete with all supports; all mechanical equipment required for proper operation, including complete drive units. The fully detailed scope of supply is reflected on the enclosed General Arrangement (GA) drawing set.

2.2 The shaftless screw conveying equipment meets the performance and design requirements of “Table A” and the Drive Calculations, at the end of this section.

3. **GENERAL METHODS AND MATERIALS OF CONSTRUCTION**

3.1 Fabrication. All welds to be continuous unless otherwise specified. Facing surfaces of field-welded components are beveled and match marked.

3.2 Welding: All shop welding conforms to the latest standards of the American Welding Society (AWS).

3.3 Edge Grinding. Sharp corners of all cut and sheared edges are made smooth.

3.4 Fasteners. Bolts, nuts, washers, and other fasteners are stainless steel.

3.5 Surface Preparation

3.5.1 Iron and mild steel surfaces to be coated, are dry abrasive blasted in accordance with SSPC-SP6. Surfaces are painted or hot dip galvanized within 24 hours to prevent rusting and surface discoloration.

3.5.2 Stainless steel is cleaned with mild abrasive wheels and/or nonferrous blast media to remove heavy scale and welding carbon and/or passivated with stainless steel cleaner, then rinsed.

3.6 Painting.

3.6.1 Stainless Steel surfaces do not require painting.

3.6.2 The spiral is furnished with one coat of shop primer only.

3.6.3 Electric motors, gear reducers, electrical control panels, and other purchased sub-components are furnished with the manufacturer’s standard finish.

4. **SHAFTLESS SCREW CONVEYOR CONSTRUCTION**

4.1 Spiral Flighting: Spiral flights are cold-formed high strength chrome alloy steel with a minimum hardness of 225 Brinnell. Flights are designed with adequate stability to prevent distortion and jumping in the trough. The torsional rating of the auger flighting exceeds the torque rating of the drive system, and the "spring effect" of the spiral does not exceed +/- 1.0mm per 100mm of length at maximum load.

4.1.1 Flighting is formed in sections from one continuous flat bar and is concentric to within ±2mm.

4.1.2 Flighting has full penetration welds at all splice connections. The flights are aligned at fabrication in order to ensure true alignment when assembled in the field. Flights are coupled to the end shaft by a flanged, bolted connection.

4.1.3 Field welds at the jobsite by Others may be necessary for installation, when any overall conveyor length presents shipping or handling constraints.

4.2 Gland Packing: A gland packing ring consisting of three teflon fiber packing rings seals the drive shaft at its penetration through the end plate.

4.3 Coupling Disc: The connection of the spiral to the drive system is through a flanged connection plate that is welded to the spiral, forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft has a mating flange which is bolted to the spiral connection plate.

4.4 Troughs: Horizontal and shallow inclines incorporate a U-shaped trough, similar to the dimensional standards of CEMA 350 and enclosure classification IIE. Vertical or steep inclines are provided with an octagonal trough.

4.4.1 Drain outlets or flushing connections, when required for cleaning or drainage, are specifically described and located on the General Arrangment drawing set. Drain outlets should be piped to a drain with adequate cleaning facilities. Responsibility for labor and materials to connect flush water and/or drains with the plant water or drain system shall be the responsibility of Others.

4.4.2 Each trough is equipped with inlet and/or discharge openings as detailed on the GA drawing set.

4.4.3 Covers are at least bolted, and furnished for any portion of trough that is not covered by the filling chute. Covers are manufactured in maximum five (5) foot length section to allow for easy access and ease of liner replacement.

4.4.4 Each conveyor is fixed with the appropriate warning labels to call for lock out – tag out of the electrical system before servicing.

4.4.5 All trough configurations are constructed to prevent "wobble" and/or binding of the spiral during normal operation.

4.5 Liner: SPIRAC equipment is provided with a liner material appropriate for the product being conveyed. Liner style and dimensions are detailed on the attached Table A and listed on the Bill of Material of the GA set.

4.5.1 Typical, less abrasive applications call for the inside trough surfaces to be lined with SPIRAC Duraflo type SPX, an Ultra High Molecular Weight Polyethylene (UHMW-PE). These wear liners are formed and bonded with two (2) layers, each of a different color, to provide a visible indication when the liner is nearing the end of its useful life. The liners are supplied in maximum 3.3 foot long sections to provide ease of replacement, and are held in place with stainless steel clips welded to the inner wall of the trough.

4.5.2 More aggressive or abrasive product may require the use of Hardox bar on SS, as a liner configuration. Typically seen for grit or grit-like applications, this style liner is also supplied in sections for ease of servicing, and are held in place with tack welds on the inner surface of the trough wall.

4.5.3 Refer to the GA set for configuration details, and the O&M Manual supplied with your equipment for detailed liner servicing information.

4.6 Supports Conveyors are complete with supports suitable for mounting as shown on the GA set, fabricated of stainless steel structural angle. Supports are factory assembled, fit to the conveyor prior to delivery, and match-marked for field assembly by Others. For floor supports, SPIRAC allows up to 1 inch of grout beneath each foot pad to allow for compensation for uneven floor elevations.

Drive Units

4.7 Each spiral conveyor is driven by a constant-speed gear reducer motor drive unit mounted to a bellhousing adapter flange mounted to the end plate of the conveyor.

4.8 The adapter flange allows the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. The drive unit is rigidly supported so there is no visible "wobble" movement under any operating condition.

4.9 Manufacturer's specifications and cut sheets, and detailed drive and capacity calculations are provided within the appropriate section of this package.

4.10 Gear Reducers All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Bearings are designed for the thrust loads from the fully loaded startup condition and shall have an AFBMA B-10 life of 30,000 hours. Reducers are air-cooled, with no auxiliary cooling requirement.

5. ELECTRICAL EQUIPMENT

5.1 Motor: Totally enclosed, fan cooled (TEFC), designed for the specific environment and in accordance with the customer specifications. Detailed manufacturer's cut sheets are provided within this package.

5.2 Motion Failure Alarm Unit. When conveyors are equipped with a motion failure alarm unit ("Loss of Rotation" or "Zero Speed Switch") they will be shown on the GA set, with detailed cut sheets provided within the specific section of this package.

5.3 Emergency Shutdown: When conveyors are furnished with an emergency trip safety switch and pull-cord, they will be shown on the GA set, with detailed cut sheets provided within the specific section of this package.

6. MANUFACTURER'S FIELD SERVICES

6.1 When provided, SPIRAC shall furnish the services at site of a factory-trained representative as specified. Service shall be provided as necessary after the Contractor has installed the equipment. These services shall be furnished for the purposes of:

6.1.1 Inspection of the equipment following installation by others.

6.1.2 Certification that the equipment has been properly installed and is ready to operate.

6.1.3 Training of the Owner's personnel in the operation, and maintenance of the equipment.

6.1.4 Observation and supervision of the initial operation of the equipment.

6.2 After inspection of the installed equipment, SPIRAC shall furnish a written report certifying that the equipment has been properly installed and is fully ready for operation.

Table A – Conveyor Design Table

1	PERFORMANCE	CV 1
	Design Load / vol. (ft3/hr)	316
	Design fill @ load (%)	33%
2	MOTOR	SEW
	HP	5
	Part Number	DRE100LC4
	Environment	Severe Duty
	Electrical	230/460V 3ph 60Hz
3	GEARBOX	SEW
	Style	FA87B
	Gear ratio	88.01
	RPM	19
	Mounting Position	M1
	Inclination	0
4	Bell Housing	HDG or MSP
5	Drive Shaft	1045 / K1040
6	CONVEYOR	
	Trough Type/Size-mm	U355
	Trough Material	11ga 304SS
	Lids	12ga 304SS
	Driveplate	3/8" 304SS
	Endplate	1/4" 304SS
7	LINER	UHMW PE
	Liner Material	12mm SPX
8	SPIRAL (TYP OD/PITCH)-mm	AB315/330
	Spiral Material	HTMAS
	Spiral Handed / Direction	RH/Push
	SUPPLEMENTAL ITEMS	
9	E-Stop Mfr	Conveyor Components
	E-Stop Model	RS-2
10	Loss of Rotation (LOR) Mfr	Milltronics
	LOR Probe Model	MSP12
	LOR Controller Mod./Env.	MFA4P / NEMA 4X
11	Manual Slide Gates	See GA Set
12	SPARE PARTS	
	Gland Packing Seals	1 set
	Liners	1 set

Capacity and Drive Calculations

Project Engineering Data.xls

VOLUMETRIC CAPACITY

Conveyor		Spiral Type	Spiral Dia	Spiral Pitch	Spiral Speed	Design Target	Fill Rate @ Design	Fill Rate @ Max	Max Incline	Calculated DESIGN Capacity		Calculated MAX Capacity	
Nbr	ID	(style)	(mm)	(mm)	(rpm)	(ft^3/hr)	(%)	(%)	(deg)	(m^3/hr)	(ft^3/hr)	(m^3/hr)	(ft^3/hr)
CV 1	U355	AB	315	330	19	313	33%	100%	0	8.94	316	24.37	861

POWER REQUIREMENTS

	Conveyed Length		Material Conveyed	Material Efficiency	Product Properties			Power Required at DESIGN trough fill		Power Required at MAX Capacity		Selected Motor	
Nbr	(m)	(ft)		(0.5-1.0)	Mat'l Factor	Specific Gravity	(lbs/ft^3)	kW	HP	kW	HP	HP	kW
CV 1	9.0	29.5	sludge	1.0	5	1.0	62.4	1.34	1.79	3.23	4.33	5.0	3.73

SPIRAL LOADING

	SPIRAL			Torque (Design)	Torque (Max)	Torque (spiral)	Spiral Load to Strength	
Nbr	ID		Config.	in-lbs	in-lbs	in-lbs	@ Design	@ MAX
CV 1	AB315/330	60x25+40x8	RH/Push	5,942	14,363	35,058	16.9%	41.0%

NOTES OR SPECIAL CONSIDERATIONS:

DRIVE SELECTION

	DRIVE			Reducer MAX Capacity	Reducer Capacity @ Motor Selected	Drive Service Factor	Overall Design Torque Service Factor
Nbr	Style	RPM	ratio	(in-lbs)	(in-lbs)		
CV 1	FA87B	19	88.01	26600	16500	1.6	2.78

THEORETICAL LOADING

The figures below represent the theoretical load capacity based on the volumetric flow, % trough fill, and density figures stated above.

@ DESIGN % Fill		@ MAX CAP.% Fill	
(lbs/hr)	(mtons/hr)	(lbs/hr)	(mtons/hr)
19695	8.9	53713	24.4

SPIRAC ENGINEERING PTY LTD
AB315.330

Spiral Strength Calculation

Input material		Value
Yield Strength	N/mm2	**450**
Shear Strength	N/mm2	**70000**
Elasticity Modulus	N/mm2	**210000**

Input Main Spiral		Value
Outer Diameter	mm	**315**
Pitch	mm	**330**
Height	mm	**60**
Width	mm	**25**
Number of	pcs	**1**

Input Insert		Value
Outer Diameter	mm	**195**
Height	mm	**40**
Width	mm	**8**
Number of	pcs	**1**

Input F-spiral		Value
Outer Diameter	mm	**0**
Height	mm	**40**
Width	mm	**20**
Number of	pcs	**0**

Input E-spiral		Value
Outer Diameter	mm	**FALSE**
Height	mm	**50**
Width	mm	**15**
Number of	pcs	**0**

Input V-spiral		Value
Outer Diameter	mm	**0**
Height	mm	**40**
Width	mm	**1**
Number of	pcs	**0**

Output / Results		Value
Axiel Force, Pushing	N	**13792**
Torque, Pushing	N-m	**3961**
	in-lbs	**35058**
Axiel Force, Pulling	N	**10919**
Torque, Pulling	N-m	**3136**
	in-lbs	**27754**

1	**PERFORMANCE**	CV 1
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	Design fill @ load (%)	33%
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	HP	5
	Part Number	DRE100LC4
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	Style	FA87B
	Gear ratio	88.01
	RPM	19
	Mounting Position	M1
	Inclination	0
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	Liner Material	12mm SPX
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	Spiral Material	HTMAS
	Spiral Handed / Direction	RH/Push
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	E-Stop Model	RS-2
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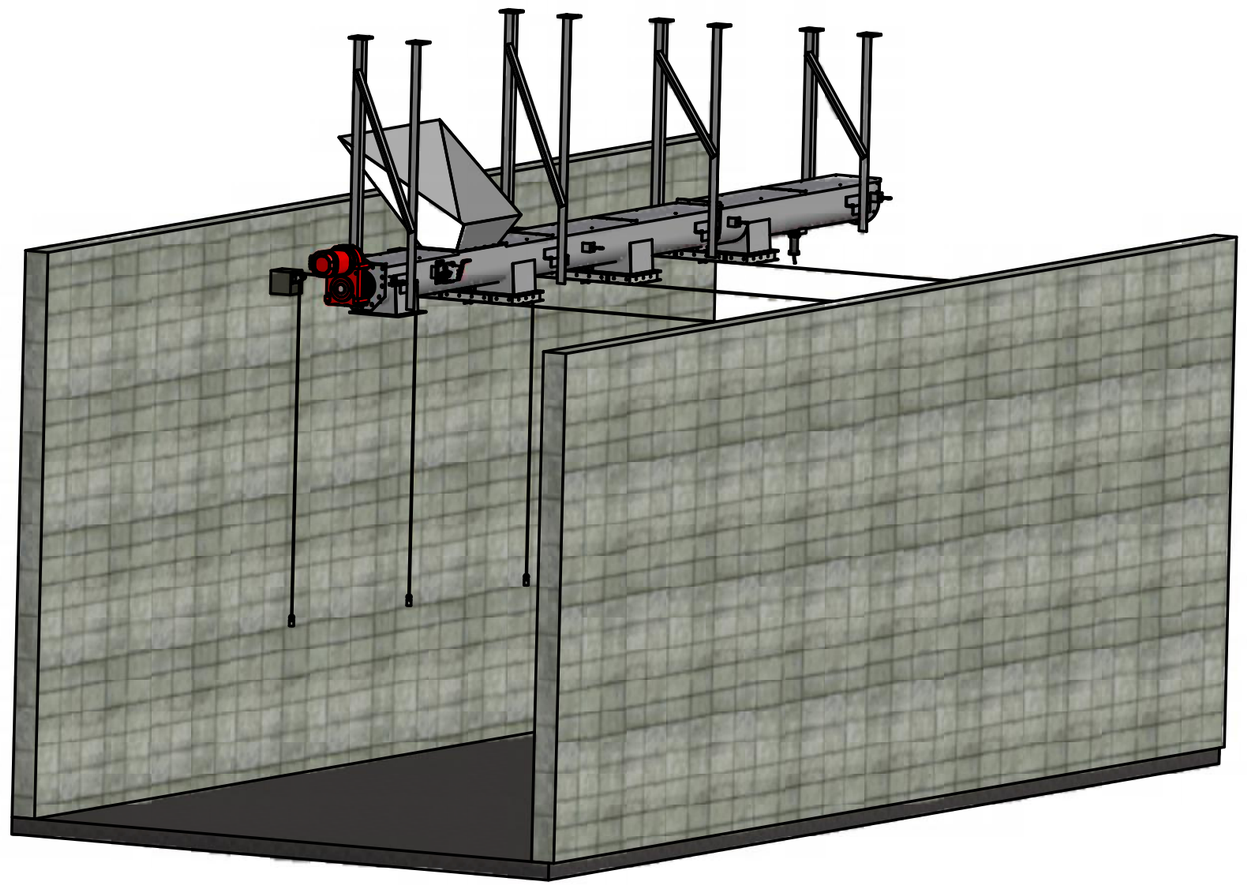
	LOR Probe Model	MSP12
	LOR Controller Mod./Env.	MFA4P / NEMA 4X
11	Conveyor Supports	Angle 3 x 3 x 1/4 304 SS
12	Manual Slide Gates	See GA Set
13	**SPARE PARTS**	
	Gland Packing Seals	1 set
	Liners	1 set



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ph (770) 632-9833
fax (770) 632-9833

TOLERANCES EXCEPT WHERE OTHERWISE STATED:-

UP TO 120 IN	±1/8 in
120 IN AND OVER	±1/4 in
HOLE CENTERS	±1/16 in
CLEARANCE HOLE DIA	±1/16 in
ALL ANGLES	±1°

DIMENSIONS IN INCHES
DO NOT SCALE

741 Fountian CO
General Arrangement
Distribution Convetor CV-1
U355-SPX/304 SS

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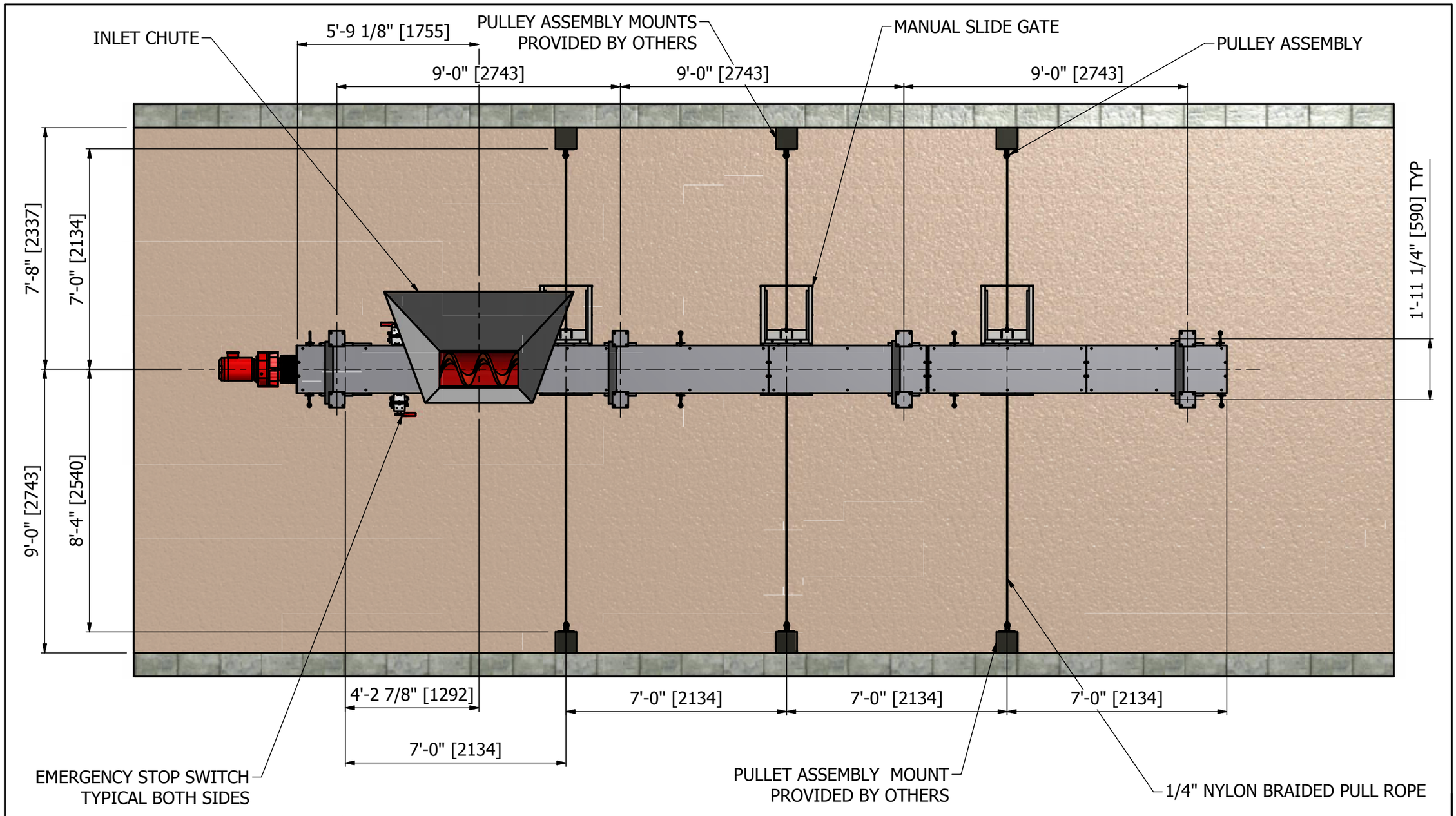

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741 Fountain HDTWRF CO
General Assembly
Distribution Conveyor CV-1
U355-SPX/304 SS

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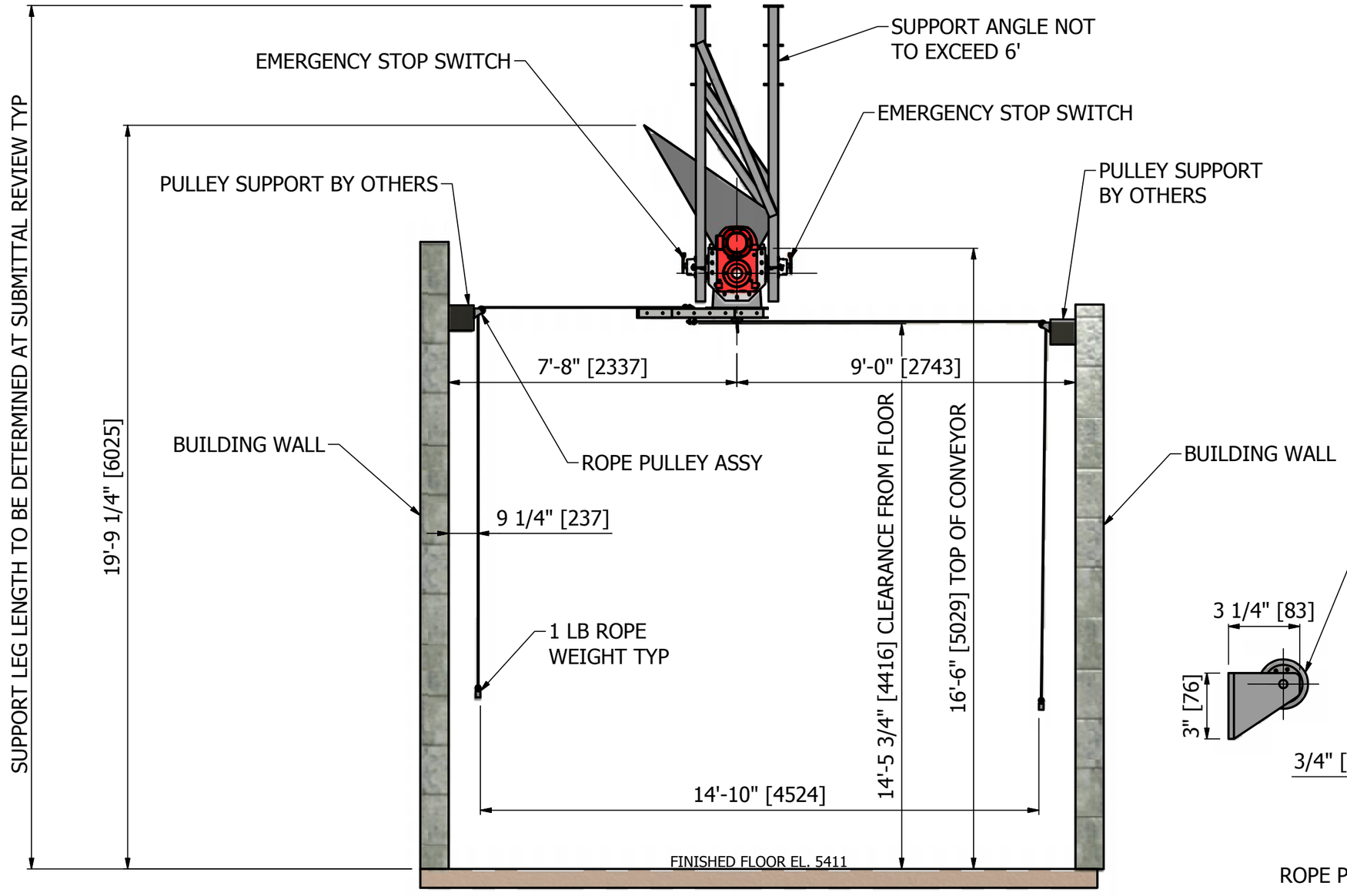

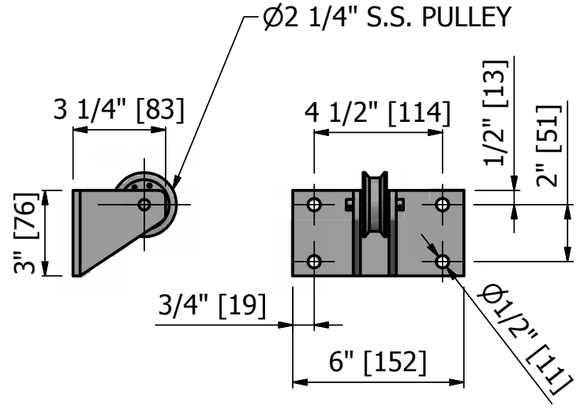

ROPE PULLEY ASSEMBLY

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741 Fountain HDTWRF CO
General Arrangement
Distribution Conveyor CV-1
U355-SPX/304 SS

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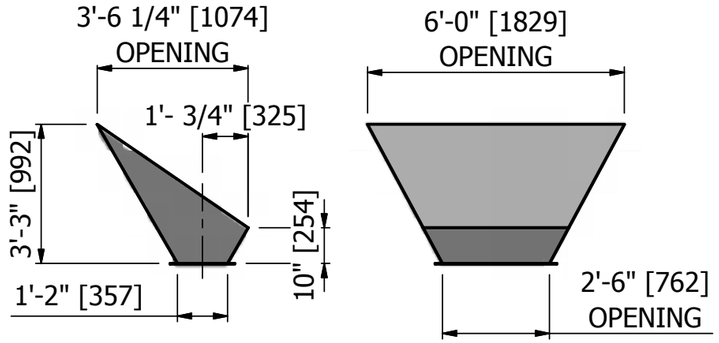

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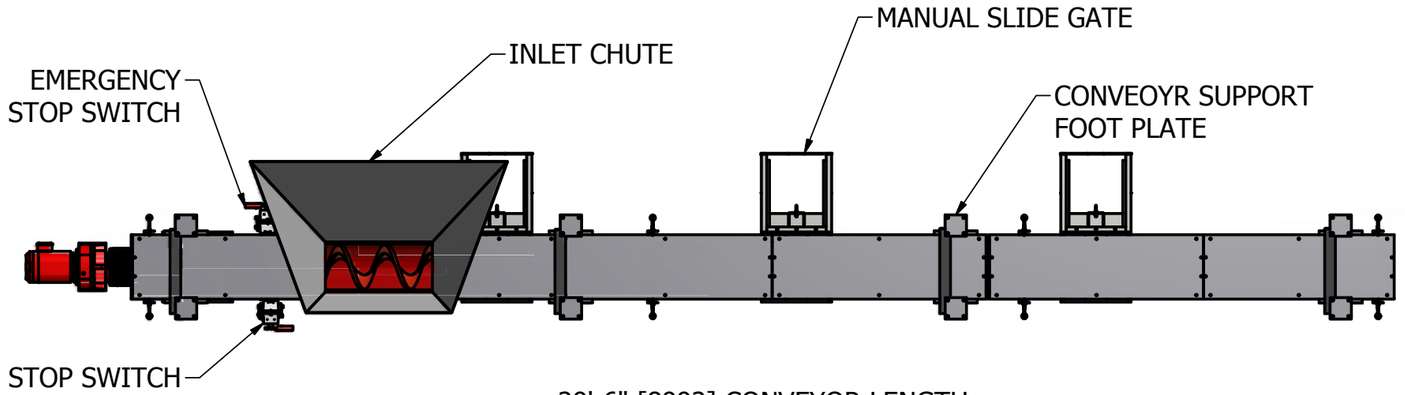
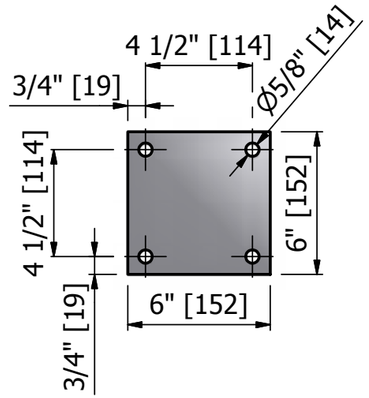
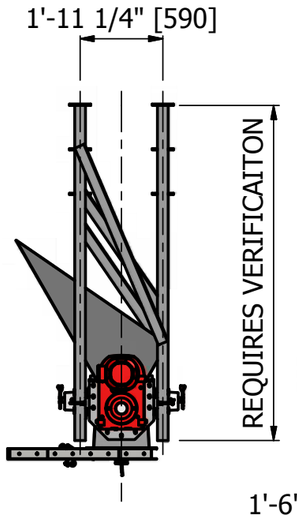
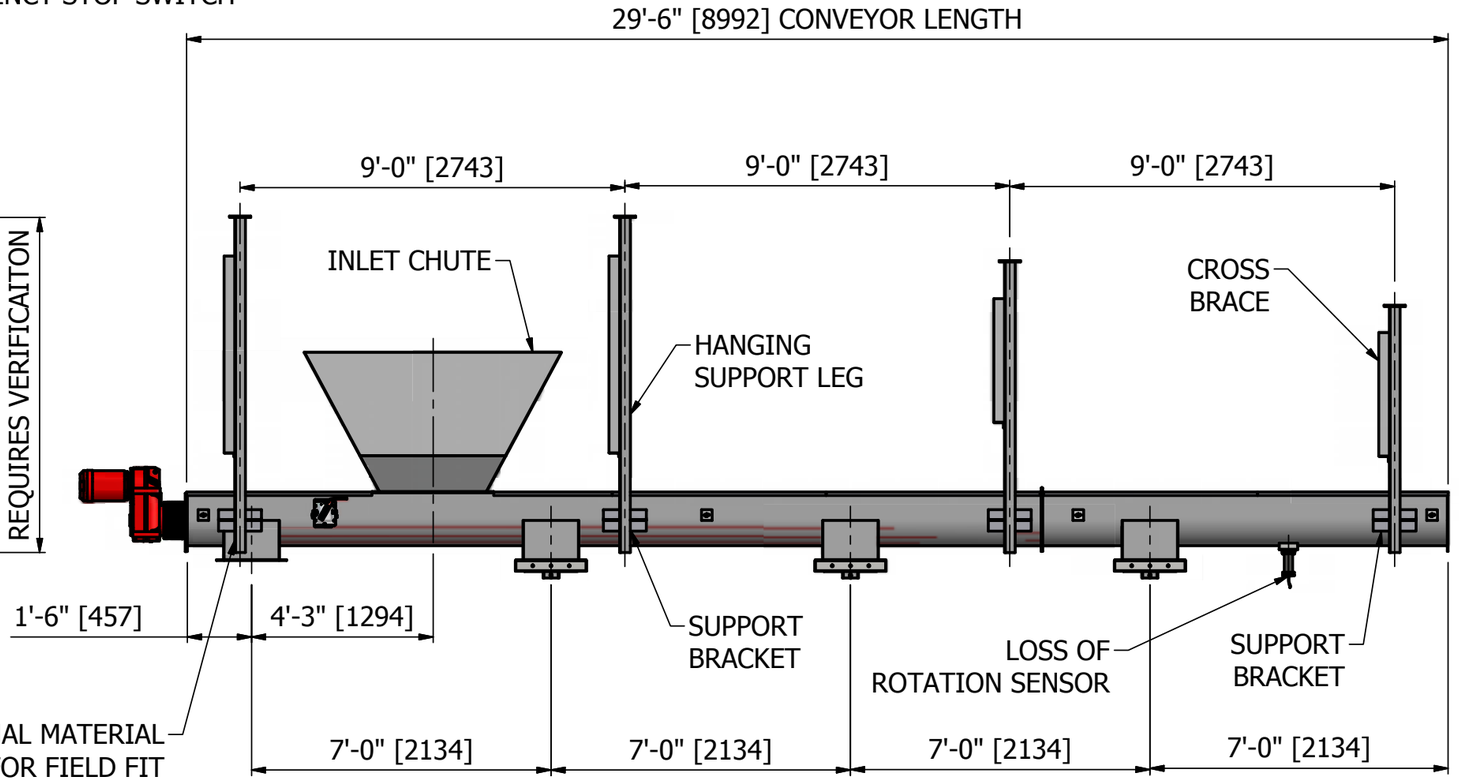




TYPICAL FOOT PLATE





NOTES:

ALL LIDS FULLY GASKETED
WITH 1" WIDE MATERIAL

ALL HARDWARE STAINLESS STEEL

LOCATE & WELD SUPPORT LEG
CROSS BRACE AT INSTALLATION TYP

LOCATE & WELD SUPPORT
BRACKET TO SUPPORT LEG
AT INSTALLATION

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75 Jackson Street Suite 300
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fax (770) 632-9833

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DIMENSIONS IN INCHES
DO NOT SCALE

741 Fountain HDTWRF CO
General Arrangement
Distribution Conveyor CV-1
U355-SPX/304 SS

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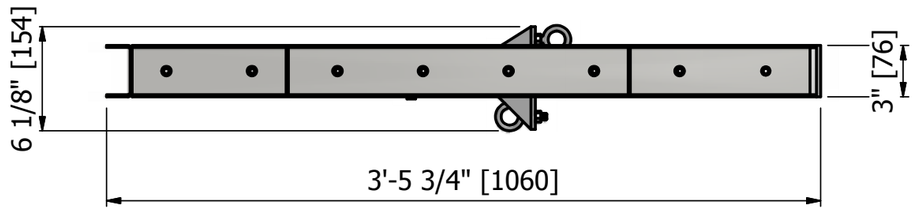
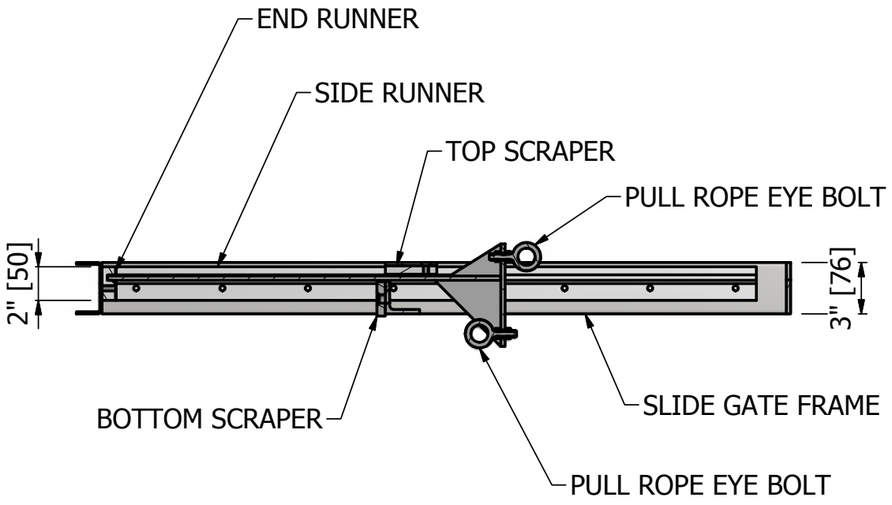
NOTES:

ALL HARDWARE STAINLESS STEEL

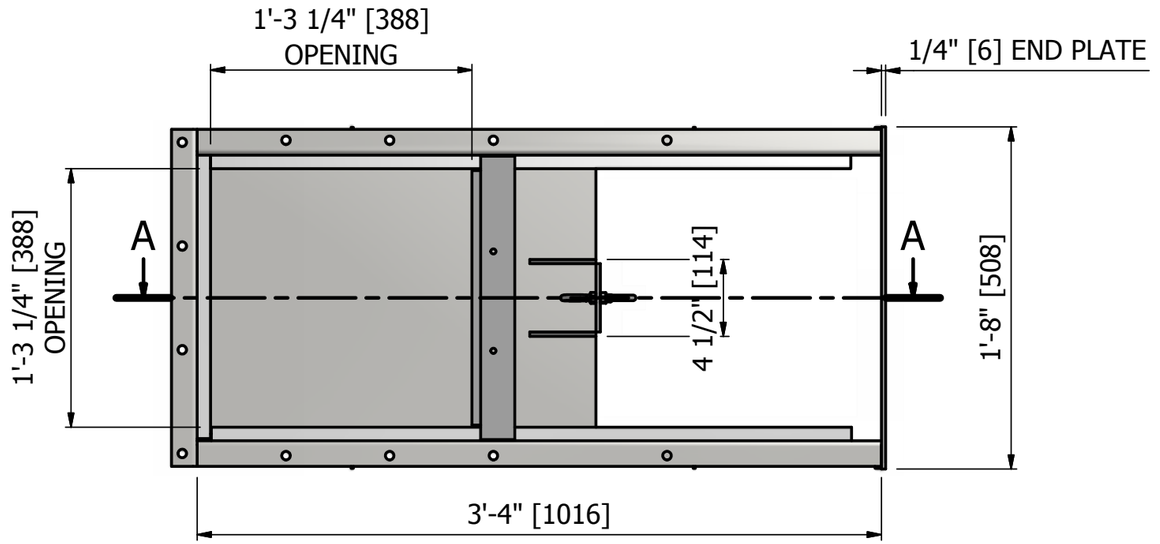
END RUNNER & SIDE RUNNER
UHMW PLASTIC

SLIDE GATE FRAME
11 GA 304 STAINLESS STEEL





SECTION A-A



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741 Fountain HDTWRF CO
General Arrangement
Distribution Conveyor CV-1
U255-SPX/304 SS

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SHEET:	SCALE: NTS

DWG. No. GA-741-05

REV. 0

Motor Power P_n HP	Output Speed n_a rpm	Service Factor	Torque T_a lb-in	OHL[1] F_{Ra}	Ratio i	Gear Stages[2] Pri.	Gear Stages[2] Sec.	Model Gear	Model Motor
5.0	**25.0**	2.1	12800	5330	68.40	3	-	**FA87**	**DT100L4**
	23.0	1.0	13600	3480	72.50	3	-	**FA77**	**DT100L4**
	23.0	2.8	13600	8140	72.29	3	-	**FA97**	**DT100L4**
	22.0	1.9	14300	5430	76.39	3	-	**FA87**	**DT100L4**
	21.0	2.5	15100	8070	80.31	3	-	**FA97**	**DT100L4**
CV-1	**19.0**	1.6	16500	5540	88.01	3	-	**FA87**	**DT100L4**
	19.0	2.3	16900	7990	89.85	3	-	**FA97**	**DT100L4**
	17.0	1.5	18400	5620	97.89	3	-	**FA87**	**DT100L4**
	17.0	2.1	18300	7920	97.58	3	-	**FA97**	**DT100L4**
	16.0	2.0	19200	7880	102.16	3	-	**FA97**	**DT100L4**
	15.0	1.3	20500	5690	109.49	3	-	**FA87**	**DT100L4**
	15.0	1.8	21200	7780	112.99	3	-	**FA97**	**DT100L4**
	14.0	1.2	23100	5480	123.29	3	-	**FA87**	**DT100L4**
	14.0	3.1	22100	13800	117.94	3	-	**FA107**	**DT100L4**
	13.0	1.1	25200	5290	134.16	3	-	**FA87**	**DT100L4**
	13.0	1.6	23900	7640	127.42	3	-	**FA97**	**DT100L4**
	13.0	2.8	24400	13700	129.97	3	-	**FA107**	**DT100L4**
	12.0	1.5	26400	7490	140.71	3	-	**FA97**	**DT100L4**
	11.0	1.3	29300	7320	156.30	3	-	**FA97**	**DT100L4**
	11.0	2.5	27500	13500	146.49	3	-	**FA107**	**DT100L4**
	10.0	2.2	30300	13400	161.28	3	-	**FA107**	**DT100L4**
	9.6	1.2	32800	7090	174.87	3	-	**FA97**	**DT100L4**
	9.4	2.0	33500	13200	178.64	3	-	**FA107**	**DT100L4**
	8.9	1.1	35600	6900	189.92	3	-	**FA97**	**DT100L4**
	8.8	2.1	32700	13300	190	3	2	**FA107R77**	**DT100L4**
	8.6	1.2	33600	7040	195	3	2	**FA97R57**	**DT100L4**
	8.4	1.8	37400	13000	199.31	3	-	**FA107**	**DT100L4**
	8.1	1.1	35900	6880	208	3	2	**FA97R57**	**DT100L4**
	7.8	1.7	40400	12900	215.37	3	-	**FA107**	**DT100L4**
	7.5	2.8	37900	20200	223	3	2	**FA127R87**	**DT100L4**
	6.6	1.4	47700	12500	254.40	3	-	**FA107**	**DT100L4**
	6.5	2.4	43900	20200	259	3	2	**FA127R87**	**DT100L4**
	6.3	1.5	46300	12500	266	2	2	**FA107R77**	**DT100L4**
	5.7	2.1	49700	20200	293	3	2	**FA127R87**	**DT100L4**
	5.6	1.4	52200	12200	300	2	2	**FA107R77**	**DT100L4**
	5.4	2.0	53000	20200	312	3	2	**FA127R87**	**DT100L4**
	4.9	1.2	59300	11800	340	2	2	**FA107R77**	**DT100L4**
	4.5	1.7	64500	20200	376	3	2	**FA127R77**	**DT100L4**
	4.3	1.1	67600	11200	387	2	2	**FA107R77**	**DT100L4**
	3.9	1.5	73600	20200	428	3	2	**FA127R77**	**DT100L4**
	3.8	2.1	75700	26800	446	3	2	**FA157R97**	**DT100L4**
	3.4	1.3	85100	20200	495	3	2	**FA127R77**	**DT100L4**
	3.1	1.1	94500	20200	549	3	2	**FA127R77**	**DT100L4**

NOTES: Consult Assembly Center for additional speed (rpm) selections or dimension pages not listed.
See page 166 for available mounting options. See page 278 for weights.
See page 230 for index to F gearmotor dimension pages. Dimensions are on pages 232 - 265.
[1] Overhung loads (OHL) apply only for F gearmotors and are at shaft midpoint. Contact SEW for other reducer type OHL's.
[2] Pri. = primary reducer Sec. = secondary reducer

	FA87					AM143			AM145			AM182			AM184		
Ratio *i*	Output Speed n_a	Input Power P_{emax}	Output Torque T_{amax}	Stages		Input Power P_e	Output Torque T_a	Output OHL F_{Ra}	Input Power P_e	Output Torque T_a	Output OHL F_{Ra}	Input Power P_e	Output Torque T_a	Output OHL F_{Ra}	Input Power P_e	Output Torque T_a	Output OHL F_{Ra}
	rpm	HP	lb-in	Pri.	Sec.	HP	lb-in	lb	HP	lb-in	lb	HP	lb-in	lb	HP	lb-in	lb
270.68	6.50	2.93	26600	3	-	1	8580	6530	2	18100	5920	-	-	-	-	-	-
255.37	6.90	3.06	26600	3	-	1	8050	6570	2	17000	6010	-	-	-	-	-	-
228.93	7.60	3.46	26600	3	-	1	7260	6590	2	15200	6120	3	22700	5540	-	-	-
197.20	8.90	3.99	26600	3	-	1	6240	6660	2	13100	6280	3	19600	5810	3.99	26600	4460
179.97	9.70	4.26	26600	3	-	1	5710	6680	2	11900	6350	3	17900	5940	4.26	26600	4460
159.61	11	4.79	26600	3	-	1	5040	6710	2	10600	6410	3	15800	6080	4.79	26600	4460
134.16	13	5.72	26600	3	-	1	4250	6730	2	8940	6530	3	13300	6260	5	22700	5540
123.29	14	6.25	26600	3	-	1	3890	6750	2	8230	6550	3	12200	6320	5	20900	5690
109.49	16	7.05	26600	3	-	1	3450	6750	2	7260	6590	3	10800	6410	5	18500	5810
97.89	18	7.85	26600	3	-	-	-	-	2	6460	6640	3	9650	6390	5	16500	5720
88.01	20	8.78	26600	3	-	-	-	-	2	5750	6500	3	8580	6230	5	14800	5630
76.39	23	10.11	26600	3	-	-	-	-	2	4910	6280	3	7430	6030	5	12700	5490
68.40	26	11.31	26600	3	-	-	-	-	-	-	-	3	6590	5850	5	11300	5400
56.75	31	13.57	26600	3	-	-	-	-	-	-	-	3	5350	5580	5	9380	5200
50.36	35	14.90	26000	3	-	-	-	-	2	3320	5560	3	4960	5380	5	8500	5040
45.28	39	15.83	25000	3	-	-	-	-	2	2960	5380	3	4430	5240	5	7610	4930
39.30	45	17.69	24100	3	-	-	-	-	2	2520	5150	3	3810	5040	5	6550	4770
35.19	50	18.89	23100	3	-	-	-	-	-	-	-	3	3360	4880	5	5840	4640
33.92	52	19.28	23100	2	-	1	1090	5040	2	2300	4930	3	3410	4820	5	5800	4590
29.20	60	21.94	22200	3	-	-	-	-	-	-	-	3	2790	4640	5	4820	4430
28.78	61	21.41	21700	2	-	1	920	4790	2	1950	4680	3	2880	4590	5	4910	4390
26.50	66	27.93	26600	2	-	1	850	4660	2	1770	4570	3	2660	4480	5	4510	4300
23.68	74	31.92	26600	2	-	1	750	4500	2	1590	4410	3	2390	4340	5	4030	4160
21.32	82	35.91	26600	2	-	-	-	-	2	1420	4280	3	2120	4210	5	3630	4050
19.31	91	38.57	26600	2	-	-	-	-	2	1270	4140	3	1900	4070	5	3270	3940
17.12	102	43.89	26600	2	-	-	-	-	2	1120	3980	3	1680	3940	5	2880	3830
15.48	113	49.21	26600	2	-	-	-	-	-	-	-	3	1500	3830	5	2610	3710
13.12	133	57.19	26600	2	-	-	-	-	-	-	-	3	1260	3620	5	2170	3530
8.29	211	46.55	13500	2	-	-	-	-	2	550	3150	3	820	3130	5	1410	3060
7.35	238	51.87	13500	2	-	-	-	-	2	480	3040	3	725	3020	5	1240	2950
6.65	263	57.19	13500	2	-	-	-	-	-	-	-	3	645	2930	5	1120	2880
5.63	311	67.83	13500	2	-	-	-	-	-	-	-	3	540	2770	5	940	2720

Please consult your SEW-Eurodrive Assembly Center for additional speed (RPM) selections and dimension pages not listed.

Technical Note

Breathers

Mechanical

General:
The movement of meshing gears inside a gear reducer during normal operation produces friction and heat that cause the oil and air to expand. Expansion produces pressure that can become strong enough to cause seal failure, oil leakage and failure.

However, during rest periods, the oil and air cool to create a vacuum that draws outside air into the reducer. Consequently, water begins to collect as the moisture from the outside air condenses inside the reducer. Since water and oil do not mix, the water combines with oxygen and metal to produce rust, which is catastrophic to the bearings and gears. Even a small amount of water can be devastating.

Therefore, all SEW reducers are supplied with pressure relief breathers, with the following exceptions:

- W-series reducers
- R07, R17, R27 reducers in mounting positions M1, M3, M5, and M6 (M2 and M4 positions are supplied with breathers)

Features/Benefits:
The SEW breather, shown in Figure 1, offers the following features:

- **Brass construction** – provides excellent corrosion resistance and reliable operation.
- **Check Valve** - contains a spring-loaded one-way check valve that allows venting from the inside out. Since it prevents outside air from entering the reducer during cooling, the entry of moisture is minimized.
- **4 psi Rating** – the venting pressure is approximately 4 psi, regardless of reducer type or size.

Breathers are equipped with a protective band (see Figure 1) to prevent the breather's vents from becoming clogged during painting. This band is normally removed by SEW before shipping to allow the breather to vent properly.

The top portion of the band merely provides a grip to aid in removal. The bottom portion actually protects the vents. To remove the band, peel off the top ring and use it as a grip to remove the remaining part.

Compact Series:
The breathers used for the Compact series of gear reducers are an open type, allowing an unobstructed transfer of air between the reducer's interior and the surrounding atmosphere. The breather is filled with a filtering agent (similar to fine steel wool) to help prevent outside contaminants from entering the reducer.

Technical Note

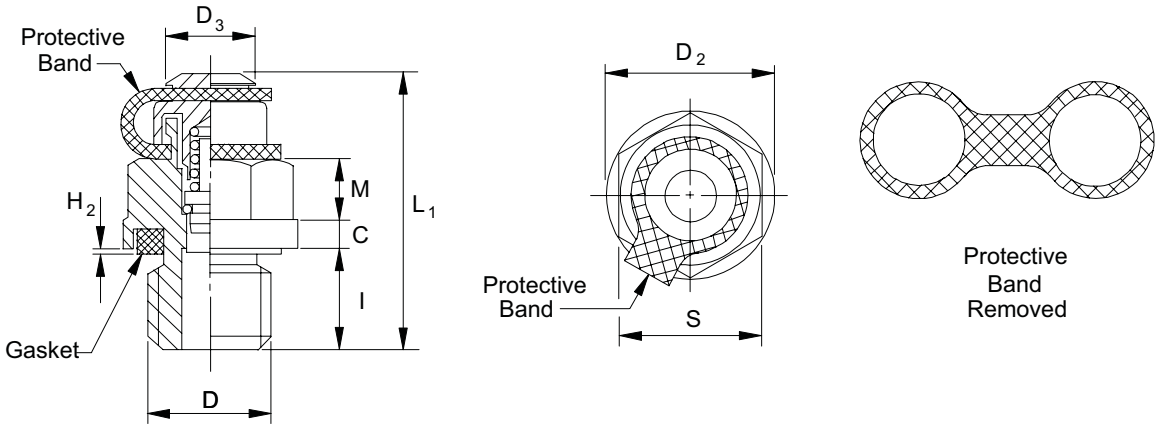

Figure 1

Specifications:

	Breather (in/mm)				
Dimensions	**M10 x 1**	**M12 x 1.5**	**M22 x 1.5**	**M33 x 2**	**M42 x 2**
L_1	0.98/25	1.06/27	1.08/27.5	1.32/33.5	1.32/33.5
I (± 0.008/0.2)	0.31/8	0.39/10	0.39/10	0.51/13	0.51/13
C	0.12/3	0.12/3	0.14/3.5	0.18/4.5	0.184.5
M	0.24/6	0.24/6	0.24/6	0.31/8	0.31/8
L_1 - I	0.67/17	0.67/17	0.69/17.5	0.81/20.5	0.81/20.5
D_3	0.43/11	0.43/11	0.43/11	0.43/11	0.43/11
H_2	0.01/0.25	0.01/0.25	0.01/0.25	0.01/0.3	0.01/0.3
S (-0.008/-0.2)	12mm	13mm	19mm	27mm	30mm
D_2 (-0.008/-0.2)	0.55/14	0.67/17	1.06/27	1.54/39	1.93/49
Reducer Sizes					
R series*	07 – 67	77 – 87	97 – 137	147	167
F series	27 – 67	77 – 87	97 – 107	127	157
S series	37 – 67	77 – 87	97	-	-
K series	37 – 67	77 – 87	97 – 107	127	157 – 187
Part number	013 030 3	013 031 1	013 032 X	013 033 8	013 034 6
Tightening Torque (lb-in/Nm)	70/8	140/16	400/45	885/100	1400/160

* No breather required for R07, R17, R27 mounted in M1, M3, M5, and M6 positions. (M2 and M4 positions are supplied with breathers)

8 Mounting Positions

8.1 General information on mounting positions

Mounting position designation

SEW differentiates between six mounting positions M1 ... M6 for gear units. The following figure shows the spatial orientation of the gearmotor in mounting positions M1 ... M6.

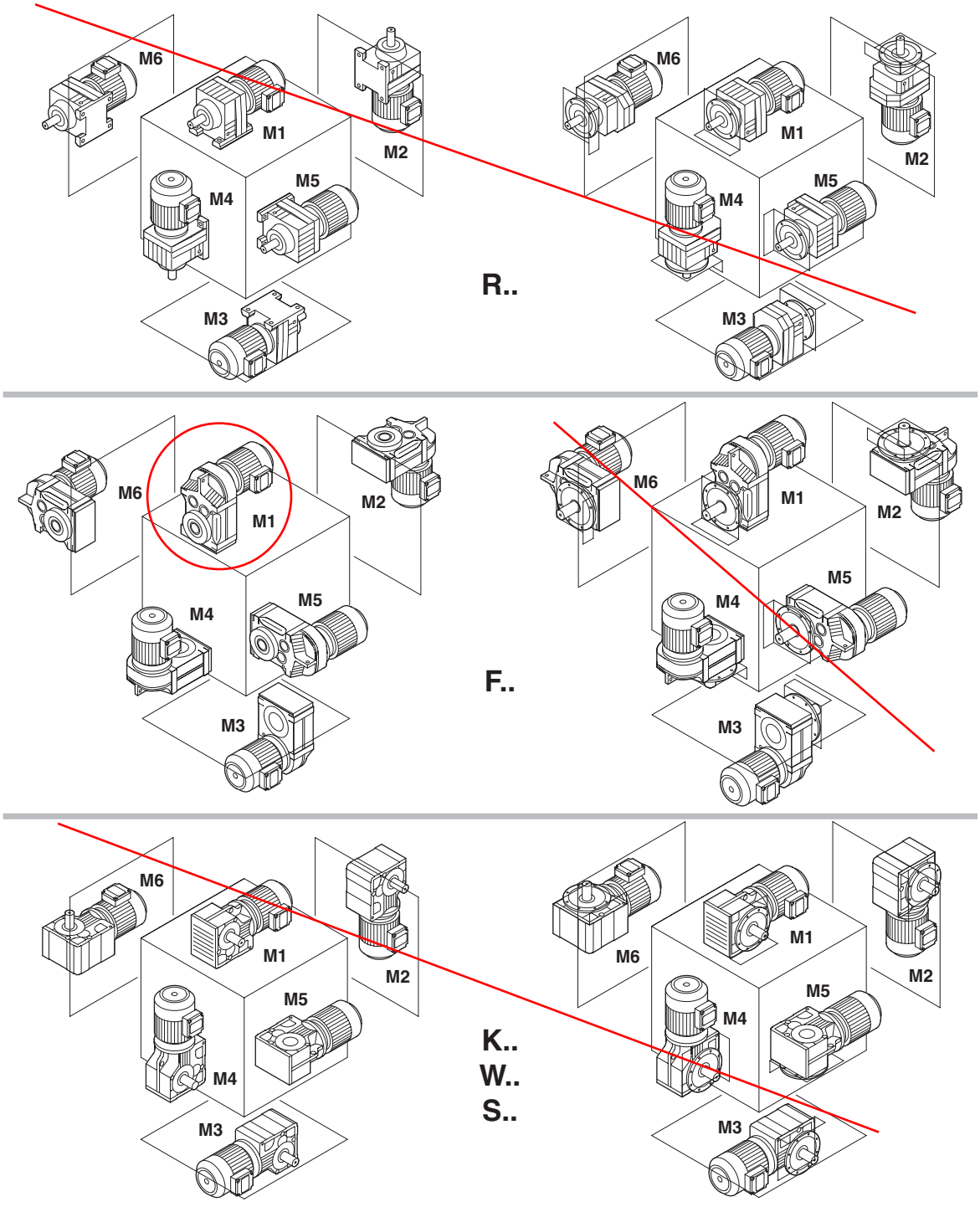

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Figure 14: Depiction of mounting positions M1 ... M6

FA.., FH.., FV.., FAF.., FHF.., FVF.., FAZ.., FHZ.., FVZ..:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
F..27	0.60	0.80	0.65	0.70	0.60	0.60
F..37	0.95	1.25	0.70	1.25	1.00	1.10
F..47	1.50	1.80	1.10	1.90	1.50	1.70
F..57	2.70	3.50	2.10	3.40	2.90	3.00
F..67	2.70	3.80	1.90	3.80	2.90	3.20
F..77	5.9	7.3	4.30	8.0	6.0	6.3
F..87	10.8	13.0	7.7	13.8	10.8	11.0
F..97	18.5	22.5	12.6	25.2	18.5	20.0
F..107	24.5	32.0	19.5	37.5	27.0	27.0
F..127	39.0	54.5	34.0	61.0	45.0	46.5
F..157	68.0	103.0	62.0	104.0	85.0	77.0

Helical-bevel (K) gear units

K.., KA..B, KH..B, KV..B:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
K..37	0.50	1.00	1.00	1.25	0.95	0.95
K..47	0.80	1.30	1.50	2.00	1.60	1.60
K..57	1.20	2.30	2.50	2.80	2.60	2.40
K..67	1.10	2.40	2.60	3.45	2.60	2.60
K..77	2.20	4.10	4.40	5.8	4.20	4.40
K..87	3.70	8.0	8.7	10.9	8.0	8.0
K..97	7.0	14.0	15.7	20.0	15.7	15.5
K..107	10.0	21.0	25.5	33.5	24.0	24.0
K..127	21.0	41.5	44.0	54.0	40.0	41.0
K..157	31.0	62.0	65.0	90.0	58.0	62.0
K..167	33.0	95.0	105.0	123.0	85.0	84.0
K..187	53.0	152.0	167.0	200	143.0	143.0

KF..:

Gear unit type	Fill quantity in liters					
	M1	M2	M3	M4	M5	M6
KF37	0.50	1.10	1.10	1.50	1.00	1.00
KF47	0.80	1.30	1.70	2.20	1.60	1.60
KF57	1.30	2.30	2.70	3.15	2.90	2.70
KF67	1.10	2.40	2.80	3.70	2.70	2.70
KF77	2.10	4.10	4.40	5.9	4.50	4.50
KF87	3.70	8.2	9.0	11.9	8.4	8.4
KF97	7.0	14.7	17.3	21.5	15.7	16.5
KF107	10.0	21.8	25.8	35.1	25.2	25.2
KF127	21.0	41.5	46.0	55.0	41.0	41.0
KF157	31.0	66.0	69.0	92.0	62.0	62.0

Lubricant table

01 805 09 92US

Gear unit	5) °C -50 0 +50 +100	DIN (ISO)	ISO,NLGI	ExxonMobil	Shell	Klüber Lubrication	Aral	bp	Tribol	Texaco	Optimol	Fuchs	Total
R...	Standard -10 +40	CLP(CC)	VG 220	Mobilgear 600XP 220	Shell Omala 220	Klüberoil GEM 1-220 N	Aral Degol BG 220	BP Energol GR-XP 220	Tribol 1100/220	Meropa 220	Optigear BM 220	Renolin CLP 220	Carter EP 220
	-25 +80	CLP PG	VG 220	Mobil Glygoyle 30	Shell Tivela S 220	Klübersynth GH 6-220	Aral Degol GS 220	BP Enersyn SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex A 220		Carter SY 220
K...(HK...)	4) -40 +80	CLP HC	VG 220	Mobil SHC 630	Shell Omala HD 220	Klübersynth GEM 4-220 N	Aral Degol PAS 220		Tribol 1510/220	Pinnacle EP 220	Optigear Synthetic A 220	Renolin Unisyn CLP 220	
	4) -40 +40	CLP HC	VG 150	Mobil SHC 629	Shell Omala HD 150	Klübersynth GEM 4-150 N				Pinnacle EP 150			Carter SH 150
	-20 +25	CLP (CC)	VG 150 VG 100	Mobilgear 600XP 100	Shell Omala 100	Klüberoil GEM 1-150 N	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150	Carter EP 100
F...	-30 +10	HLP (HM)	VG 68-46 VG 32	Mobil D.T.E. 13M	Shell Tellus T 32	Klüberoil GEM 1-68 N	Aral Degol BG 46		Tribol 1100/68	Rando EP Ashless 46	Optigear 32	Renolin B 46 HVI	Equivis ZS 46
	4) -40 +10	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46			Dacnis SH 32
	4) -40 -20	HLP (HM)	VG 22 VG 15	Mobil D.T.E. 11M	Shell Tellus T 15	Isoflex MT 30 ROT		BP Energol HLP-HM 15		Rando HDZ 15			Equivis ZS 15
S...(HS...)	Standard 0 +40	CLP (CC)	VG 680	Mobilgear 600XP 680	Shell Omala 680	Klüberoil GEM 1-680 N	Aral Degol BG 680	BP Energol GR-XP 680	Tribol 1100/680	Meropa 680	Optigear BM 680	Renolin CLP 680	Carter EP 680
	-20 +60	CLP PG	VG 680 1)		Shell Tivela S 680	Klübersynth GH 6-680		BP Enersyn SG-XP 680	Tribol 800/680	Synlube CLP 680			
	4) -30 +80	CLP HC	VG 460	Mobil SHC 634	Shell Omala HD 460	Klübersynth GEM 4-460 N				Pinnacle EP 460			
	4) -40 +10	CLP HC	VG 150	Mobil SHC 629	Shell Omala HD 150	Klübersynth GEM 4-150 N				Pinnacle EP 150			Carter SH 150
	-20 +10	CLP (CC)	VG 150 VG 100	Mobilgear 600XP 100	Shell Omala 100	Klüberoil GEM 1-150 N	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150	Carter EP 100
	-25 +20	CLP PG	VG 220 1)	Mobil Glygoyle 30	Shell Tivela S 220	Klübersynth GH 6-220	Aral Degol GS 220	BP Enersyn SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex A 220		Carter SY 220
	4) -40 0	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46			Dacnis SH 32
R...,K...(HK...), F...,S...(HS...)	Standard -20 +40	CLP PG	VG 460 1)			Klübersynth UH1 6-460							
	4) -30 +40	HCE	VG 460		Shell Cassida Fluid GL 460	Klüberoil 4UH1-460 N	Aral Eural Gear 460				Optileb GT 460		
	-20 +40	E	VG 460			Klüberbio CA2-460	Aral Degol BAB 460				Optisynt BS 460		
W...(HW...)	Standard -20 +40	SEW PG	VG 460 2)			Klüber SEW HT-460-5							
	4) -40 +10	API GL5	SAE 75W90 (~VG 100)	Mobilube SHC 75 W90-LS									
	-20 +40	CLP PG	VG 460 3)			Klübersynth UH1 6-460							

6 Inspection and Maintenance

6.1 Inspection and maintenance intervals

Frequency	What to do?
• Every 3000 machine hours, at least every 6 months.	• Check oil and oil level. • Check the seals visually for leakage. • For gear units with a torque arm: Check the rubber buffer and change it, if necessary
• Depending on the operating conditions (see chart below), every 3 years at the latest. • According to oil temperature.	• Change mineral oil.
	• Replace anti-friction bearing grease (recommendation). • Replace oil seal (do not install it in the same track).
• Depending on the operating conditions (see chart below), every 5 years at the latest. • According to oil temperature.	• Change synthetic oil
	• Replace anti-friction bearing grease (recommendation). • Replace oil seal (do not install it in the same track).
• Gear unitsR07, R17, R27, F27 and Spiroplan® are have lubrication for life and are therefore maintenance-free	
• Varying (depending on external factors).	• Touch up or renew the surface/anticorrosion coating.

6.2 Lubricant change intervals

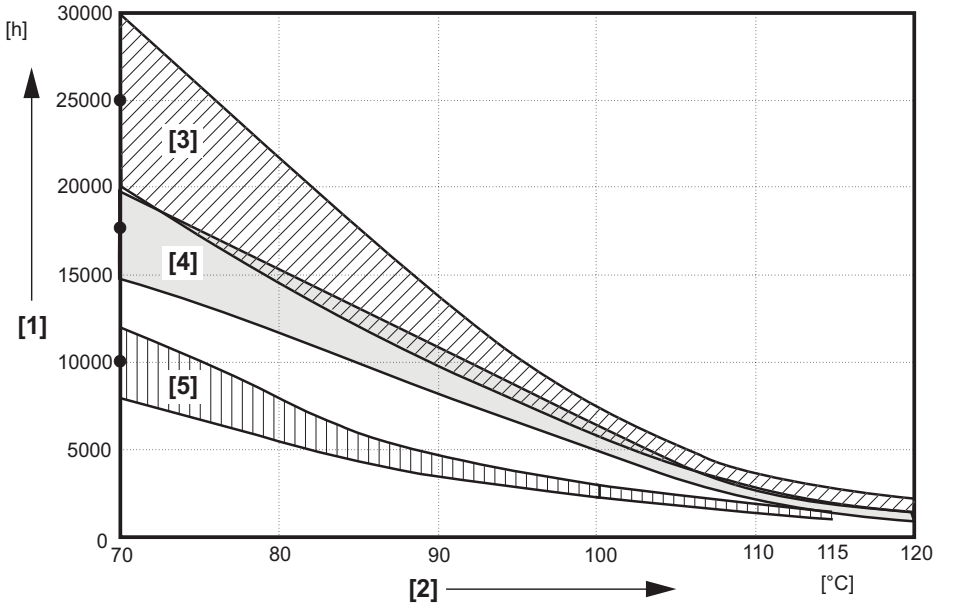

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Figure 13: Oil change intervals for standard gear units under normal environmental conditions

[1] Operating hours
[2] Sustained oil bath temperature
- Average value per oil type at 70 °C

[3] CLP PG
[4] CLP HC / HCE
[5] CLP / HLP / E

6.3 Inspection and maintenance of the gear unit

Do not intermix synthetic lubricants and do not mix synthetic and mineral lubricants together!

The standard lubricant is mineral oil (except for Spiroplan® gear units).

The position of the oil level and oil drain plug and the breather valve depends on the mounting position. Refer to the diagrams of the mounting positions.

Checking the oil level

1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**

   Wait until the gear unit has cooled off – Danger of burns!
2. Refer to Sec. "Installing the gear unit" when changing the mounting position!
3. For gear units with an oil level plug: Remove the oil level plug, check the fill level and correct it if necessary. Screw the oil level plug back in.

Checking the oil

1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**

   Wait until the gear unit has cooled off – Danger of burns!
2. Remove a little oil from the oil drain plug.
3. Check the oil consistency.
   - Viscosity
   - If you can see that the oil is heavily contaminated, we recommend that you change the oil even if this is outside the service intervals specified in "Inspection and maintenance periods".
4. For gear units with an oil level plug: Remove the oil level plug, check the fill level and correct it if necessary. Screw the oil level plug back in.

Changing the oil

Only change the oil when the gear unit is at operating temperature.

De-energize the gearmotor and secure it to prevent it from being switched back on inadvertently!

Wait until the gear unit cools down - Danger of burns!

Note: The gear unit must still be warm otherwise the high viscosity of excessively cold oil will make it harder to drain the oil correctly.

With oil drain plug / oil level screw

1. Place a container underneath the oil drain plug
2. Remove the oil level plug, breather plug/breather valve and oil drain plug.
3. Drain all the oil.
4. Screw in the oil drain plug.
5. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.
   - Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.
   - Check at the oil level plug.
6. Screw the oil level plug back in
7. Screw in the breather plug/breather valve.

Without oil drain plug / oil level plug

1. Remove cover plate.
2. Drain the oil through the cover plate opening.
3. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.
   – Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.
4. Check the oil level (→ Sec. "Check oil level for gear units with oil level plug")
5. Attach cover plate (observe the tightening torque and series → Sec. "Check the oil level for gear units without an oil level plug")

Changing the oil seal

1. **De-energize the gearmotor and secure it to prevent it from being switched on inadvertently!**

   Wait until the gear unit has cooled off – Danger of burns!
2. When changing the oil seal, ensure that there is a sufficient grease reservoir between the dust lip and protective lip, depending on the type of gear unit.
3. If you use double oil seals, the space has to be filled one-third with grease.

6.4 Inspection / maintenance of AM / AQA adapters

Frequency	What to do?
• Every 3000 machine hours, at least every 6 months	• Check torsional play • Visually check the elastic annular gear • Check the adapter visually for leakage
• After 25000 - 30000 machine hours	• Renew the anti-friction bearing grease • Replace oil seal (do not install it in the same track) • Change the elastic coupling spider

6.5 Inspection / maintenance of AD adapters

Frequency	What to do?
• Every 3000 machine hours, at least every 6 months	• Check running noise for possible bearing damage • Check the adapter visually for leakage
• After 25000 - 30000 machine hours	• Renew the anti-friction bearing grease
	• Change the oil seal

7 Malfunctions

Customer service

Please have the following information to hand if you require the assistance of our customer service:
- Data from the nameplate (complete)
- Nature and extent of the fault
- Time and peripheral circumstances of the fault
- Presumed cause

7.1 Gear unit malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	A Meshing/grinding noise: Bearing damage. B Knocking noise: Irregularity in the gearing	A Check the oil (see Sec. "Inspection and Maintenance"), change bearings B Contact customer service
Unusual, irregular running noise	Foreign bodies in the oil	• Check the oil (see Sec. "Inspection and Maintenance") • Stop the drive, contact customer service
Oil leaking[1)] • From the gear cover plate • From the motor flange • From the motor oil seal • From the gear unit flange • From the output end oil seal	A Rubber seal on the gear cover plate leaking B Seal defective C Gear unit not vented	A Tighten the bolts on the gear cover plate and observe the gear unit. Oil still leaking: Contact customer service B Contact customer service C Vent the gear unit (see Sec. "Mounting Positions")
Oil leaking from breather valve	A Too much oil B Drive operated in incorrect mounting position C Frequent cold starts (oil foams) and/or high oil level	A Correct the oil level (see Sec. "Inspection and Maintenance") B Mount the breather valve correctly (see Sec. "Mounting Positions") and correct the oil level (see "Lubricants")
Output shaft does not turn although the motor is running or the input shaft is rotated	Connection between shaft and hub in gear unit interrupted	Send in the gear unit/gearmotor for repair

1) Short-term oil/grease leakage at the oil seal is possible in the run-in phase (24 hours running time).

7.2 AM / AQA / AL adapter malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	Meshing/grinding noise: Bearing damage	Contact SEW-EURODRIVE customer service
Oil leaking	Seal defective	Contact SEW-EURODRIVE customer service
Output shaft does not turn although the motor is running or the input shaft is rotated	Connection between shaft and hub in gear unit interrupted	Send the gear unit to SEW-EURODRIVE for repair.
Change in running noise and / or vibrations occur	A Annular gear wear, short-term torque transfer through metal contact B Bolts to secure hub axially are loose.	A Change the coupling spider B Tighten the bolts
Premature wear in annular gear	A Contact with aggressive fluids / oil; ozone influence; too high ambient temperatures etc, which can cause a change in the physical properties of the annular gear. B Impermissibly high ambient/contact temperature for the annular gear; maximum permitted temperature –20 °C to +80 °C. C Overload	Contact SEW-EURODRIVE customer service

14.4 Technical data of 4-pole high efficiency motors

1800 rpm - S1

Motor type	P_N T_N [HP] [lb-in]	n_N [rpm]	I_N 230V [A]	I_N 460V [A]	I_N 575V [A]	cosφ	$\eta_{100\%}$ [%][1]	I_A/I_N	T_A/T_N T_H/T_N	Code Letter	J_{Mot} [10^{-3} lb-ft^2]	m [lb][2]
DRS71S4[3]	0.25 8.93	1700	0.9	0.45	0.36	0.69	72.0	4.2	1.9 1.9	G	11.6	17.2
DRS71S4[3]	0.33 12.3	1700	1.24	0.62	0.49	0.69	72.0	4.2	1.9 1.9	G	11.6	17.2
DRS71S4[3]	0.5 18.5	1700	1.84	0.92	0.74	0.69	72.0	4.2	1.9 1.9	G	11.6	17.2
DRS71M4[3]	0.75 27.4	1690	2.5	1.25	1.0	0.71	74.0	4.3	2.2 2.1	G	16.8	20.1
DRE80M4	1 36.2	1740	2.9	1.44	1.15	0.78	82.5	7.1	3 2.1	K	51	31.5
DRE90M4	1.5 53.1	1740	4.5	2.25	1.8	0.73	84.0	7.7	3.6 2.9	L	84.3	40.6
DRE90L4	2 72.5	1740	5.7	2.85	2.3	0.77	85.5	7.5	3.4 3.0	K	103	47.4
DRE100L4	3 107	1735	8.0	4.0	3.2	0.79	87.5	8.1	4 3.3	K	161	63.9
DRE100LC4	5 177	1750	12.9	6.5	5.2	0.83	87.5	7.6	2.5 2.3	J	213	68.4
DRE132S4	5.4 190	1765	13.8	6.9	5.5	0.81	88.5	8.7	2.9 2.5	K	451	102
DRE132M4	7.5 265	1755	18	9	7.2	0.85	89.5	8.1	2.5 1.6	J	605	132
DRE132MC4	10 358	1770	24.5	12.3	9.8	0.82	89.5	8.7	2.1 1.6	K	807	138
DRE160M4	12.5 438	1770	31	15.4	12.3	0.82	91.0	8	3 2.2	J	1068	196
DRE160MC4	15 522	1780	36.5	18.3	14.6	0.82	91.7	8.2	2.9 2	J	1401	207
DRE180M4	20 716	1775	47.5	24	19	0.86	91.7	7.4	2.6 1.9	H	2636	304
DRE180L4	25 885	1775	60	30	24	0.84	93.0	8.1	2.9 2.2	J	3087	335
DRE180LC4	30 1044	1780	71	35.5	28.5	0.84	93.0	7.6	2.4 1.8	J	3990	355
DRE200L4	40 1424	1780	99	49.5	39.5	0.82	93.0	7.4	2.6 2.1	J	5605	573
DRE225S4	50 1761	1775	119	59	47.5	0.84	93.0	7.2	2.7 2.0	H	6958	650
DRE225M4	60 2124	1780	142	71	57	0.85	93.6	7.3	2.8 1.9	H	8146	694

1) Efficiency levels according to IEC 60034-2-1 Ed. 1 (2007) / PLL from Residual Losses, NEMA MG1 and/or DoE

2) Applies for foot-mounted motor (DRS and DRE.../FL..)

3) Standard efficiency motor

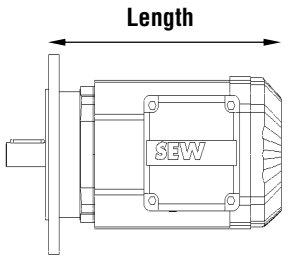
US DoE CC056A applies to DRE, DRP and DVE motors

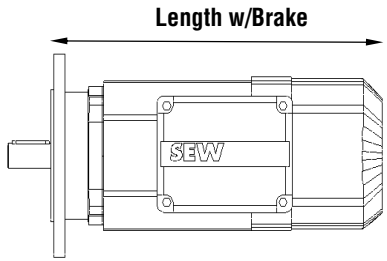
Dimension Comparison – DR & DT/DV Motors

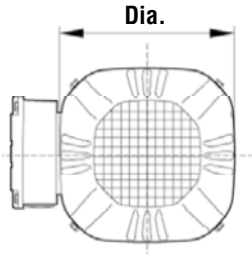
4-2010
Replaces: M-111-01

DT/DV Series Motor	DRS Series Standard Efficiency	DRE Series High Efficiency	DRP Series PREMIUM Efficiency	Power [Hp]	Power [kW]	DT/DV/DR			DRS			DRE			DRP			New Standard vs. DT/DV		
						Length	w/BMG	Diameter	Length	w/BE	Dia.	Length	w/BE	Dia.	Length	w/BE	Dia.	Length	w/Brake	Dia.
DT56M4	-	-	-	0.13	0.09	136	172	109	-	-	-	-	-	-	-	-	-	-	-	-
DR63S4	-	-	-	0.15	0.12	187	242	132	-	-	-	-	-	-	-	-	-	-	-	-
DT56L4	-	-	-	0.2	0.15	136	172	109	-	-	-	-	-	-	-	-	-	-	-	-
DR63M4	DRS71S4	-	-	0.25	0.18	187	242	132	198	266	139	-	-	-	-	-	-	+11	+24	+7
DT71K4						202	266	145				-	-	-	-	-	-	-4	0	-6
DR63L4	DRS71S4	-	-	0.33	0.25	187	242	132	198	266	139	-	-	-	-	-	-	+11	+24	+7
DT71C4						202	266	145				-	-	-	-	-	-	-4	0	-6
DT71D4	DRS71S4	-	-	0.5	0.37	202	266	145	198	266	139	-	-	-	-	-	-	-4	0	-6
DT80K4	DRS71M4	-	-	0.75	0.55	252	316	145	223	291	139	-	-	-	-	-	-	-29	-25	-6
DT80N4	DRS80S4	DRE80M4	DRP90M4	1.0	0.75	252	316	145	241	322	156	272	353	156	266	359	179	+20	+37	+11
DT90S4	DRS80M4	DRE90M4	DRP90L4	1.5	1.1	257	342	197	272	353	156	266	359	179	286	379	179	+9	+17	-18
DT90L4	DRS90M4	DRE90L4	DRP90L4	2.0	1.5	257	342	197	266	359	179	286	379	179	286	379	179	+29	+37	-18
DT100LS4	DRS90L4	DRE100L4	DRP112M4	3.0	2.2	311	396	197	286	379	179	346	439	197	352	464	221	+41	+43	0
DV100M4	DRS90L4	DRE100L4	DRP112M4	3.0	2.2	341	426	197	316	409	197	346	439	197	387	499	221	+5	+13	0
DT100L4	DRS100M4	DRE100LC4	DRP132S4	5.0	3.7	341	426	197	316	409	197	346	439	197	387	499	221	+5	+13	0
DV100L4																				
DV112M4	DRS100L4	DRE132S4	-	5.4	4.0	349	429	221	346	439	197	387	499	221	-	-	-	+38	+70	0
DV132S4	DRS132S4	DRE132M4	DRP160S4	7.5	5.5	394	474	221	387	499	221	437	549	221	460	597	272	+43	+75	0
DV132M4	DRS132M4	DRE132MC4	DRP160S4	10	7.5	407	519	275	437	549	221	437	549	221	460	597	272	+30	+30	-54
DV132ML4	DRS132MC4	DRE160M4	DRP160M4	12.5	9.2	462	574	275	437	549	221	460	597	272	460	597	272	-2	+23	-3
DV160M4	DRS160M4	DRE160MC4	DRP160MC4	15	11	462	574	275	460	597	272	460	597	272	460	597	272	-2	+23	-3
DV160L4	DRS160MC4	DRE180M4	DRP180M4	20	15	509	665	331	460	597	272	540	739	317	540	739	317	+31	+74	-14
DV180M4	DRS180M4	DRE180L4	DRP180L4	25	18.5	581	737	331	540	739	317	600	799	317	583	772	317	+19	+62	-14
DV180L4	DRS180L4	DRE180LC4	DRP180LC4	30	22	581	737	331	600	799	317	600	799	316	600	799	316	+19	+62	-15
DV200L4	DRS180LC4	DRE200L4	DRP225S4	40	30	616	772	394	600	799	317	649	869	394	649	869	394	+33	+97	0
DV225S4	DRS225S4	DRE225S4	DRP225M4	50	37	690	846	394	649	869	394	649	869	394	699	919	394	-41	+23	0
DV225M4	DRS225M4	DRE225M4	-	60	45	690	846	394	699	919	394	699	919	394	-	-	-	+9	+73	0
DV250M4	DRS225MC4	DVE250M4	-	75	55	772	957	510	699	919	394	772	957	510	-	-	-	0	0	0
DV280S4	-	DVE280S4	-	100	75	772	957	510	-	-	-	772	957	510	-	-	-	0	0	0
DV280M4	-	DVE280M4	-	125	90	-	-	-	-	-	-	772	957	510	-	-	-	-	-	-
-	-	DRE315K4	-	150	110	-	-	-	-	-	-	941	1192	624	-	-	-	-	-	-
-	-	DRE315S4	-	200	150	-	-	-	-	-	-	941	1192	624	-	-	-	-	-	-
-	-	DRE315M4	-	250	185	-	-	-	-	-		1071	1322	624	-	-	-	-	-	-
-	-	DRE315L4	-	275	200	-	-	-	-	-	-	1071	1322	624	-	-	-	-	-	-
-	-	DRE315L4	-	300	225	-	-	-	-	-	-	1071	1322	624	-	-	-	-	-	-

NOTES:
1. BLUE denotes USA standard motor
2. Copper rotor always selected for non-standard motor
3. All dimension units are metric [mm]
4. Dia. (diameter) dimension does not include conduit box
5. Longest flange selected for Length, w/BMG, and /BE dimensions
6. **New Standard vs. DT/DV** useful when replacing motors
7. RED = larger new dimension Δ, GREEN = smaller Δ







SEW EURODRIVE

Technical Note

M-111-02

Technical Note

Severe Duty Motors

Motors

Motors operating outdoors or within chemical or food processing plants are subjected to corrosive conditions. Large temperature and humidity variations draw moist air inside the motor's stator. As the motor cools, the moist air condenses. As the condensation accumulates, corrosion occurs. Eventually, corrosion degrades the wire insulation, causing the windings to short and the motor to fail.

SEW-Eurodrive motors and brakemotors are available with Severe Duty (-KS) protection. This option is available with induction motors, permanent magnet servomotors, and Movimot® motors.

Features of Severe Duty Protection

- 6mm drain holes are drilled into the motor stator, the conduit box, and endshields at the lowest location for the given mounting position. These holes allow the draining of all condensation inside the motor. (Exception: Movimot® motors and motors with TENV, IP55, or IP65 ratings do not have drain holes.)
- Internal surfaces including the stator bore, windings, endshields, and conduit box are coated with Dolph's Spray ER-41, Class F polyurethane red insulator.
- Mating surfaces of the endshields are sealed.
- All fastener hardware is plated or stainless steel.
- Paint process includes a primer base coat followed by a corrosion resistant topcoat.
- 1.15 Service Factor on motor
- Clamps are attached to the sealing band of the brake.

Optional Features

- Drain holes may be sealed with threaded plugs for applications involving partial or temporary submersion of the motor.
- Stators with an encapsulated winding and conduit box are available for extremely corrosive or moisture-laden applications. Refer to **Technical Note GM-038** for additional information.
- Tropical duty may be substituted for Severe Duty. The only difference is the type of insulator used to coat the internal surfaces. Tropical Duty includes an insulator that contains an anti-fungal agent.
- Heat strips may be added to the stator for applications involving low ambient temperatures. Heat strips prevent condensation from freezing, allowing it to drain.

Technical Note

AC Induction Motors

Motors

SEW-Eurodrive's DT/DV squirrel-cage induction motors and brakemotors deliver exceptional performance and reliability combined with low maintenance. The high-quality design and construction meet the standards of AC inverter/vector duty motors. In addition, the low-noise, low-inertia, and continuous-duty rating of SEW's brakemotors meet the demands of major applications that require fast, safe braking under tough service conditions.

Product Range

- Power ratings: 0.25 – 100 hp
- 2, 4, 6, 8 single pole configurations
- 2/4, 4/8, 2/6, 2/8 dual pole, two-speed configurations
- Integral mechanical brakes to fit all frames

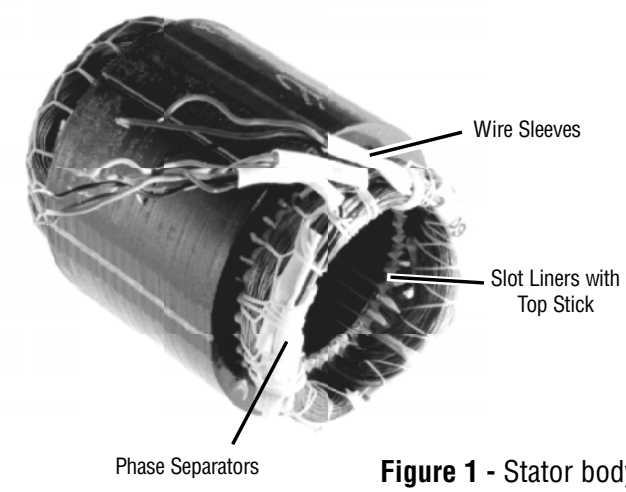


Figure 1 - Stator body

Insulation System

The high-quality insulation system of SEW motors meets NEMA MG1 – 31.4.4.2 Voltage Spikes, a standard used for rating inverter/vector duty motors. The insulation system consists of the following.

- **Insulating varnish** prevents short circuits between adjacent coil wires.
- **Phase Separators** wrapped around each phase bundle prevent short circuits between phases.
- **Insulated Wire Sleeves** protect the motor leads going to the connection block.
- **Paper Slot Liners** and **Top Sticks** prevent winding-to-ground short circuits.
- Entire core assembly is **dipped** into an insulating varnish, then **baked** and cured to provide additional insulation protection and to form the stator into a solid, rugged assembly.

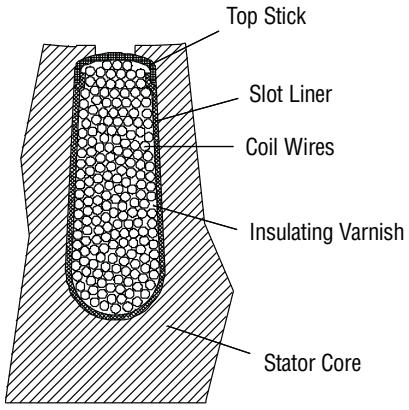


Figure 2 – Stator Slot

Technical Note

Standard Features

- Totally Enclosed Fan Cooled (TEFC)
- Continuous Duty
- Inverter/Vector duty
  - Full-load torque to 300 rpm without additional cooling
  - Inverter/Vector Duty nameplate available at no extra charge upon request
- Electrical Standards per NEMA-MG1
- NEMA Design B/C characteristics
- IEC dimensions (metric)
- Extremely low rotor inertias for high cycle applications
- CSA approved
- CE mark for shipment into Europe
- Oversize cast iron conduit box with connection terminals
- Pressed steel fanguard
- Molded plastic fan
- Class F winding insulation with DuPont® Nomex® phase separators and slot liners
- Copper wound stator
- Oil seal at shaft end shield
- Double sealed or shielded bearings lubed for life
- Stainless steel nameplate
- Cast iron stator frame sizes DV200 and larger
- Aluminum alloy stator frame sizes DV180 and smaller, consisting of the following:
  - Aluminum
  - Silicon 11-13.5%
  - Manganese 0.05%
  - Iron 0.15% maximum
  - Copper 0.01% maximum
  - Zinc 0.01% maximum
  - Magnesium 0.03% maximum
  - Titanium 0.05% maximum

Refer to Technical Note **M-022** for nameplate speeds of Inverter Duty

Mounting Configurations

SEW motors are suitable for mounting in any position. They are available as a stand-alone motor or as an integral part of a gear reducer. The mounting configurations are flange-mounted, foot-mounted, and a combination of foot/flange-mounted.

All SEW motors and brakemotors are available with an IEC standard shaft and an IEC standard flange. Since the shaft diameter, shaft length, flange diameter, flange bolt pattern, and shaft height are industry standard dimensions, SEW motors can interchange with any standard IEC footed or flanged motor (regardless of brand) in either 50 or 60 Hz. Plus, all parts are stocked in the USA for quick delivery.

Figure 3 – Flange-mounted

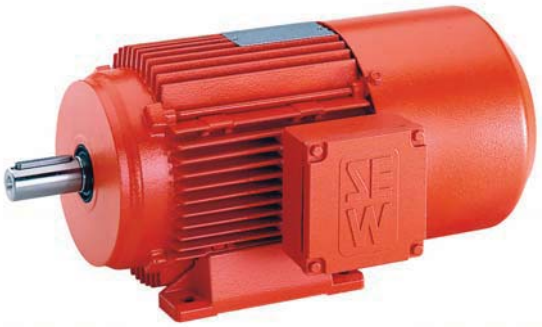


Figure 4 – Foot-mounted

Figure 5 – Foot/flange-mounted

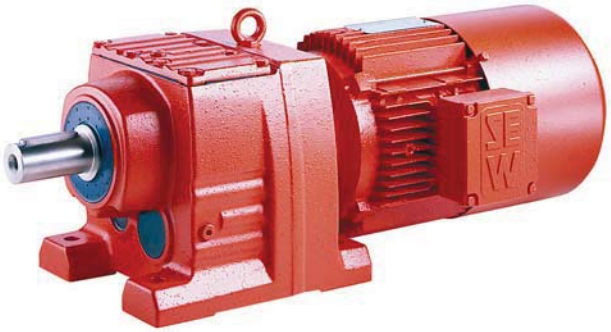


Figure 6 – Integral gearmotor

Optional Features

- High cycling fail-safe brake
- Mounted Movimot® frequency inverter
- 50Hz for worldwide use
- Forced cooling fan for low frequency operation
- Thermostats or thermistors
- Class F or H insulation
- Mounted incremental encoder or absolute encoder
- Mounted proximity sensors
- High inertia cast-iron fan
- Fan-end protective canopy
- Fan-end extended shaft
- Backstop
- Totally Enclosed Non-Ventilated (TENV)
- Metric to NPT adapters for use with conduit
- Severe Duty protection for moist environments
- Encapsulated stator and conduit box
- PTFE seals and PTFE V-ring on motor shaft for superior chemical and washdown protection
- Special, baked 4-layer paint process for extremely harsh environments
- Inverter/Vector Duty nameplate (no extra charge)

Figure 7 – Motor with Movimot®

See **Technical Note GM-038,** Food Industry Option Package, for additional information about extreme motor protection.

Schaltbild/ Circuit diagram/ Schéma de branchement 68 043 05 06

YY/Y in Y, 6pol. Klemmbrett / Double star/star in star, 6 pin terminal board / 6 bornes pour couplage ,YY/Y en Y

Spannungsumschaltbar 1:2 / Voltage switchable 1:2 / Tensions Commutables 1:2

R76

YY-Schaltung – niedere Spannung
Beispiel: 230V

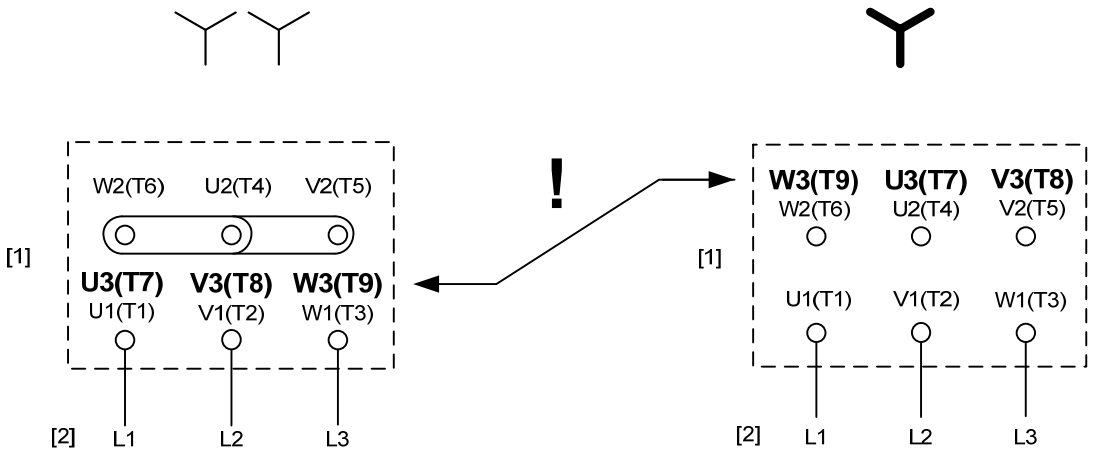
Double Star-connected – low voltage
Example: 230V

Branchement YY – basse tension
Exemple: 230V

Y-Schaltung – hohe Spannung
Beispiel: 460V

Star-connected – high voltage
Example: 460V

Branchement Y – haute tension
Exemple: 460V



68043 XX 06 01 03

Werkseitig Y geschaltet

! Wechsel der Schaltung:
Die Anschlüsse U3(T7), V3(T8) und W3(T9) und Brücken gemäß Schaltbild umverdrahten

[1] Motorklemmenplatte
[2] Zuleitungen

Drehrichtungsumkehr: Vertauschen von 2 Zuleitungen (L1-L2)

Connected star in factory

! Voltage Change:
Move the location of wires U3(T7), V3(T8) and W3(T9). Install or remove brass jumpers according to the wiring diagram

[1] Motor terminal board
[2] Supply leads

To reverse: Interchange 2 supply leads (L1-L2)

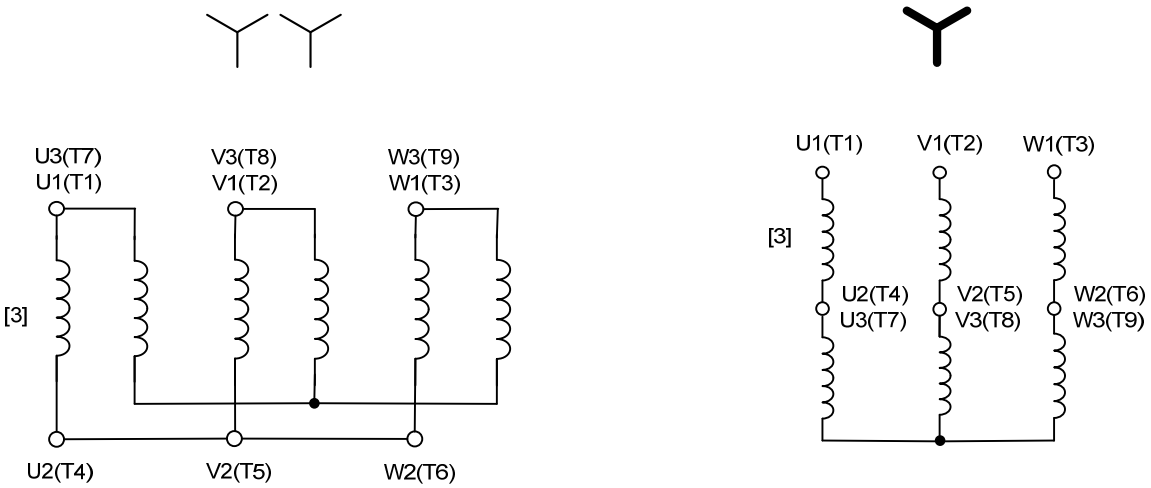
Câblée Y en usine

! Changement de couplage:
Recâbler les raccords U3(T7), V3(T8) et W3(T9) comme indiqué dans le schéma de branchement

[1] Plaques à bornes du moteur
[2] Alimentation

Changement du sens de rotation Inverser deux conducteurs d'alimentation (L1-L2)

R76



68043 XX 06 02 05

[3] Motorwicklung

[3] Motor winding

[3] Bobinage moteur

Instruction Manual • February 2004

milltronics
MFA 4P

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Contact SMPI Technical Publications at the following address:

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Table of Contents

Milltronics MFA 4p

Milltronics MFA 4p is a highly sensitive, single setpoint motion sensor alarm unit, used with MSP and XPP probes. The probe detects an increase or decrease in the speed of rotating, reciprocating, or conveying equipment and sends the information to the MFA 4p. The MFA 4p works with a pre-amplifier which can be internal to the motion sensing probe, or remote from the motion sensing probe.

Pulses generated from the probe are continually compared to the adjustable setpoint. If the pulse rate is lower than the setpoint, the alarm relays operating in a fail-safe mode will de-energize, indicating failure. The relays will not energize until the pulse rate increases above the setpoint.

Safety Notes

Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.

! WARNING means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.

Note: means important information about the product or that part of the operating manual.

The Manual

This instruction manual covers the installation, operation and maintenance of the Milltronics MFA 4p. It is essential that this manual be referred to for proper installation and operation of your unit. Adhering to the installation and operating procedures will insure a quick, trouble free installation and allow for the maximum accuracy and reliability of your motion sensing alarm unit and probes.

If you have any questions, comments, or suggestions about the manual contents, please email us at techpubs@siemens-milltronics.com.

For the complete library of Siemens Milltronics manuals,

go to www.siemens-milltronics.com.

Specifications

Safety

Note: The Milltronics MFA 4p (Motion Failure Alarm) is to be used only in the manner outlined in this manual, otherwise protection provided by the equipment may be impaired.

Power

- 100/115/200/ 230 V AC ±15%, 50/60 Hz, 15 VA

Output

- 2 relays with Form C (S.P.D.T.) fail-safe contacts (relays operate in unison)

Resistive Rating:

- 8 A @ 250 V AC

Repeatability

- ± 1%

Temperature coefficient (setpoint variance)

- 0.018%/ °C (0.01% / °F)

Setpoint adjustment range

- 2 to 3,000 ppm (pulses per minute): standard model
- 0.15 to 15 ppm: slow speed version

Dynamic range

- 0 to 7,200 ppm

Weight

- polycarbonate enclosure: 1.5 kg (3.3 lb.)
- mild steel or stainless steel enclosure: 4.3 kg (9.5 lbs.)

Approvals[1]

- CE, $CSA_{(C/US)}$, FM
- EMC performance available on request

Environmental

- location: Indoor/outdoor
- altitude: 2000 m max.
- ambient temperature: –20 °C to 50 °C (–4 °F to 122 °F)
- relative humidity: suitable for outdoor (Type 4X / NEMA 4X / IP65)*
- installation category: II
- pollution degree: 4

*Type 4/ NEMA 4 /IP65 with mild steel enclosure

Related Equipment	Ambient Temperature Range	Approx wt.
RMA	–40 °C to 60 °C (–40 °F to 140 °F)	2.3 kg (5 lb)
MSP-12	–40 °C to 60 °C (–40 °F to 140 °F)	1.4 kg (3 lb)
XPP-5	–40 °C to 60 °C (–40 °F to 140 °F)	1.8 kg (4 lb)
MSP-1	–40 °C to 80 °C (–40 °F to 180 °F)	0.5 kg (1 lb)
MSP-3	–40 °C to 260 °C (–40 °F to 500 °F)	1.4 kg (3 lb)
MSP-9	–40 °C to 260 °C (–40 °F to 500 °F)	1.8 kg (4 lb)

1. EMC performance available upon request.

Installation

Milltronics MFA 4p

The MFA 4p (and RMA if applicable) must be mounted in a non-hazardous area that is clean, dry, vibration-free, within the ambient temperature range, and non-corrosive to the electronics or its enclosure. The door should be accessible for viewing and to allow calibration of the MFA 4p.

Note: Do not mount MFA 4p in direct sunlight.

Probe

The probe should be mounted onto a vibration free structure using the mounting flange. The gap between probe and target should be large enough to prevent the target from damaging the probe. The probe environment must be within the probe's ambient temperature range and non-corrosive to the probe's body. Refer to Applications drawings on page 23.

The probe design detects a changing magnetic field, typically caused by a ferromagnetic target disturbing the probe's magnetic field. Extremely strong magnetic fields (like those produced by the 30A/m requirements of 1EC 60004-8, Power Frequency Magnetic Field Immunity test) will be detected and will result in loss of functionality.

Functionality loss indicators:

- alarm conditions by relay trip
- false pulse readings in LED1

Consider the probe location carefully before installation. Avoid strong magnetic fields (50/60 Hz) from nearby power transformers, heater elements, or large industrial motors, because these can affect the probe's performance.

Wiring

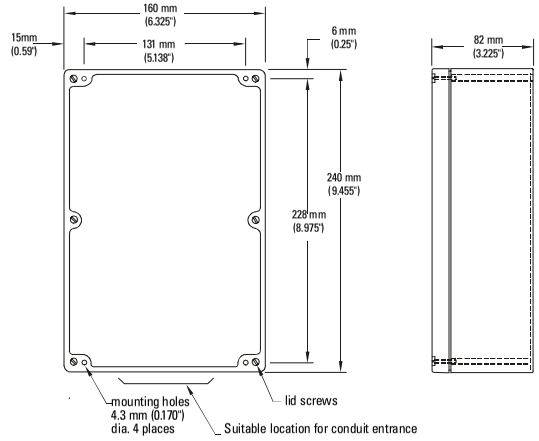
Where possible, the probe components should be interconnected via flexible conduit. This allows for easier removal or adjustment of the probe and mounting flange assembly.

Note: Installation shall only be performed by qualified personnel and in accordance with local governing regulations.

Dimensions

MFA 4p

Type 4X / NEMA 4X / IP65 Polycarbonate Enclosure

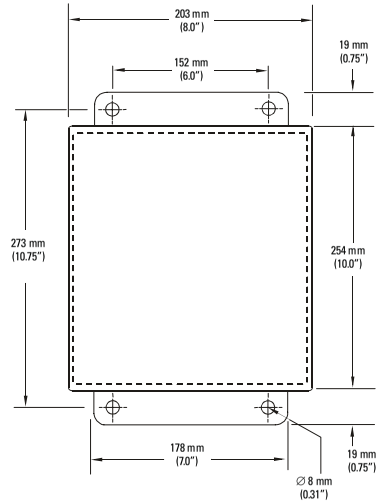


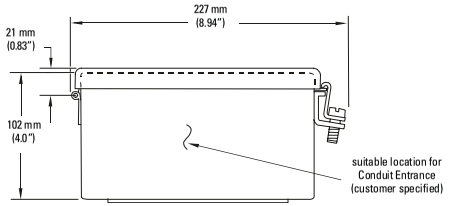
Notes:

- Non-metallic enclosure does not provide grounding between conduit connections: use grounding type bushings and jumpers.
- Use only approved, suitable size hubs for watertight application.

Installation

Type 4 / NEMA 4 / IP65 Painted Steel Enclosure & Type 4X / NEMA 4X / IP65 Stainless Steel Enclosure





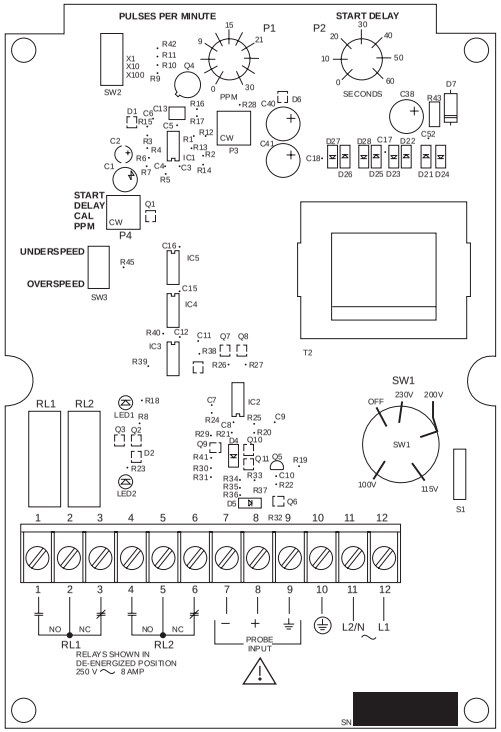
Notes:

- Painted steel enclosure does not provide grounding between conduit connections: use grounding type bushings and jumpers.
- Use only approved, suitable size hubs for watertight application.

Installation

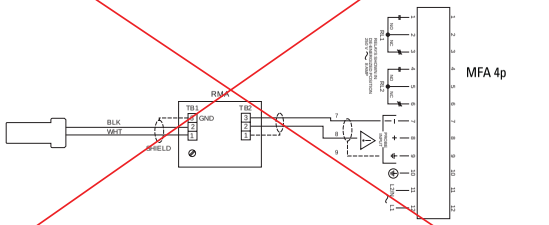
Layout

MFA 4p Circuit Board



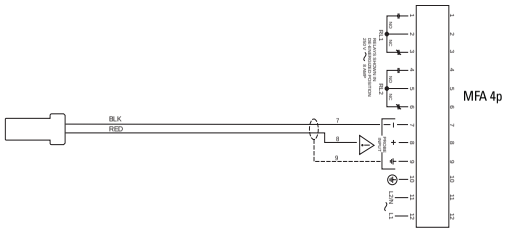
Interconnection

MSP-1, 3, or 9 Probe with RMA (remote mounted pre-amplifier)



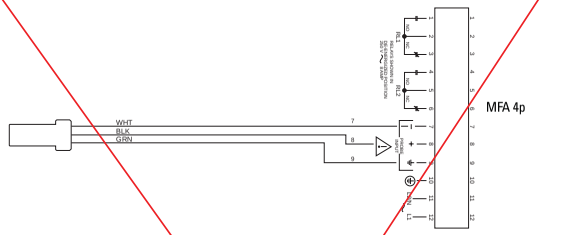
Maximum cable length from probe to RMA is 30 m / 100 ft of shielded cable, 18 ga. wire. See table on page 9 for cable lengths from RMA to main group.

MSP-12 Probe with IMA (internally mounted pre-amplifier)



Wire can be run in conduit common to motor supply or control wiring. Connection to probe leads can be made under probe cap. See table on page 9 for lengths from probe at MFA 4p.

XPP-5 with IMA (internally mounted pre-amplifier)



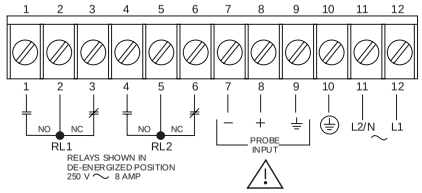
XPP-5 cable must be run in dedicated, approved metal conduit, boxes and fittings and to procedures in accordance with all governing regulations. See table below for lengths from probe at MFA 4p.

Note: Refer to Interconnection Diagram for the XPP-5 (drawing number 23650131) on page 21.

Cable length from RMA or IMA to MFA 4p

Wire gauge	Length in feet	Length in metres
22 AWG (0.34 mm^2)	2500	760
18 AWG (0.75 mm^2)	5000	1520
12 AWG (4 mm^2)	25000	7600

Connection to power:

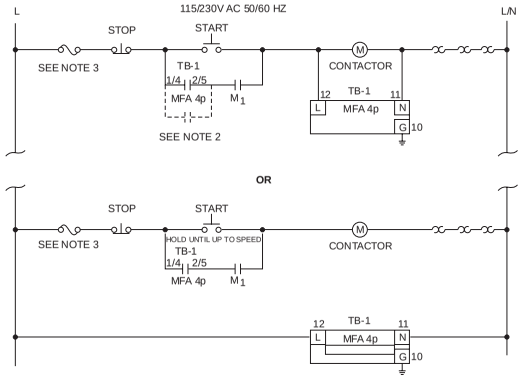


- Terminal 10 ⏚ must be connected to reliable ground.
- The equipment must be protected by a 15A fuse or circuit breaker in the building installation.
- A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.
- AC input circuit, relay circuits, min. 14 AWG copper wire
- Recommended torque on terminal clamping screws, 7 in.lbs. max.

! WARNING: All field wiring must have insulation suitable for at least 250 V.

Wiring

MFA 4p Wiring for Automatic Start Delay



Notes:

1. Interlocks and Safety Pull Switches are not shown.
2. If START is initiated by programmable logic controller, closure time may be too brief to allow MFA 4p contact to latch. In this case, program a timer contact into the circuit.
3. CSA requires an 8A or less fuse to protect contacts. For 240 V AC, protect the contacts with a 1500 VA transformer as well.

Should the Time Delay feature on start-up not be required, power should be applied continuously from a separate source and the potentiometer turned to zero. This is usually necessary for automatic up-stream start up of conveying devices after the down-stream drive has reached its operation speed.

Operating Principles

MFA 4p

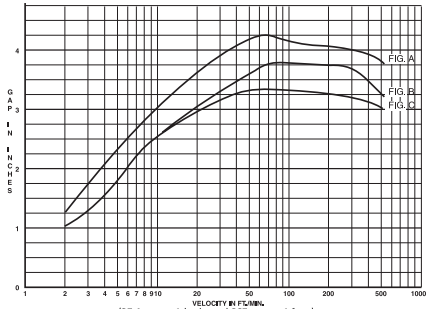
Milltronics MFA 4p is a highly sensitive, single setpoint motion sensor alarm unit, used with MSP and XPP probes. The probe detects an increase or decrease in the speed of rotating, reciprocating, or conveying equipment and sends the information to the MFA 4p. The MFA 4p works with a pre-amplifier which can be internal to the motion sensing probe, or remote from the motion sensing probe.

Pulses generated from the probe are continually compared to the adjustable setpoint. If the pulse rate is lower than the setpoint, the alarm relays operating in a fail-safe mode will de-energize, indicating failure. The relays will not energize until the pulse rate increases above the setpoint.

Probe

The Milltronics probes work on the principle of Faraday's Laws of Electromagnetic Induction. When a ferromagnetic object enters the probe's permanent magnetic field, it distorts the flux causing it to cut the coil windings and generate a voltage. This voltage is proportional to the strength of the magnet and the number of wire turns in the coil (constant in the Milltronics probes) and the speed at which the ferrous target passes through the flux. The generated voltage is also inversely proportional to the square of the distance between the target and the probe.

The relationship between speed and gap of a standard probe:



(25.4 mm = 1 inch and 305 mm = 1 foot)

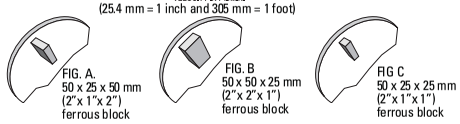


FIG. A.
50 x 25 x 50 mm
(2"x 1"x 2")
ferrous block

FIG. B
50 x 50 x 25 mm
(2"x 2"x 1")
ferrous block

FIG C
50 x 25 x 25 mm
(2"x 1"x 1")
ferrous block

The resultant line indicates the threshold tolerance of the accompanying MFA 4p electronics. For example, in FIG. A, a 100 mm (4") gap requires a minimum velocity of about 10 m / minute (35 ft / minute): with a velocity of 0.61 m / minute (2 ft / minute), a maximum gap of 31 mm (1.25") is possible.

Note: 25.4 mm = 1 inch and 0.305 m = 1 foot

The graph was plotted from tests using four ferrous blocks set equidistantly on a 406 mm (16") diameter circle on a non-ferrous disc.

The physical shape of the ferrous target generally becomes important at low velocities or large gaps. At these points, tests indicate that a cubic shape gives the best results due to the sudden change it causes in the magnetic field.

An increase in block size beyond 50 x 50 x 25 mm (2" X 2" X 1") is generally not as effective as minimizing the gap, except at very low velocities.

The Milltronics Mini Sensing Probe, MSP-1

- The MSP-1 is approximately one-quarter the size of the standard probe with about one-eighth the sensitivity.
- Divide all operating values by 0.125 to obtain the specifications of the MSP-1. For example, with a gap of 12 mm (0.5"), the minimum velocity is approximately 60 m / min. (200 ft / min.), and with a velocity of 0.6 m / min. (2 ft / min.) a maximum gap of 0.125" (3 mm) is possible.

Milltronics manufactures probes to suit a wide variety of environments: low temperature, high temperature, corrosive, and Class I, II and III applications.

Pre-Amplifier (IMA and RMA)

The pre-amplifier accepts the voltage pulses generated by the probe and converts them into noise-immune current pulses. Current levels are 12 mA low and 45 mA high. The pre-amplifier comes internally mounted in the probe, or in an enclosure for remote mounting.

Internally mounted pre-amplifiers are called IMAs. Remote mounted pre-amplifiers are called RMAs.

MFA 4p Operation

The MFA 4p provides a short circuit protected, +24 V DC unregulated supply to the pre-amp. In the event that the interconnecting wiring is shorted, output current from the MFA 4p is automatically limited and the on-board alarm relays are de-energized to indicate failure.

The output current pulses from the pre-amp are super-imposed onto the dc current supply. These are monitored by Probe LED 1, which is illuminated at the rate of the incoming pulses and is useful for positioning the probe.

The rate at which the pulses are received by the MFA 4p is compared to a setpoint reference signal from the time base generator.

Although two pulses within range are required to energize the relays, as long as the frequency of the incoming pulses exceeds the setpoint frequency (or is less than that of the setpoint in the case of overspeed detection), the MFA 4p keeps the alarm relays energized. The reference generator is frequency adjustable by the pulses per minute (ppm) switch and potentiometer.

The alarm relays will de-energize after two time constants of the setpoint when the frequency of the incoming pulses falls below that of the setpoint (or exceeds that of the setpoint in the case of overspeed detection). The relay status is indicated by Relay LED 2, which is illuminated when the relays are energized (normal).

The MFA 4p has a 0 to 60 second time delay feature, allowing the monitored device to accelerate to normal running speed before monitoring begins.

This feature is activated when power is applied to the MFA 4p in parallel with the motor starter contact coil. The time delay circuit simulates normal operating conditions for the amount of time as set by the Start Delay potentiometer, keeping the alarm relays energized. If the monitored device does not reach normal speed before the set time period, the relays will de-energize giving an alarm condition. This feature is not applicable in the overspeed detection mode.

Calibration

The probe and pre-amplifier require no calibration.

Connect the probe, pre-amp, and MFA 4p as shown in the Interconnection diagrams on pages 8 and 9. Connect the MFA 4p to power as shown in the Power Connection diagram on page 10, and if applicable, as shown for Automatic Start Delay on page 11.

Note: To help the calibration procedure, short N.O. contacts of relays to prevent motor shut-down (terminals 1 to 2 and/or 4 to 5). This allows the system to run uninterrupted until an operating setpoint is established.

MFA 4p (Refer to MFA 4p Circuit Board layout on page 7.)

1. Operate monitored equipment at its normal operating speed.
2. Confirm that Probe LED 1 is pulsing at a regular frequency.
3. Set Start Delay fully counter-clockwise (CCW) to 0 seconds.

Underspeed

1. Set switch SW3 to Underspeed.
2. Set pulses per minute (ppm) switch SW2 to X 100 position.
3. Turn ppm potentiometer fully clockwise (CW) to 30.
4. Determine incoming pulse rate by slowly turning ppm potentiometer CCW until relay LED 2 goes on. As the MFA 4p requires 2 pulses within range before energizing relays, low ppm applications (e.g. 2 ppm) may require stepping of potentiometer at appropriate time intervals.

5. If no response is obtained when you set the ppm potentiometer to 3 (below this stability suffers), reset potentiometer fully CW, set switch SW2 to X 10 and then X 1 if required, and repeat step 4.
6. When Relay LED 2 goes on, indicating the incoming pulse rate, turn potentiometer CCW slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations. For 50% of full speed, set potentiometer (and **SW2** if required) to halfway between incoming pulse rate of normal speed and 0 ppm.
7. Set Start Delay by adjusting potentiometer so that equipment being monitored can attain normal operating speed before LED 2 can turn off.

Overspeed

1. Set switch SW3 to Overspeed.
2. Set ppm switch SW2 to X 1 position.
3. Set ppm potentiometer fully CCW to 0.
4. Determine incoming pulse rate by slowly turning ppm potentiometer CW until Relay LED 2 goes on. Because the MFA 4p requires 2 pulses within range before energizing relays, low ppm applications (e.g. 2 ppm) may require stepping of potentiometer at appropriate time intervals.
5. If no response is obtained when you set the ppm potentiometer to 3, (below this stability suffers), re-set potentiometer fully CCW and set switch SW2 to X 10, and then X 1 if required, and repeat step 4.
6. When Relay LED 2 goes on, indicating the incoming pulse rate, turn potentiometer CW slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations.

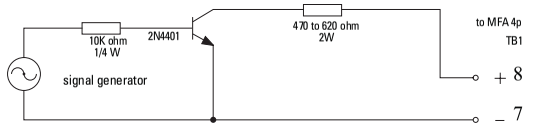
Remember:
If N.O. contacts were shorted as described in final note of calibration preamble, remove them now as calibration is complete.

Wiring

Probes

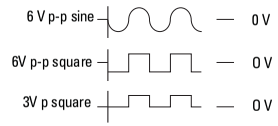
Signal Generator Interface

The following circuit may be used for calibrating or for troubleshooting the MFA 4p.



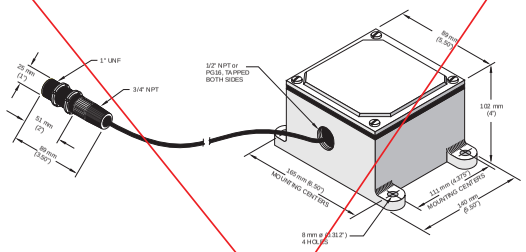
Circuit substitutes operating probe and pre-amp.

Set signal generator for:



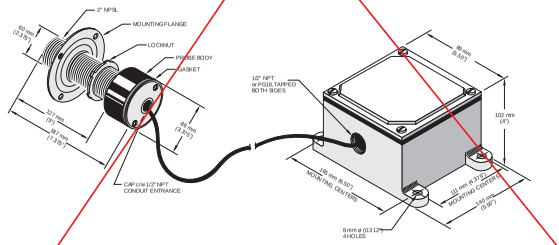
Probes

Mini Sensing Probe MSP-1



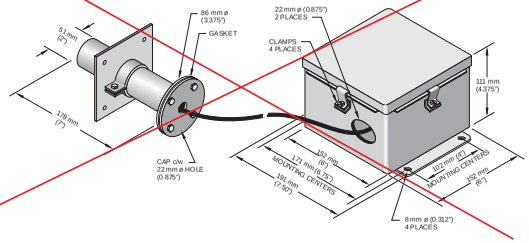
- CPVC body comes with 2 CPVC locknuts
- 180 cm (6 ft.) of Belden 8760 supplied potted in probe
- Remote mounted pre-amp in NEMA 4 cast aluminum enclosure.

High Temperature Probe MSP-3

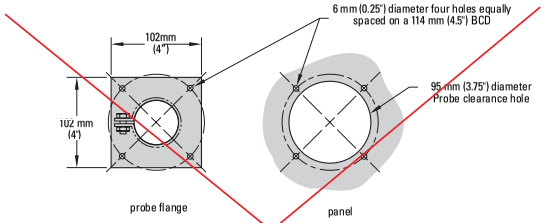


- Cast aluminum body comes with cast aluminum cap and zinc flange, zinc plated locknut, and silicone rubber gasket
- See page 22 for Flange and Mounting Details
- Pre-amp is mounted in a NEMA 4 cast aluminum enclosure

Stainless Steel Probe MSP-9



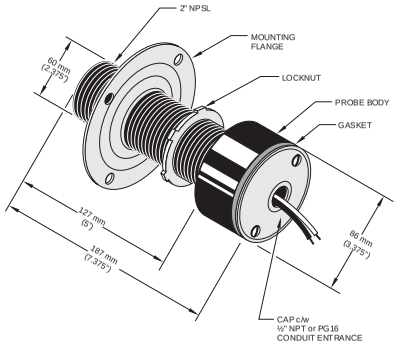
Mounting Details



- For high temperature and corrosion resistance applications
- 304 stainless steel body comes with stainless steel clamp and silicone gasket
- 1.5 m (5 ft.) Belden 83321 Teflon®[1] cable potted in probe
- Pre-amp is mounted in an enamel painted steel Hammond 1414N4E enclosure

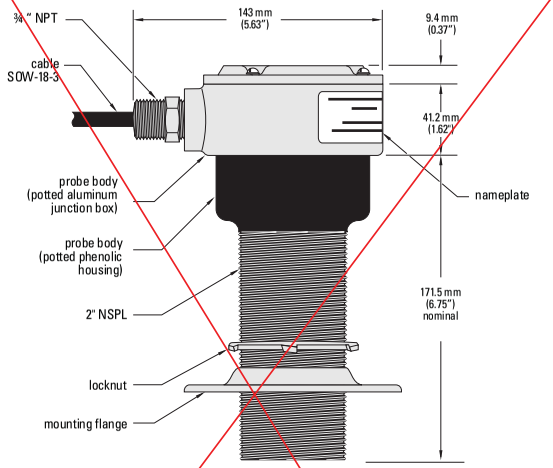
1. Teflon is a registered trademark of E.I. du Pont de Nemours and Company

Standard Probe MSP-12



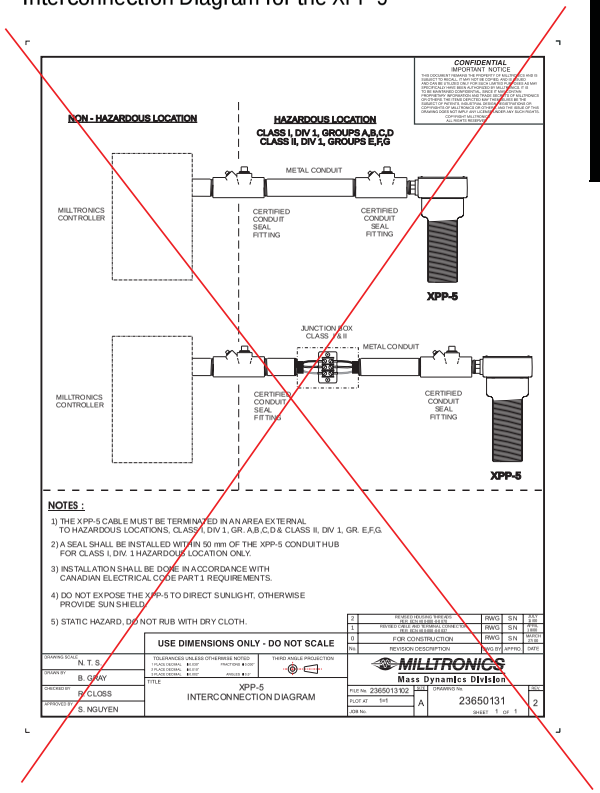
- Phenolic body comes with die-cast aluminum cap and zinc flange, zinc plated locknut, and neoprene gasket
- See page 22 for Flange and Mounting Details
- Pre-amp is potted in the probe body and comes with two 127 mm (5") long hook-up wires

Hazardous Locations XPP-5

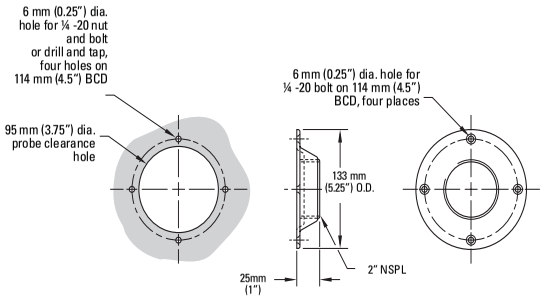


- C.S.A Approved for:
  Class I, Div.1, Gr. A, B, C & D
  Class II, Div 1, Gr. E, F & G
  Class III
- phenolic/aluminum body with die-cast flange and zinc-plated locknut
- see page 22 for mounting details, and pages 9 and 21 for interconnection information.
- pre-amp and cable potted in the probe's body

Interconnection Diagram for the XPP-5



Mounting Details



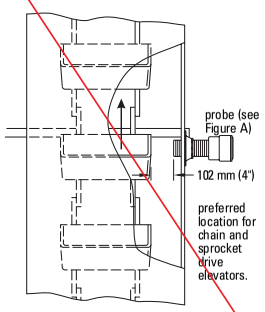
Mounting Flange

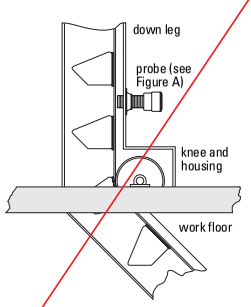
APPLICABLE TO ALL PROBES

EXCEPT MSP-1 AND MSP-9

Applications

Bucket Elevators



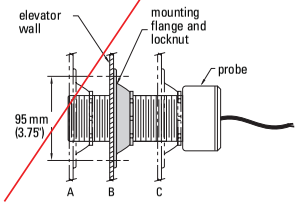


For chain and sprocket drive elevators, place the probe so that the gap between the bucket and the probe does not exceed 102 mm (4"). To prevent damage to the probe from eccentric bucket motion, ensure that the gap is not less than 12.5 mm (0.5") in the worst condition.

Preferred location for belt-driven elevators with ferrous bucket spacing greater than 76 mm (3"), and non-ferrous buckets with ferrous bolts.

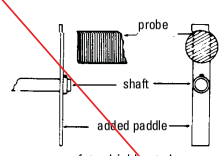
For ferrous buckets with spacings less than 76 mm (3") locate probe on the front of the leg.

Figure A

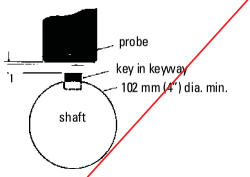


For elevators with ferrous walls, cut 88 mm to 95 mm (3.5" to 3.75") hole in the elevator wall. Any position from A to C may be used to maintain the gap.

Shafts



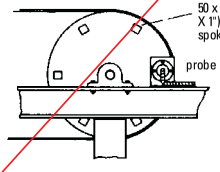
safety shield not shown

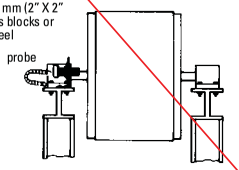


These methods are viable if the speed is such that the blades or key will provide the number of pulses required at a minimum velocity of 1.5 m / minute (5 ft. / minute). In applications where exposed moving parts are required, safety shields and precautions should be applied.

Where conditions prevent the sensing of buckets, a belt pulley or paddle mounted on an exposed shaft end, preferably the tail pulley, may be used.

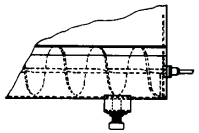
Belt Conveyors



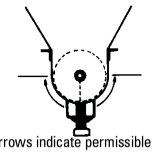


Potential for damage in each application governs the minimum gap allowable. Maximum gap for operation is 102 mm (4"), optimum 25 mm to 50 mm (1" to 2").

Screw Conveyors



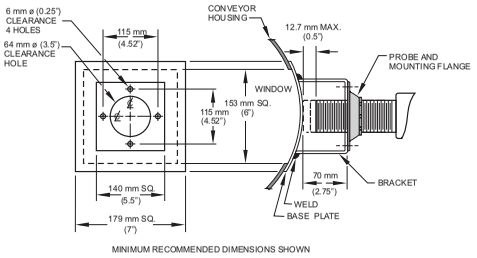
The probe should be located at the idler end (usually feed end)



Arrows indicate permissible placement range of the probe

A ferrous mass added behind the flight of a screw conveyor, where it passes the probe aids Borderline Operation. This mass must be added for all non-ferrous screws.

Non-Ferrous Window



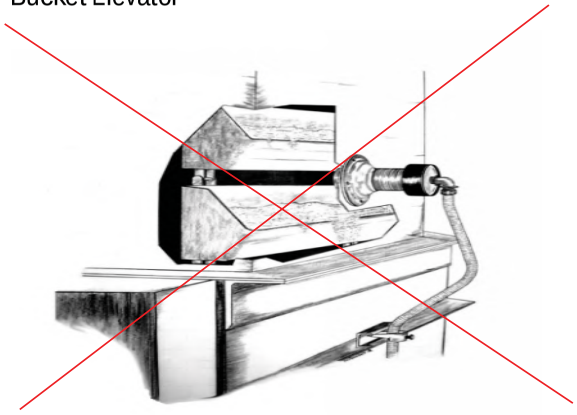
MINIMUM RECOMMENDED DIMENSIONS SHOWN

Applications

For screw conveyor with trough over 3.1 mm (0.125") thick or for high temperature applications. The dimensions shown for the base, window, and bracket are the minimum recommended with tolerances of ± 0.8 mm (0.031"). Use 305, 310, or 316 stainless steel, brass, or aluminum.

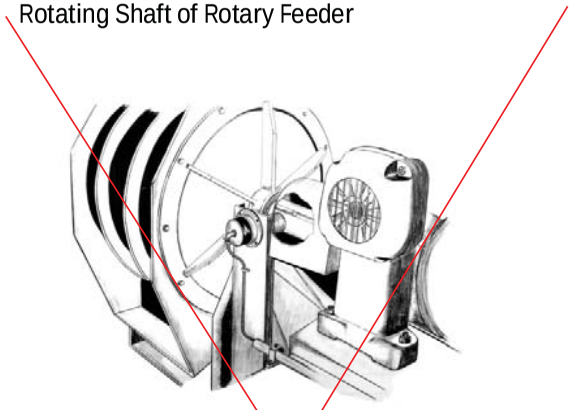
The probe may not touch the window if temperatures are in excess of 60 °C (140 °F) when using the low temperature probes or 260 °C (500 °F) when using the high temperature probes.

Bucket Elevator

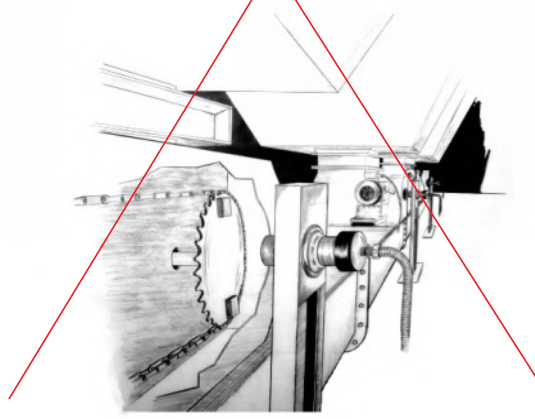


Rotating Shaft of Rotary Feeder

Applications

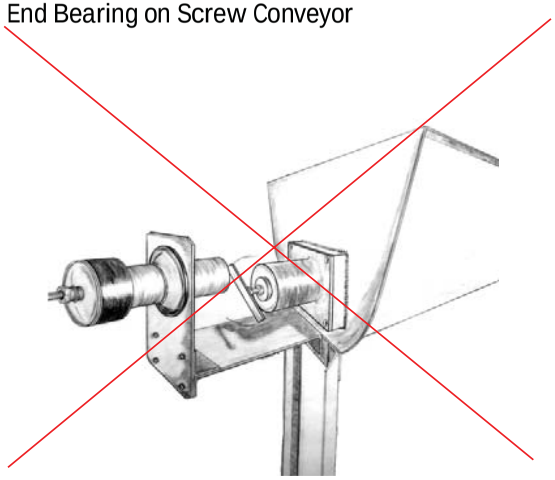


Drive Sprocket on Rotary Feeder



Screw Conveyor Flights

End Bearing on Screw Conveyor



Troubleshooting

	LED 1	LED 2	term 7/8 (note 1)	C8	term 1/2 relay 1 out	term 4/5 relay 2 out
normal	pulsing	on	24 V	27 V	closed	closed
alarm	pulsing	off	24 V	27 V	open	open
probe reversed polarity	on	off	20 V	27 V	open	open
probe wiring open circuit	off	off	27 V	27 V	open	open
probe wiring short circuit	off	off	0 V	27 V	open	open
relay defective	pulsing	on	24 V	27 V	open	open

Notes:

- Voltage levels are dc, nominal values, and may appear to be pulsing, coincidental with LED 1.
- If diagnosis does not solve the malfunction, the probe, pre-amp or MFA 4p may be defective.
- If no spare circuit boards or probes are available for interchanging, the MFA 4p may be tested as follows in order to determine which section is defective:

  a. To find out if the MFA 4p is defective:
     i. Disconnect the pre-amp.
     ii. Set ppm switch SW2 to X 1 position and turn potentiometer to 15.
     iii. Connect one lead of a 530 ohm, 1 watt resistor to terminal 7 and then momentarily contact terminal 8 at a rate of once per second. If the MFA 4p is functional, the relays will energize after two pulses and de-energize approximately 8 seconds after last pulse.

  b. To find out if the RMA is defective:
     i. Disconnect pre-amp from the MFA 4p. Attach probe across terminals TB1 1/2 and a 24Vdc (floating) power supply across terminals TB2 3/2, according to the RMA Interconnectiondiagram on page 8.
     ii. Run equipment to be monitored at normal operating speed or pass a ferrous object in front of and as close to probe as possible at a continuous rate.
     iii. With an oscilloscope, look for approximately 6V peak to peak pulses or alternating hi/lo levels across ground and link 3. Or with an amp meter connected in series between the RMA and the 24Vdc power supply, look for hi/lo levels of approximately 12mA/40mA alternating at the rate of the passing ferrous objects.

c. To find out if the probe is defective (non-IMA type only; i.e. MSP-1 , MSP-3, and MSP-9):

i. Disconnect probe from pre-amp.

ii. Connect an ohmmeter across the black and white leads.

iii. Nominal probe impedances are as follows

MSP-1	115 ohms
MSP- 3 and MSP- 9	750 ohms

If impedance deviates substantially from these values, an open or short circuit condition is indicated.

Maintenance

The Motion Failure Alarm MFA 4p requires no maintenance: however, we recommend a program of periodic checks.

If it is necessary to clean the enclosure and circuit boards:

1. First, make sure the power is disconnected at the main breaker.
2. Use a vacuum cleaner and a clean, dry paint brush.
3. Check all electrical contacts for corrosion and arcing.

It is a good idea to periodically check the face of the probe: it should be free of material build-up, corrosion or deformation.

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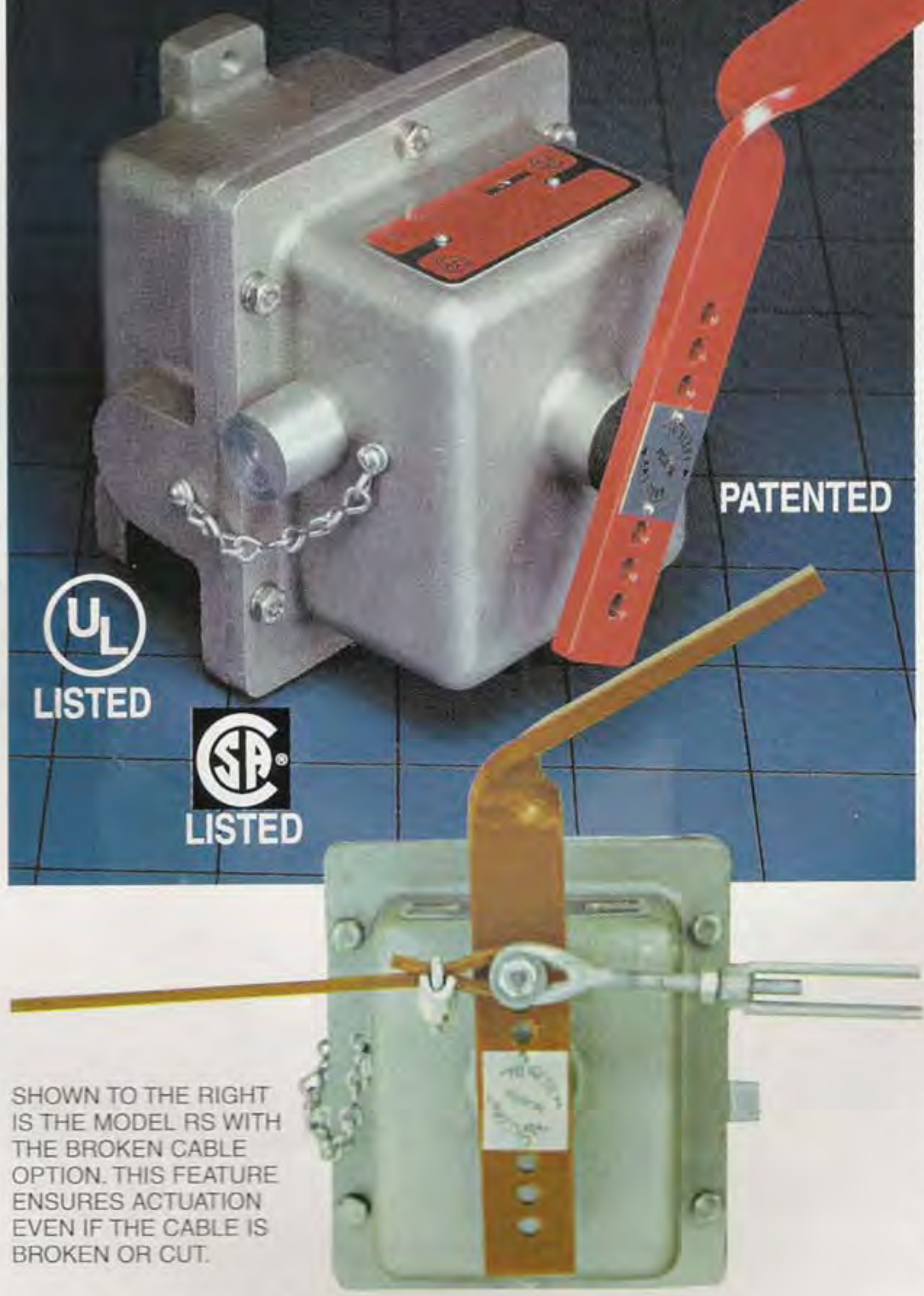
7ML19985FM01
Printed in Canada

Rev. 1.1

MODEL RS

CABLE OPERATED SAFETY STOP SWITCH FOR CONVEYORS



SHOWN TO THE RIGHT IS THE MODEL RS WITH THE BROKEN CABLE OPTION. THIS FEATURE ENSURES ACTUATION EVEN IF THE CABLE IS BROKEN OR CUT.

The model RS Safety Stop Switch in operation for immediate shutdown of conveyor system at a sand and gravel company.

WHAT IT IS AND DOES:

The Model RS is a rugged safety switch that provides a quick positive shut off of dangerous equipment in emergencies or normal operation. It is actuated by a cable pulled by endangered personnel. The output contacts of the Model RS can control up to two separate circuits, one for machinery shutdown and one for alarm.

WHY IS IT NECESSARY?

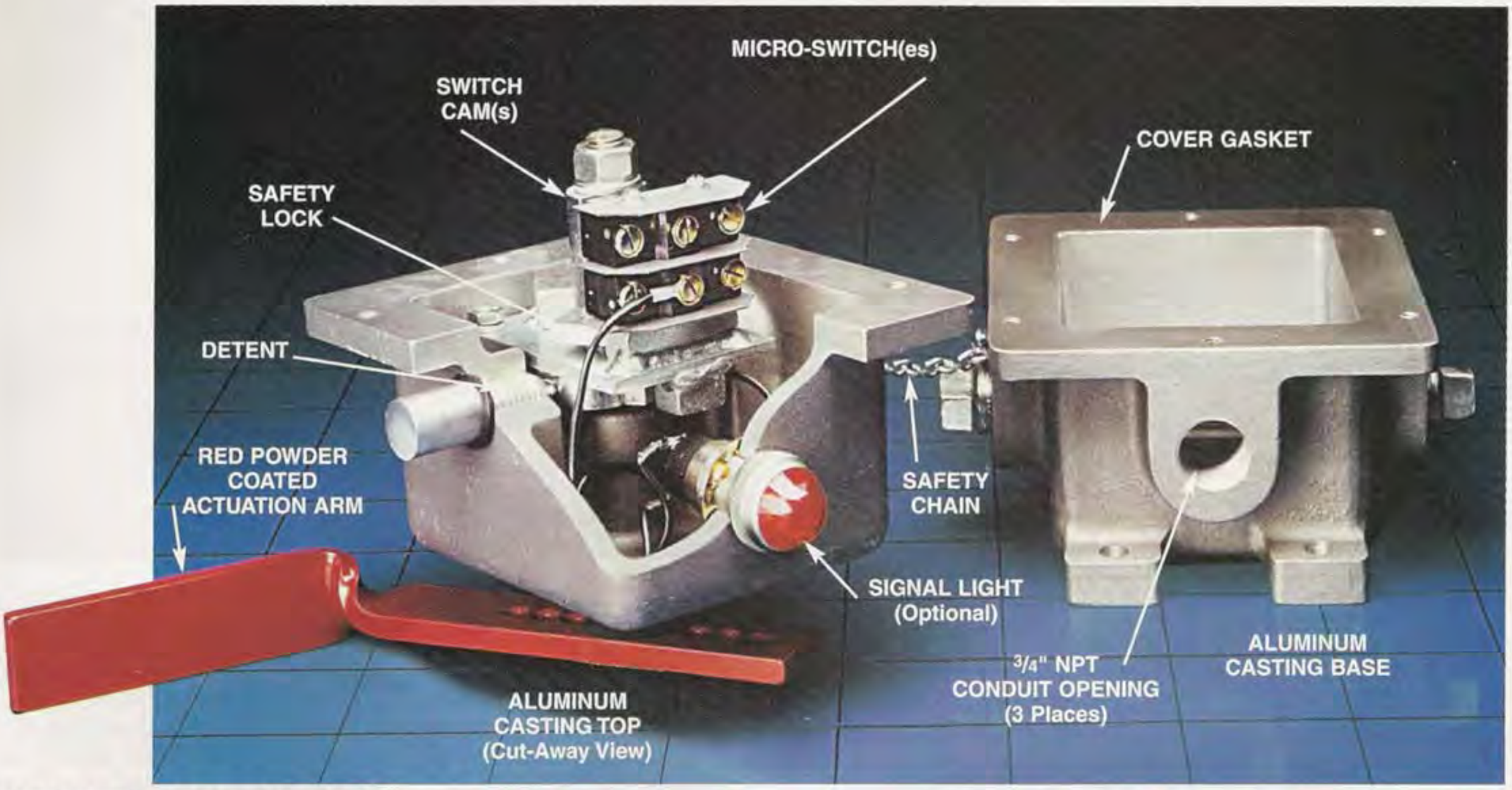
Safety minded operators of conveyors, production lines, elevator equipment, assembly lines, material handling systems, cranes, etc. consider it a must for employee protection. Most states have safety statutes that require these switches on conveyor and related equipment. American National Standard Institute recommends their use in ANSI standard No. ASME B20.1 - 1993-5.11. This ANSI standard will probably soon become part of the Williams-Steiger Act of 1970-the OSHA Act.

EXCLUSIVE FEATURES

1. The Model RS is equipped with a positive safety lock. Having once been actuated, it cannot be accidentally reset causing dangerous equipment to restart. In order to reset the switch, the actuation arm must be pushed in and turned. It takes no longer and it makes this a true "safety" switch.
2. The Model RS is installed with cable extending in both directions from the actuating handle. There is one electrical connection inside. This simple arrangement eliminates the double electrical connections required in two ended units employing a separate micro switch for cable in each direction.
3. The actuation force required is simply adjusted in the field by a change in the position of the cable in holes provided in the actuation arm. One of our units will handle as much cable length as a double ended competitive unit and there is no longer a need to specify actuating force or right or left handed units.
4. The standard construction of the unit is a corrosion resistant aluminum housing complete with stainless steel hardware and red powder coated actuation handle. The actuation shaft is of stainless steel. Powder coated cast iron construction is available if necessary. Epoxy coating of either casting is also available if required.
5. The Model RS controls are listed by Underwriters Laboratories, Inc. and Canadian Standards Association. The general purpose models are listed for non hazardous atmospheres. Explosion proof models are listed for use in hazardous atmospheres as defined by the National Electric Code handbook and the National Electrical Manufacturers Association Standards for NEMA 7 and 9 hazardous locations. Specifically, they are listed for Class I, Groups C and D; and Class II, Groups E,F, and G.
6. Model RS offers the lowest cost per foot of protection because it incorporates fewer switches and less wiring is required. Cable may be extended in either or both directions with no changes required in the internal mechanism of the unit and the wiring is still of a simple uncomplicated nature.
7. The switch is available with a warning light that may be wired to indicate actuation. This permits easy identification of actuated switches in areas where visual identification is difficult.

UL Listed for General Purpose and EXPLOSION PROOF Environments . . . the only switch of its kind to meet these requirements

The Model RSB is also designed to act as an emergency stop pull cord control on conveyors and other moving machinery that incorporates built-in broken cable detection. The Model RSB has extension springs, attached to opposite ends of the pull cable, which maintain the cable under constant tension. The RSB is mounted so that it is centered between the end springs. In this way, temperature changes, which cause cable length changes, are cancelled out. The operating handle is held in the center vertical position with the internal switch in a normally closed condition. If the cable is pulled or the cable breaks, the handle rotates to release the switch lever. In this way, the alarm signal is generated for either condition. The operating handle must be manually reset back to the center position after the cause has been corrected.



OPERATION OF THE UNIT:

The unit is usually installed with cable running in both directions from the crank type actuating arm. Each of the two sections of cable runs to a fixed point through eve-bolts spaced at regular intervals.

A pull on the cable at any point along its run will rotate the red actuation arm 60°. The actuation arm will end in a position that is easily seen from a distance, thus identifying the actuated unit. Two spring loaded detents riding on a hardened steel cam provide resistance to arm rotation. When the actuation force overcomes this resistance the assembly rotated the 60° and is locked in place by the detents. Affixed to the rotating shaft is a cam mechanism which actuates up to two micro switches during rotation. The micro switches are held in the actuated position by the detents.

To reset the unit and deactuate the micro switches, the actuation arm is pushed in a rotated backwards.

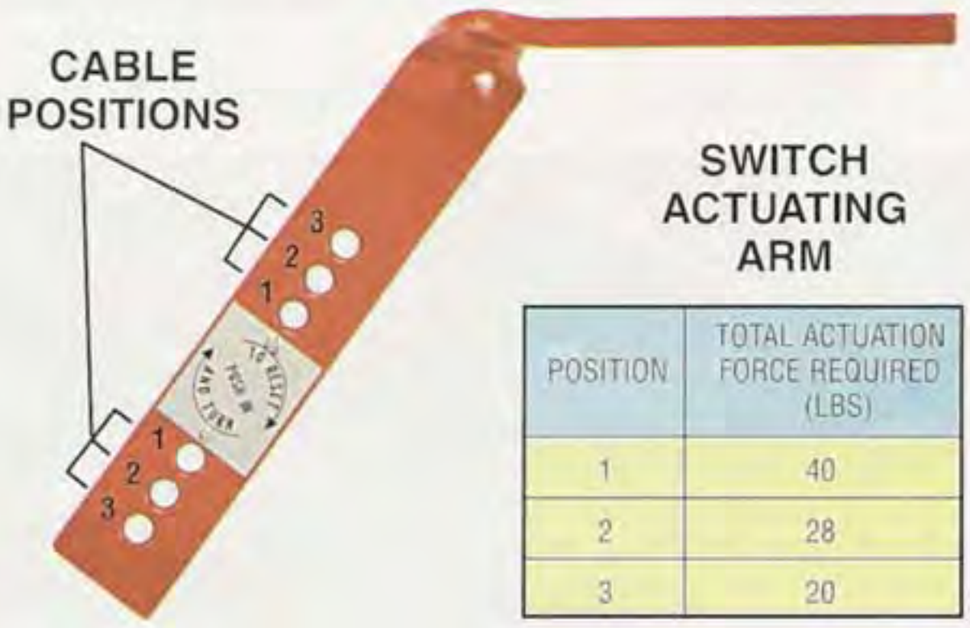
DETERMINATION OF NUMBER OF UNITS REQUIRED:

The Model RS control is designed so that a maximum of 100' of cable can be used on each side of the unit. S single switch can therefore cover a maximum of 200' of conveyor belt or other machinery. Of course, if necessary, cable can be extended in only one direction from either side of the unit. The electrical characteristics of the application will determine the numbers of micro switches to be specified in the unit: either one, or two. The environmental considerations will determine whether or not the unit is to be explosion proof or to have special paint or coatings. The possibility of a light to aid in identification of actuated units should be considered.

We recommend that high quality cable be used with the switch to assure proper actuation with no stretching. We recommend our own galvanized aircraft cable which is available with either vinyl or nylon coating. It is orange in color and weighs .0273 lbs. per foot and has an outside diameter of 3/16".

As shown in the chart and picture of the actuating arm, the actuation force can be varied by attaching the cable at any one of the three positions.

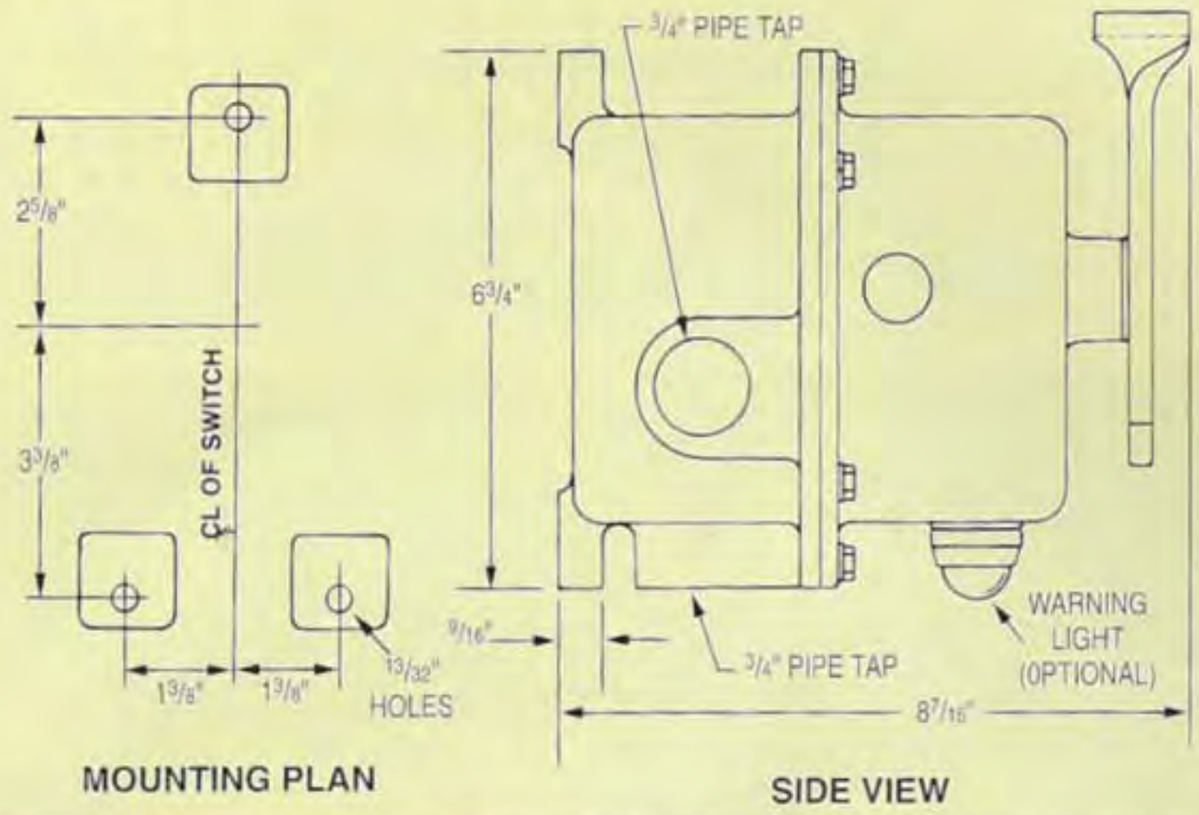
The cable should be supported by eyebolts every 8-10'. These supports ensure that the weight of the cable alone will not actuate the switch.

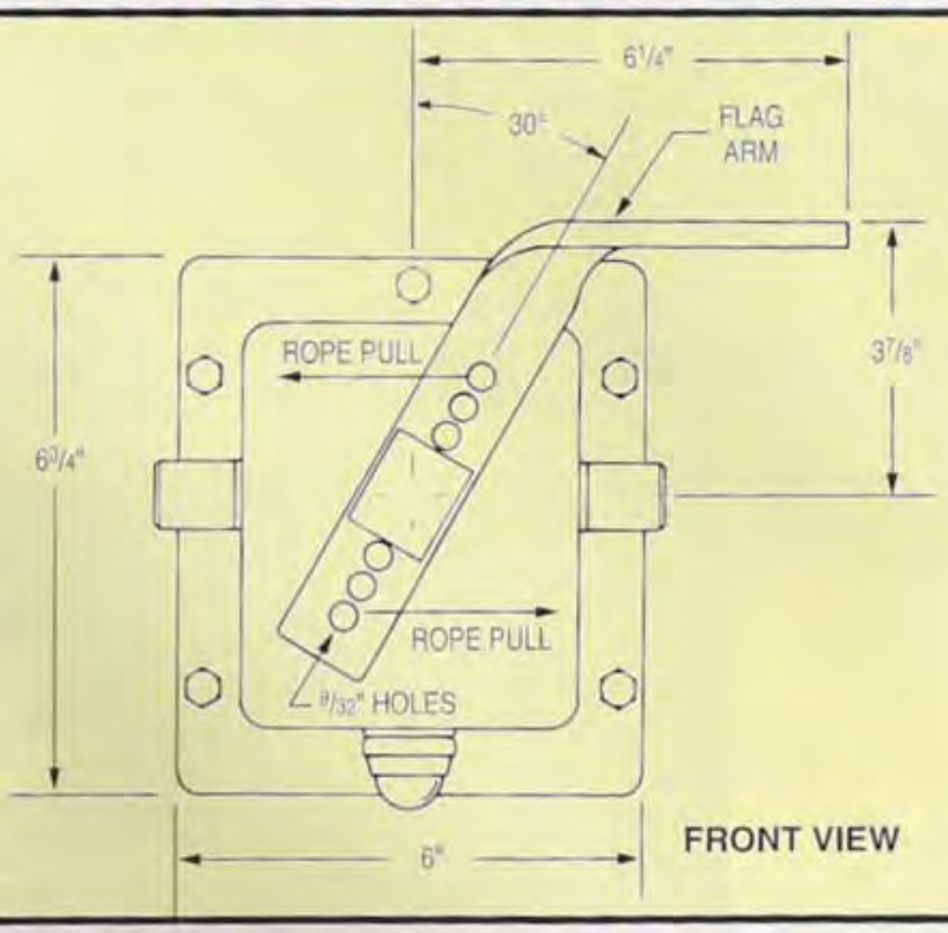


SWITCH ACTUATING ARM

POSITION	TOTAL ACTUATION FORCE REQUIRED (LBS)
1	40
2	28
3	20

MODEL RS DIMENSIONAL INFORMATION





TECHNICAL INFORMATION

MODEL	DESCRIPTION
RS-1	One sp/dt micro switch UL LISTED CSA
RS-2	Two sp/dt micro switches UL LISTED CSA
RS-2L	Two sp/dt micro switches with external signal light includes 110V lamp UL LISTED CSA
RS-1X	Explosion proof with one sp/dt micro switch for NEMA 7 and 9 UL LISTED CSA
RS-2X	Explosion proof with two sp/dt micro switches for NEMA 7 and 9 UL LISTED CSA
RSB-1 RSB-1X	One sp/dt switch w/cable break detection Explosion proof version UL LISTED
RSB-2 RSB-2X	Two sp/dt switches w/cable break detection Explosion proof version UL LISTED

Standard Construction – rubber gaskets seal unit for outside applications listed by Underwriter Laboratories for for NEMA 4 dust-tight and raintight construction. Applies to units RS-1, RS-2, and RS-2L.
Housing – aluminum or cast iron. Epoxy coating available.
Conduit Opening – 3/4" NPT standard. 1" NPT optional. Standard units have three conduit openings., explosion proof have one at the bottom.
Actuating Arm – Red epoxy coated steel handle with stainless steel shaft.
Internal Cam and Wear Plate – hardened steel.
External Hardware – stainless steel
Switches – sp/dt micro switch. Rated 20 amp at 125, 250 or 480V AC. Switches may be wired for single throw operation, either normally open or normally closed as required.

INSTALLATION INSTRUCTIONS

1. The controls should be mounted on a flat surface using the three mounting holes on the bottom half of the housing. The holes are designed for 3/8" bolts.
2. Each switch can cover a maximum of 200' of conveyor — 100' in each direction. Safety considerations dictate that not more than 100' of cable be attached on each side. More cable might result in too much slack, delaying actuation.
3. The eyebolts supporting the cable should be placed at intervals from 8-10'. Care must be taken that the cable does not become too slack. However, if the cable is too tight, false actuation of the switch might occur.
4. The Model RS control is designed for pilot duty. The control circuit should be wired through the motor starter circuit of the conveyor or other equipment to be controlled. Do not wire the unit directly into a heavy duty motor circuit.
5. The unit should be tested after installation by actuation of the cable. The protected equipment should stop and alarms should sound as required with a minimum of effort on the cable. Cable tension can be adjusted if necessary by changing the location of the cable on the handle.

RS-30 BRACKET for mounting the Model RS stop switch to the conveyor stringer at an idler

OPTIONAL CABLE AND FITTINGS

CABLE SUPPOET EYE BOLT
1/2"x6" plated, 2 1/2" long N.C. thread. 1" eye, two nuts and one lockwasher.

CABLE END FITTING
Secures protective cable to switch handle and supports.

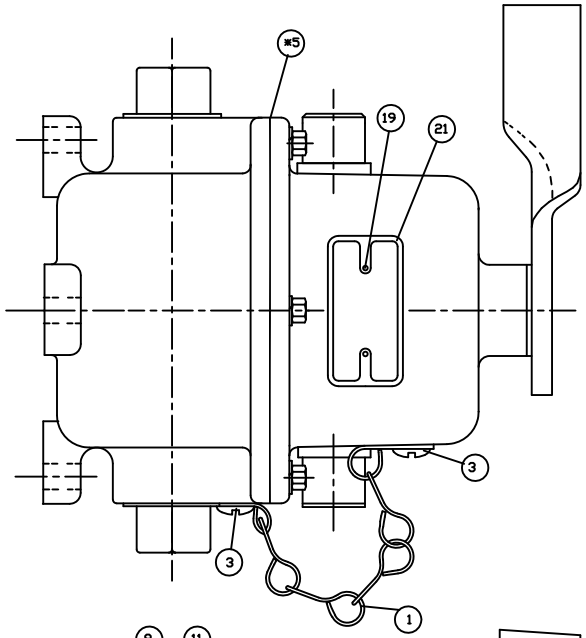
SAFETY CABLE
3/32"x7x7 preformed, galvanized aircraft cable. Protective coating in either orange coated vinyl or nylon. 3/16" O.D.

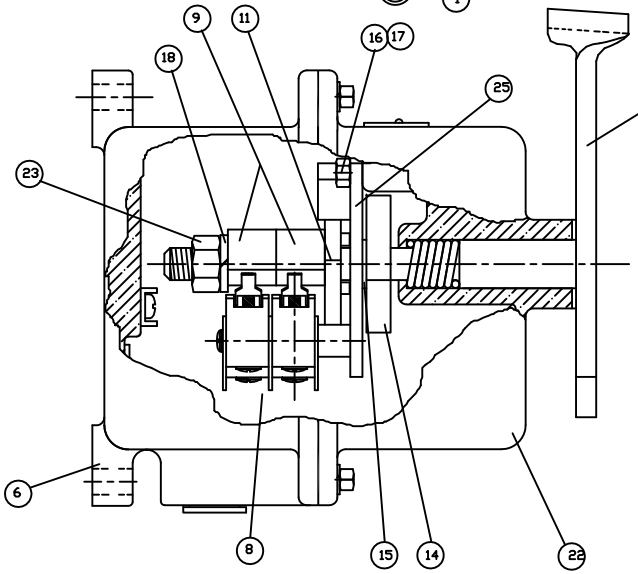
CONDUIT PLUG
3/4" metal, socket head conduit plug.

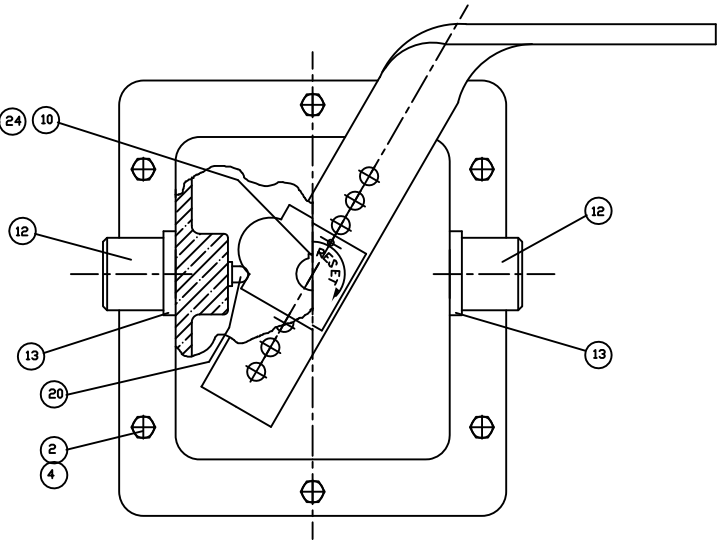
DWG. NO.	SHT.	REV.
D0170014	1-1	M

REVISIONS

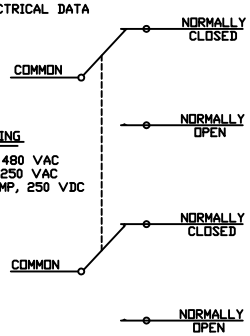
REV.	E.C.O.	DESCRIPTION	DATE	BY	APP'D
M	2887	CHANGE LOCKPLATE NUMBER	08/28/07	GL	JK







ELECTRICAL DATA



MICRO SWITCH RATING

20 AMPS, 125, 250, OR 480 VAC
1 HP, 125 VAC; 2 HP, 250 VAC
1/2 AMP, 125 VDC; 1/4 AMP, 250 VDC

NOTE: APPLY LOC-TITE TO THREADS OF CAP SCREWS (ITEM #16), & TO SPRING PLUNGER (ITEM #20) PRIOR TO ASSEMBLY OF CAP HOUSING (ITEM #7).

*APPLY ACRYLIC ADHESIVE (3M-1711) FOR GASKET.

25	20170228	B0170008	RS LOCK PLATE ASSEMBLY	1
24	20170034	A0170058	FLAG ARM AND SHAFT ASSEMBLY	1
23	22014401	--	1/2-13 HEX NUT Z/P	1
22	20170056	C0170009	RS CAP HOUSING MACHINED ALUMINUM	1
21	20170052	B0170009	NAMEPLATE	1
20	20176531	--	SPRING PLUNGER	2
19	22016101	--	#2x1/4 DRIVE RIVET SST	2
18	22013502	--	1/2" LOCKWASHER Z/P	2
17	22013425	--	1/4" SPLIT LOCKWASHER Z/P	2
16	22011090	--	1/4-20x3/4 HEX HEAD CAP SCREW Z/P	2
15	20170010	A0170008	SPACER FOR RS	1
14	20170005	A0170007	DETENT CAM	1
13	20170011	A0170039	DETENT CAP WASHER	2
12	20170012	A0170038	DETENT CAP	2
11	20170197	A0170019	LOCK PIN WELDMENT PLATED	1
10	20170015	A0170028	DOUBLE SWITCH KEY	1
9	20170018	A0170012	CAM FOR RS	2
8	20170119	--	RS-5-2 DOUBLE SWITCH ASSEMBLY	1
ITEM	MATL/PART	DWG	DESCRIPTION	QTY
RS-2 CAP ASSEMBLY ALUM 20170123:				

**SEE CAP ASSEMBLY PARTS LIST ABOVE.

**7	20170123	--	RS-2 CAP ASSEMBLY ALUM	1
6	20170062	C0170068	BASE HOUSING ASSEMBLY ALUM	1
5	20170043	B0170003	RS-14 GASKET	1
4	22013426	--	1/4" LOCKWASHER SST	6
3	22011083	--	10-32x3/8 ROUND HEAD MACH SCREW Z/P	2
2	22011075	--	1/4-20x1 HEX HEAD CAP SCREW SST	6
1	20170120	A0170061	6 IN GUARD CHAIN	1
ITEM	MATL/PART	DWG	DESCRIPTION	QTY

THIS DRAWING IS COMPUTER GENERATED.

DWN GEO	DATE 07/01/76	CONVEYOR COMPONENTS CO.
CKD	DATE	130 SELTZER RD, CROSWELL, MI 48422
APD GEO	DATE 07/01/76	RS-2 ROPE CONTROL

PART NO.	DWG. NO.	REV.
RS-2	D0170014	M
SCALE NONE		SHT. 1-1

DWG. NO. D0170014 SHT. 1-1 REV. M

SPARE PARTS

ONE (1) Packing Gland set

ONE (1) Complete liner set

SPIRAC (USA) INC
75 Jackson Street, Suite 300, Newnan, GA 30263 USA
Tel: 770 632 9833 Fax: 770 632 9838
Website: www.spirac.com

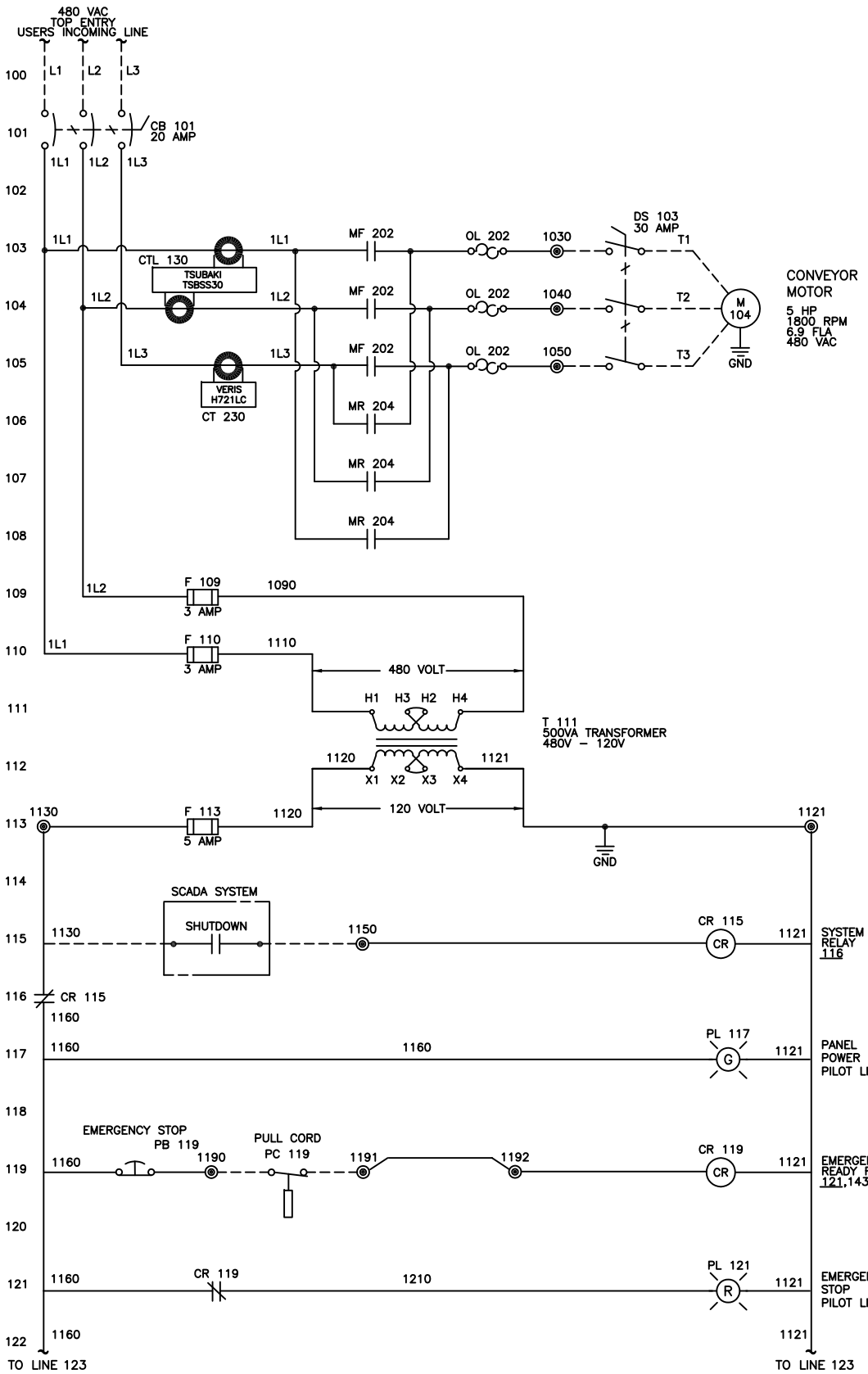
SUPPLIER INDEX

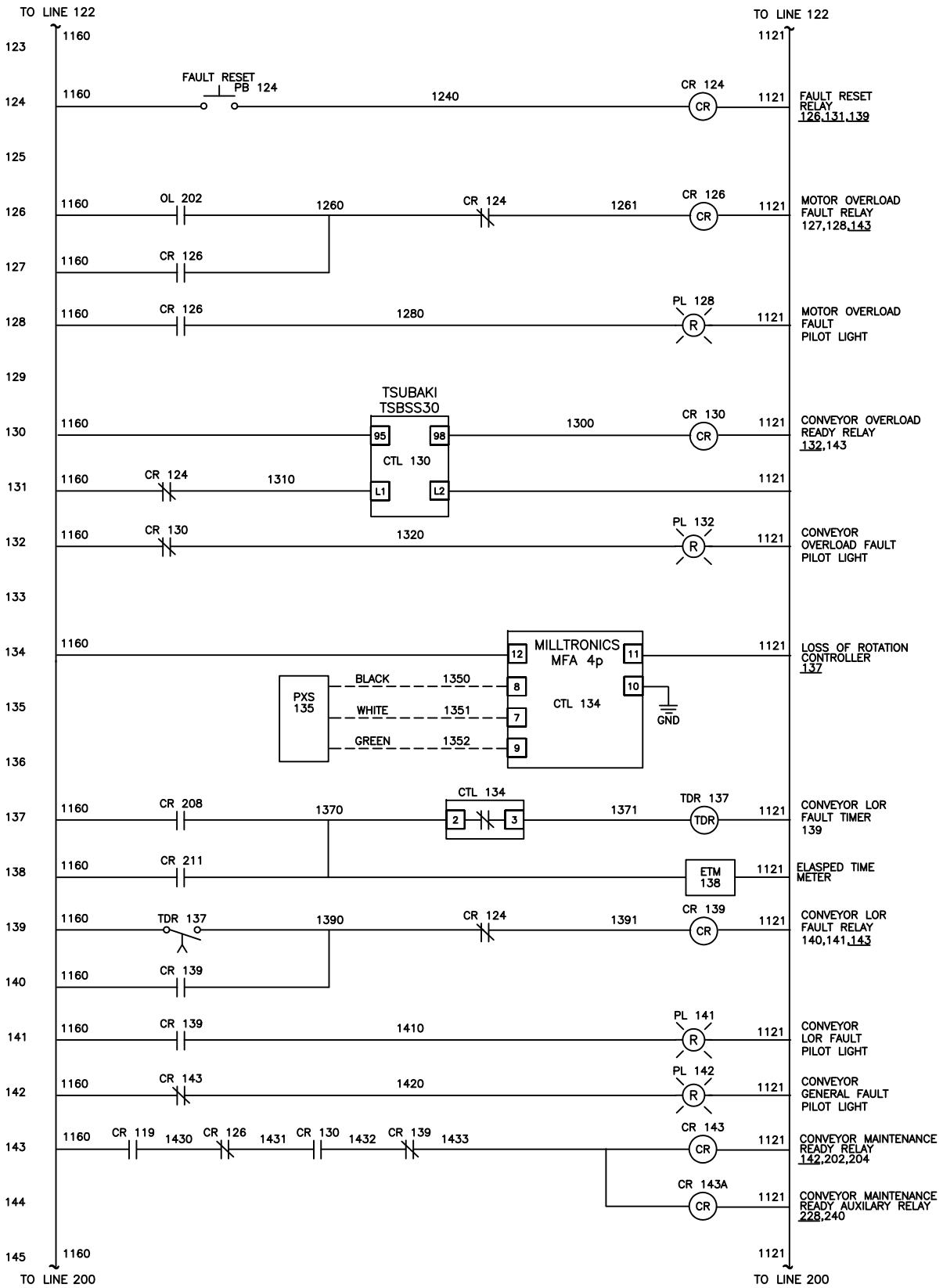
SPIRAC (USA) INC: CONVEYOR
75 JACKSON STREET, SUITE 300
NEWNAN, GA 30263
SERVICE@SPIRAC.COM
TEL: 770.632.9833
FAX: 770.632.9838

SEW EURODRIVE: GEAR REDUCER
1295 OLD SPARTANBURG HWY
LYMAN, SC 29365
TEL: 864.439.7537
FAX: 864.439.7830

SEIMENS: LOSS OF ROTATION
3333 OLD MILTON PARKWAY
ALPHARETTA, GA 30005
TEL: 800.964.4114

CONVEYOR COMPONANTS CO.: EMERGENCY STOP
130 SELTZER ROAD
CROSWELL, MI 48422
TEL: 800.233.3233
FAX: 810.679.4510





LIST OF ABBREVIATIONS

AM	AMP METER
B	BELL
BR	BRAKE
C	CONTACTOR
CB	CIRCUIT BREAKER
CPU	CENTRAL PROCESSING UNIT
CR	CONTROL RELAY
DRS	DOOR SWITCH
DS	DISCONNECT SWITCH
ETM	ELAPSED TIME METER
F	FUSE
FLS	FLOAT SWITCH
FS	FLOW SWITCH
GND	GROUND
H	HORN
HTR	HEATER
IL	INTERLOCK
IPB	ILLUMINATED PUSHBUTTON
LED	LIGHT EMITTING DIODE
LL	LOCAL LIGHT
LR	LATCH RELAY
LS	LIMIT SWITCH
M	MOTOR
MF	MOTOR STARTER–FORWARD
MR	MOTOR STARTER–REVERSE
MS	MOTOR STARTER
OL	MOTOR THERMAL OVERLOAD
PB	PUSHBUTTON
PEC	PHOTOELECTRIC CELL
PL	PILOT LIGHT
PS	PRESSURE SWITCH
PWS	POWER SUPPLY
RB	ROTATING BEACON
RECPT	RECEPTACLE
SS	SELECTOR SWITCH
SV	SOLENOID VALVE
T	TRANSFORMER
TDR	TIME DELAY RELAY
TP	TEST PROBE
TS	TEMPERATURE SWITCH

NOTES

1. ALL POWER WIRING TO BE BLACK
2. ALL AC CONTROL WIRING TO BE RED
3. ALL AC NEUTRAL WIRING TO BE WHITE
4. ALL DC CONTROL WIRING TO BE BLUE
5. ALL DC COMMON WIRING TO BE GRAY
6. ALL INTERLOCK WIRING TO BE YELLOW
7. ALL GROUND WIRING TO BE GREEN
8. ALL COMPUTER INTERFACE WIRING TO BE ORANGE

LEGEND

- EXTERNAL FIELD WIRING
- INTERNAL PANEL WIRING
- TERMINAL BLOCK
- TERMINAL ON COMPONENT
- X — COMPONENT MOUNTED IN EXTERNAL ENCLOSURE. NOTE: LETTER LOCATED IN SQUARE IDENTIFIES ENCLOSURE

NOTE:
ALL CONTROL WIRING
WILL BE 16g THHN WIRE

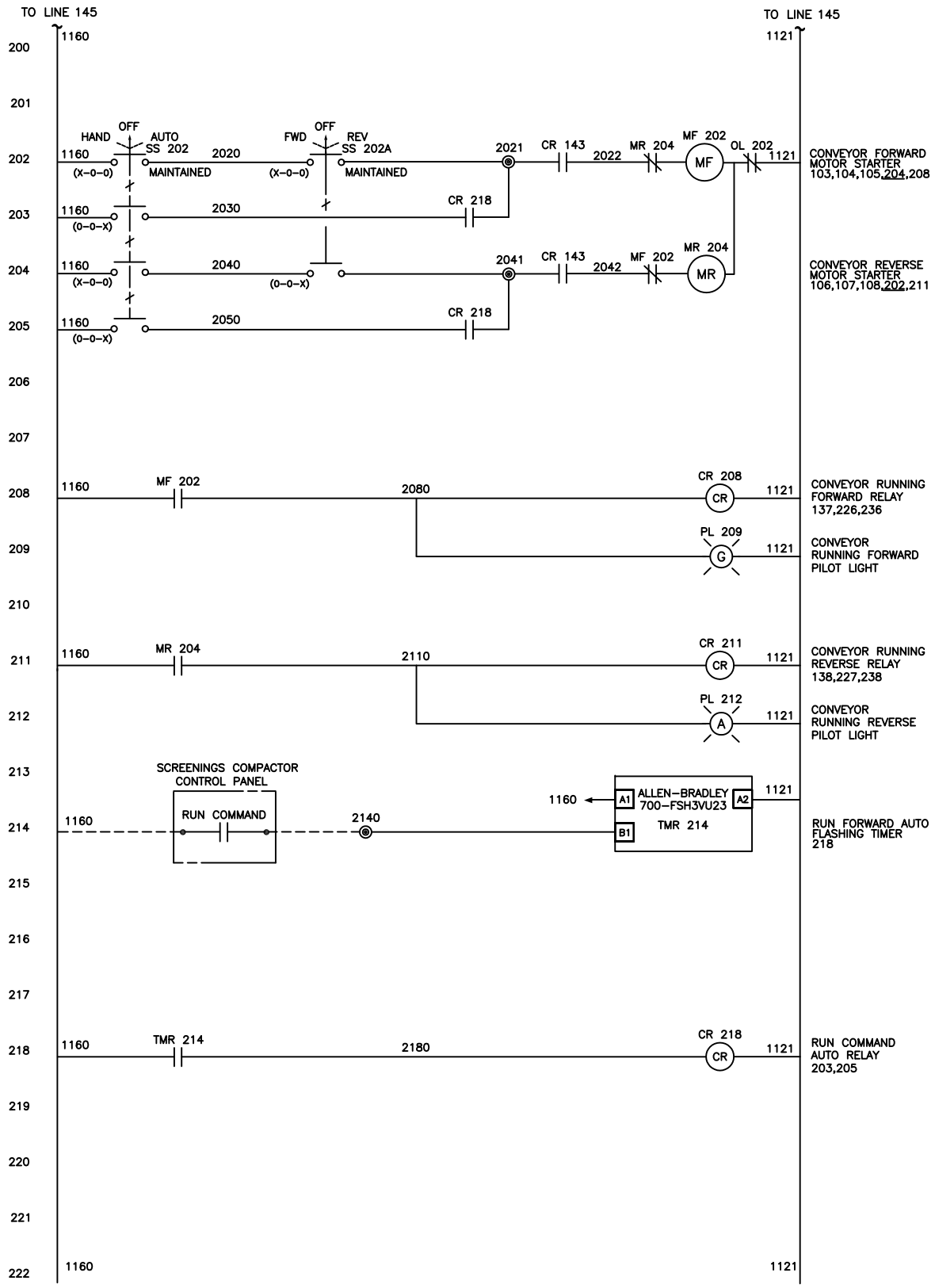
ATLANTA CONTROL TECHNOLOGIES
INNOVATIVE AUTOMATION SOLUTIONS

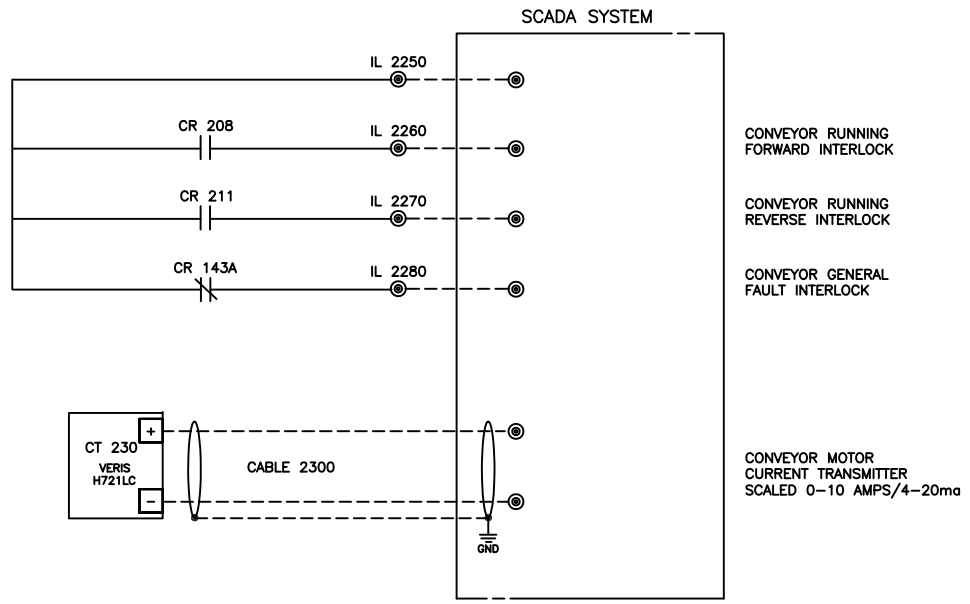
REVISION	DESCRIPTION	BY	DATE
A	ADDENDUM A	ACT	02/13

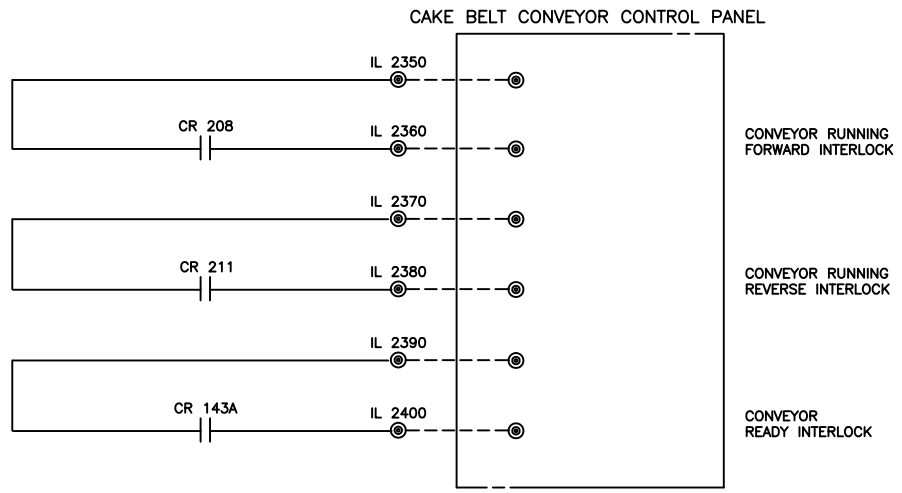
JOB NUMBER: 741
DATE: 02/25/13
SHEET NUMBER: 1 OF 3

DESCRIPTION:
SPIRAC FOUNTAIN
SLUDGE CONVEYOR
CONTROL WIRING DIAGRAM

DRAWING NUMBER:
E-741-01-01







LIST OF ABBREVIATIONS

AM	AMP METER
B	BELL
BR	BRAKE
C	CONTACTOR
CB	CIRCUIT BREAKER
CPU	CENTRAL PROCESSING UNIT
CR	CONTROL RELAY
DRS	DOOR SWITCH
DS	DISCONNECT SWITCH
ETM	ELAPSED TIME METER
F	FUSE
FLS	FLOAT SWITCH
FS	FLOW SWITCH
GND	GROUND
H	HORN
HTR	HEATER
IL	INTERLOCK
IPB	ILLUMINATED PUSHBUTTON
LED	LIGHT EMITTING DIODE
LL	LOCAL LIGHT
LR	LATCH RELAY
LS	LIMIT SWITCH
M	MOTOR
MF	MOTOR STARTER-FORWARD
MR	MOTOR STARTER-REVERSE
MS	MOTOR STARTER
OL	MOTOR THERMAL OVERLOAD
PB	PUSHBUTTON
PEC	PHOTOELECTRIC CELL
PL	PILOT LIGHT
PS	PRESSURE SWITCH
PWS	POWER SUPPLY
RB	ROTATING BEACON
RECPT	RECEPTACLE
SS	SELECTOR SWITCH
SV	SOLENOID VALVE
T	TRANSFORMER
TDR	TIME DELAY RELAY
TP	TEST PROBE
TS	TEMPERATURE SWITCH

NOTES

1. ALL POWER WIRING TO BE BLACK
2. ALL AC CONTROL WIRING TO BE RED
3. ALL AC NEUTRAL WIRING TO BE WHITE
4. ALL DC CONTROL WIRING TO BE BLUE
5. ALL DC COMMON WIRING TO BE GRAY
6. ALL INTERLOCK WIRING TO BE YELLOW
7. ALL GROUND WIRING TO BE GREEN
8. ALL COMPUTER INTERFACE WIRING TO BE ORANGE

LEGEND

- EXTERNAL FIELD WIRING
- INTERNAL PANEL WIRING
- TERMINAL BLOCK
- TERMINAL ON COMPONENT
- [X] COMPONENT MOUNTED IN EXTERNAL ENCLOSURE NOTE: LETTER LOCATED IN SQUARE IDENTIFIES ENCLOSURE

NOTE:
ALL CONTROL WIRING
WILL BE 16g THHN WIRE

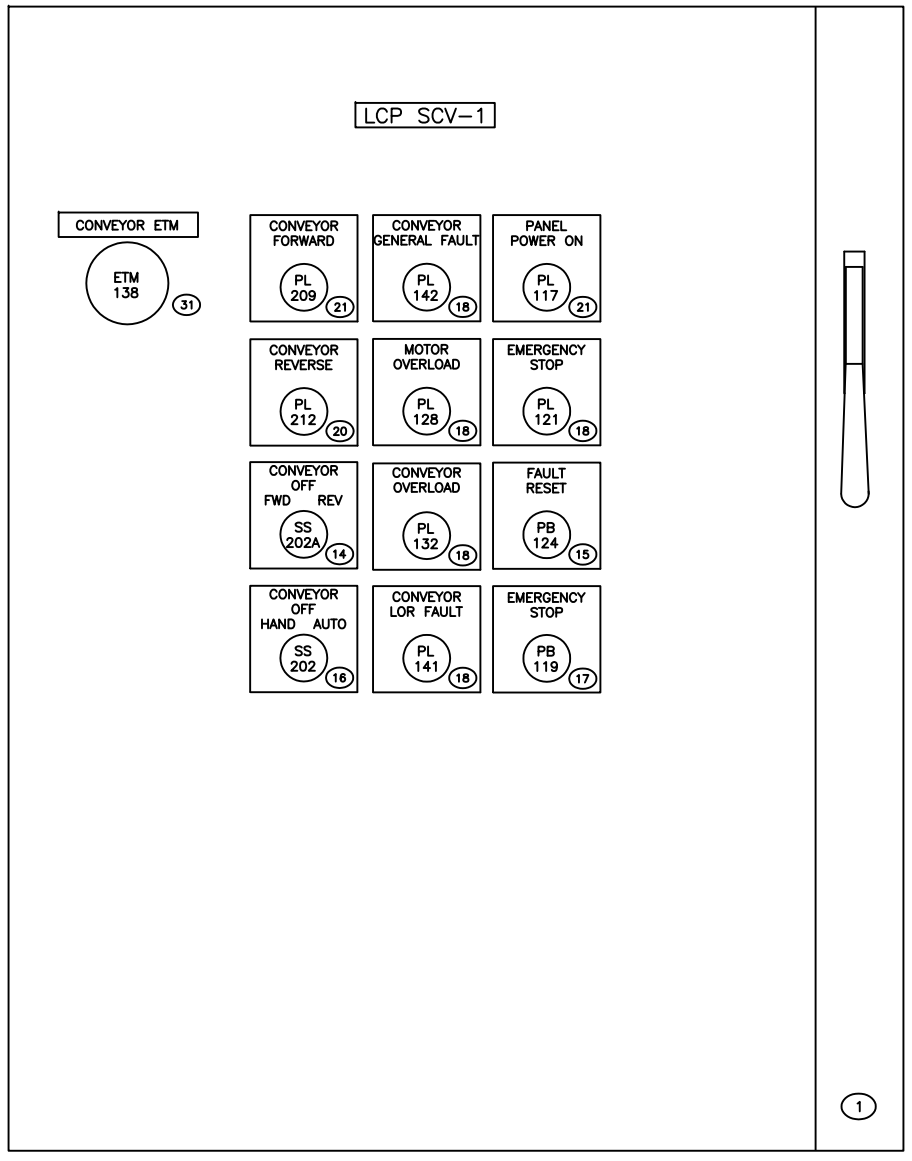
ATLANTA CONTROL TECHNOLOGIES
INNOVATIVE AUTOMATION SOLUTIONS

REVISION	DESCRIPTION	BY	DATE
A	ADDENDUM A	ACT	02/13

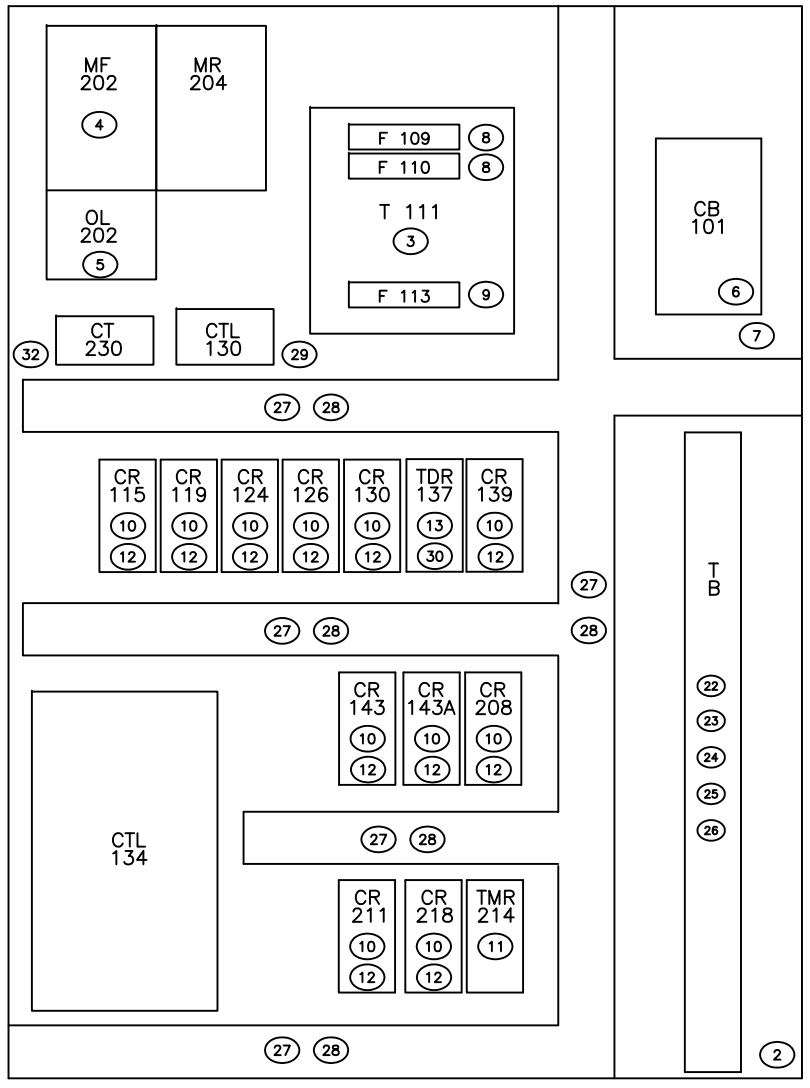
JOB NUMBER: 741 | DATE: 02/25/13 | SHEET NUMBER: 2 OF 3

DESCRIPTION:
SPIRAC FOUNTAIN SLUDGE CONVEYOR CONTROL WIRING DIAGRAM

DRAWING NUMBER:
E-741-01-02



ENCLOSURE DOOR LAYOUT



BACKPLATE LAYOUT

BILL OF MATERIAL

KEY	QTY	MANUFACTURER	CATALOG #	DESCRIPTION
1	1	SAGINAW	SCE-36XEL3010SSLP	NEMA 4X ENCLOSURE 36 X 30 X 10
2	1	SAGINAW	SCE-36P30	BACKPLATE
3	1	SQUARE-D	9070-TF500D1	500 VA TRANSFORMER W/PRIMARY & SECONDARY FUSES
4	1	ALLEN-BRADLEY	505-BOD	F/R NEMA MOTOR STARTER
5	1	ALLEN-BRADLEY	592-EEDC	ELECTRONIC MOTOR OVERLOAD 3 TO 16 AMPS
6	1	ALLEN-BRADLEY	140U-H2C3-C20	MOLDED CASE CIRCUIT BREAKER 20 AMP
7	1	ALLEN-BRADLEY	140U-H-FCX03	CABLE OPERATED DISCONNECT KIT NEMA 4X
8	2	LITTLEFUSE	CCMR-3	3 AMP CC CLASS FUSE
9	1	LITTLEFUSE	FLM-5	5 AMP MIDGET CLASS FUSE
10	11	IDEC	RR3PPULAC120V	RELAY 3 POLE PLUG IN
11	1	ALLEN-BRADLEY	700-FSH3VU23	FLASHING TIMER DUAL DIAL DUAL RANGE
12	11	IDEC	SH3B-06	3 POLE RELAY BASE
13	1	SSAC	TDM120AL	TIMER PLUG IN SECONDS
14	1	ALLEN-BRADLEY	800H-JR5A	3 POSITION SELECTOR SWITCH SSR
15	1	ALLEN-BRADLEY	800H-AR2A	BLACK PUSHBUTTON
16	1	ALLEN-BRADLEY	800H-JR2A	3 POSITION SELECTOR SWITCH
17	1	ALLEN-BRADLEY	800H-FRXT6D4	RED MUSHROOM HEAD MAINTAINED PUSHBUTTON
18	5	ALLEN-BRADLEY	800H-PR16R	PILOT LIGHT RED
19		ALLEN-BRADLEY	800H-PR16W	PILOT LIGHT WHITE
20	1	ALLEN-BRADLEY	800H-PR16A	PILOT LIGHT AMBER
21	2	ALLEN-BRADLEY	800H-PR16G	PILOT LIGHT GREEN
22	A/R	AUTOMATION DIRECT	DN-T10	TERMINAL BLOCK, HIGH DENSITY
23	A/R	AUTOMATION DIRECT	DN-EC1210	END BARRIER, HIGH DENSITY
24	A/R	AUTOMATION-DIRECT	DN-G10	GROUND TERMINAL BLOCK
25	A/R	AUTOMATION DIRECT	DN-EB35	END ANCHOR
26	A/R	AUTOMATION DIRECT		HIGH RISE DIN RAIL
27	A/R	TAYLOR		1.5" X 3" WIRE DUCT
28	A/R	TAYLOR		1.5" WIRE DUCT COVER
29	1	TSUBAKI	TSBSS30	SHOCK RELAY
30	1	IDEC	SH2B-05	2 POLE RELAY BASE
31	1	EMN	T50B212	ELAPSED TIME METER
32	1	VERIS	H721LC	CURRENT TRANSMITTER

ATLANTA CONTROL TECHNOLOGIES
INNOVATIVE AUTOMATION SOLUTIONS

REVISION	DESCRIPTION	BY	DATE
A	ADDENDUM A	ACT	02/13

JOB NUMBER: 741
DATE: 02/25/13
SHEET NUMBER: 3 OF 3
DESCRIPTION: SPIRAC FOUNTAIN SLUDGE CONVEYOR ENCLOSURE DETAIL
DRAWING NUMBER: E-741-01-03

2-Position Push-Pull Units, Non-Illuminated

2-Position Push-Pull
Cat. No. 800H-FPX6A5

Contact Type	Operator Position		Button Color	Push-Pull
	Maintained	Maintained		
	Out	In		Cat. No.
N.C.L.B	X	O	Red	800H-FPX6D4
N.O.- N.C.L.B.	O X	X O	Red	800H-FPX6A1
N.C.L.B.- N.C.L.B.	X X	O O	Red	800H-FPX6A5

Note: X = Closed/O = Open

3-Position Push-Pull Units, Non-Illuminated

3-Position Push-Pull
Cat. No. 800H-FPXM6A7

Contact Type	Operator Position			Button Color	Push-Pull
	Momentary	Maintained	Maintained		
	Out	Center	In		Cat. No.
N.C.- N.C.L.B.	X X	O X	O O	Red	800H-FPXM6A7

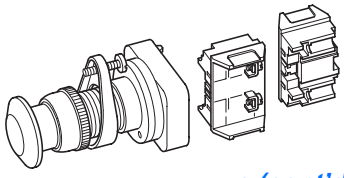
Contact Type	Operator Position			Button Color	Push-Pull
	Momentary	Maintained	Momentary		
	Out	Center	In		Cat. No.
N.C.- N.C.L.B.	X X	O X	O O	Red	800H-FPXN6A7

Note: X = Closed/O = Open

Accessories — Page 61
Legend Plates — Page 67
Approximate Dimensions — Page 69

2-Position Push-Pull Units, Non-Illuminated

800 H – FPX ___ 1 A1
a b c d e



a

Barrel Type	
Code	**Description**
H	Standard Barrel Length
HL	Long Barrel

b

Operator Type	
Code	**Description**
FPX	Push-Pull Unit

c

Head Type	
Code	**Description**
Blank	Mushroom Head
J	Jumbo Mushroom Head ❶

d

Color Cap	
Code	**Color**
Blank	No Cap
1	Green
2	Black
4	Gray (Silver)

d (cont'd)

Color Cap	
Code	**Color**
6	Red
7	Blue
9	Yellow(Gold)

e

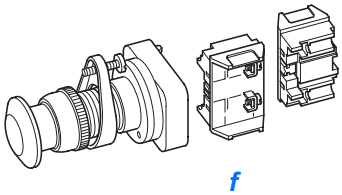
Contact Block(s)			
Standard			
Code	**Operator Position**		**Description**
	Out	**In**	
Blank	—	—	No Contacts
A1	O X	X O	1 N.O. - 1 N.C.L.B. ❷
A5	X X	O O	2 N.C.L.B. ❷
D1	O	X	1 N.O.
D2	X	O	1 N.C.
D4	X	O	1 N.C.L.B. ❷

e (cont'd)

Pen*TUFF* (Low Voltage)			
Code	**Operator Position**		**Description**
	Out	**In**	
D1V	O	X	1 N.O.
D2V	X	O	1 N.C.
AV	O X	X O	1 N.O. - 1 N.C.
Note: X = Closed/O = Open.			

3-Position Push-Pull Units, Non-Illuminated

800 H – FPX ___ M 1 A7
a b c d e f



a

Barrel Type	
Code	**Description**
H	Standard Barrel Length
HL	Long Barrel

b

Operator Type	
Code	**Description**
FPX	Push-Pull Unit

c

Head Type	
Code	**Description**
Blank	Mushroom Head
J	Jumbo Mushroom Head ❶

d

Operator Function			
Code	**Operator Position**		
	Out	**Center**	**In**
M	Momentary	Maintained	Maintained
N	Momentary	Maintained	Momentary

e

Color Cap	
Code	**Color**
Blank	No Cap
1	Green
2	Black
4	Gray(Silver)
6	Red
7	Blue
9	Yellow(Gold)

f

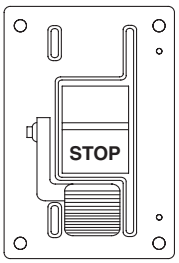
Contact Block(s)				
Standard				
Code	**Operator Position**			**Description**
	Out	**Ctr.**	**In**	
Blank	—	—	—	No Contacts
A	O X	O O	X O	1 N.O. - 1 N.C.
A1	O X	O X	X O	1 N.O. - 1 N.C.L.B.
A7	X X	O X	O O	1 N.C. - 1 N.C.L.B.
Pen*TUFF* (Low Voltage)				
Code	**Operator Position**			**Description**
	Out	**Ctr.**	**In**	
AV	O X	O O	X O	1 N.O. - 1 N.C.
Note: X = Closed/O = Open.				

❶ Not valid with color cap option **Blank** (no cap).

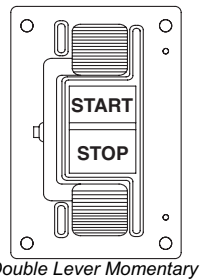
❷ Normally closed late break contact. When button is pushed from the OUT to the IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

Covers, Lever Type Actuator

Note: Lever type covers are furnished without contact blocks. Legend plate for half lever is **STOP**; full lever momentary and maintained it is a **START-STOP**.



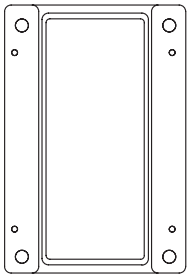
Half Lever

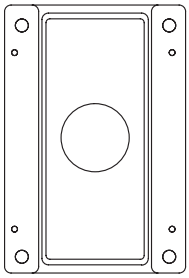


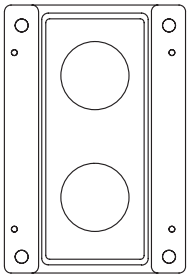
Double Lever Momentary

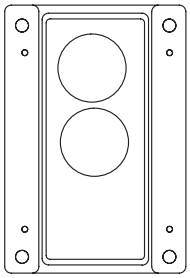
Half Lever	Double Lever Momentary	Double Lever Maintained	Double Lever Momentary/Maintained ❷
Cat. No.	Cat. No.	Cat. No.	Cat. No.
800H-NP14 ❶	800H-NP15 ❶	800H-NP16 ❶	800H-NP34

Covers, Component Type Button

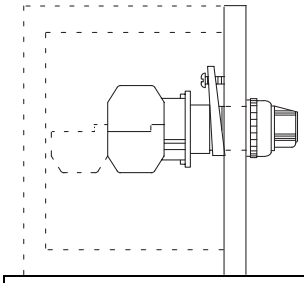


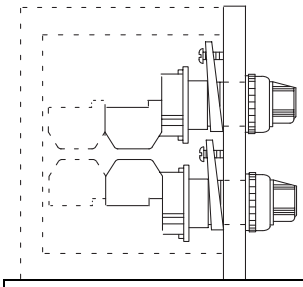


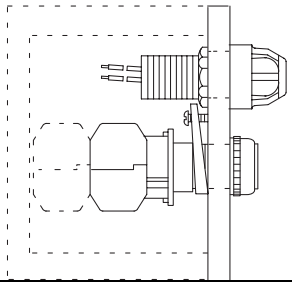




Blank	One Hole ❸	Two Hole ❹	Two Hole Special ❺
Cat. No.	Cat. No.	Cat. No.	Cat. No.
800H-NP32	800H-NP30	800H-NP31	800H-NP33







Design Guideline #4
One level of contact blocks is maximum in a shallow base or deep base when used with a sealing well. Contact blocks, except sealed switch type, may be mounted two deep in other bases.

Design Guideline #1
Push-to-test pilot lights, illuminated push buttons, push-pull units, 4-position selector switches, all operators with two contact blocks fastened along side one another or with a power module and contact block along side one another must be installed in a single hole cover.

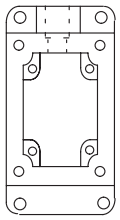
Design Guideline #3
When two components are installed in one cover, contact blocks are restricted to one side of the operator. Contact blocks of each operator must face each other.

Design Guideline #2
Dual push button units may only be installed in a single hole cover or the specially designed two hole cover (Cat. No. 800H-NP33), which can accommodate the dual Push Button and the special pigtail pilot light (Cat. No. 800H-LPK10R).

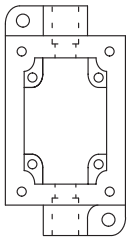
❶ To order without legend plate, add suffix "X" at the end of the catalog number.
❷ A normally open circuit configuration is recommended for use behind this momentary lever and a late break normally closed circuit configuration is required for use behind the maintained lever to achieve proper functioning of the device.
❸ One hole covers use a jumbo legend plate only.
❹ Two hole covers use a standard legend plate only.
❺ This special two hole cover can accommodate the pigtail pilot light (**Bulletin 800H-LPK10** series), the dual push button or any non-illuminated unit. Legend plates (**Cat. No. 800H-Y140J** green and red split-field) and (**Cat. No. 800H-Y141J** gray full field), are the only legend plates suitable for use with this cover.

Assembled Bases (for Field Assembly and Custom Stations)

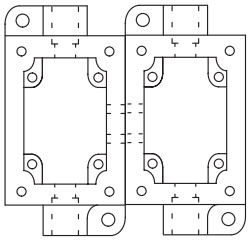
Enclosure Covers — See table on page 58 for a complete listing of covers for these bases.
Special Conduit Entries and Other Base Configurators— For conduit entries not listed, consult your local Allen-Bradley distributor.



1-Gang Shallow ❶

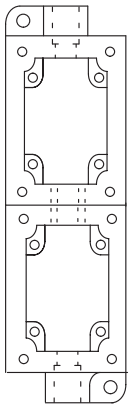


1-Gang Deep ❷

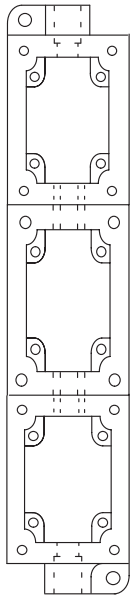


2-Gang Horizontal ❷

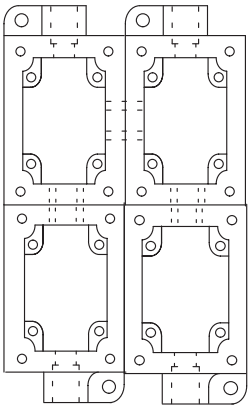
Conduit Entry	Cat. No.	Cat. No.	Cat. No.
3/4" Dead End	800H-1HZX7	800H-1HVX7	—
3/4" Feed Through	—	800H-1HVX7M1	—
1" Dead End	—	800H-1HVX7M2	800H-2HHX7
1" Feed Through	—	800H-1HVX7M3	—



2-Gang Vertical ❷

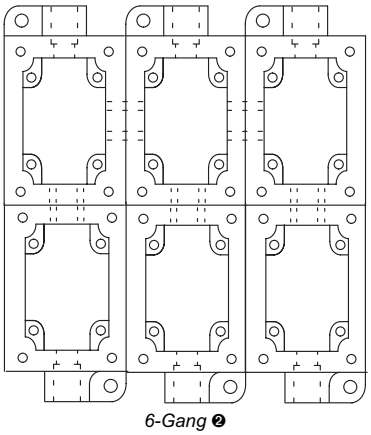


3-Gang Vertical ❷

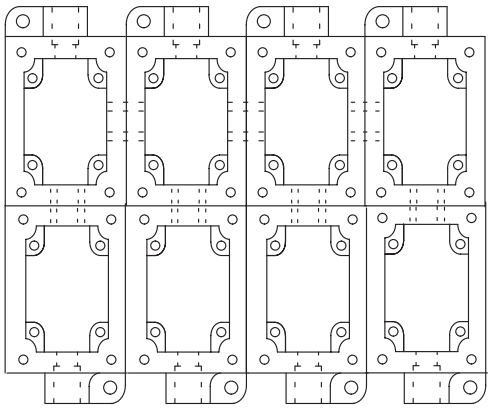


4-Gang ❷

Conduit Entry	Cat. No.	Cat. No.	Cat. No.
1" Feed Through	800H-2HYX7	800H-3HYX7	800H-4HVX7



6-Gang ❷



8-Gang ❷

Conduit Entry	Cat. No.	Cat. No.
1" Feed Through	800H-6HVX7	800H-8HVX7

❶ Shallow base cannot accommodate sealing well, sealed switched contact blocks or stacked contact blocks. Shallow base rated for Group B.
❷ Deep base can accommodate sealing well, sealed switch contact blocks or up to 2 deep standard contact blocks.

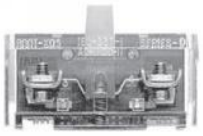
Modifications and Accessories

Contact Blocks♣

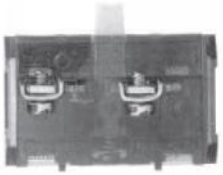
Packaged in kit form for field installation. All necessary mounting hardware is provided with each contact block kit. Contact ratings are listed on page 10-153.

Note: It is not recommended to mount more than four contact blocks on any one unit (maximum two blocks deep). Sealed switch contact blocks are limited to two blocks per unit maximum.

Shallow Block



Mini Block



PenTUFF (Low Voltage) Contact Block

Contact Type	Shallow Block∗❄‡ Cat. No.	Mini Block∗‡ Cat. No.	Pen*TUFF* (Low Voltage) Block∗❄‡ Cat. No.
1 N.O.	**800T-XD1**	**800T-XD5**	**800T-XD1V**
1 N.C.	**800T-XD2**	**800T-XD6**	**800T-XD2V**
1 N.O.E.M.	**800T-XD3**	—	**800T-XD3V**
1 N.C.L.B.	**800T-XD4**	—	**800T-XD4V**
1 N.O. - N.C.	**800T-XA**	—	**800T-XAV**
2 N.O.	**800T-XA2**	—	—
2 N.C.	**800T-XA4**	—	—
1 N.C.L.B. - 1 N.O.	**800T-XA1**	—	—
1 N.C.L.B. - 1 N.C.	**800T-XA7**	—	—

∗ To determine if a conduit seal-off is necessary, see page 10-179 for sealing well information.
❄ Specify Bulletin 800TC for finger-safe contact blocks. Example: **Cat. No. 800TC-XA**.
‡ Contact blocks with normally closed contacts meet direct drive positive opening standard requirements.

Logic Reed Block

Sealed Switch Block

Stackable Sealed Switch Block

Contact Type	Logic Reed Block§ Cat. No.	Sealed Switch Block§ Cat. No.	Stackable Sealed Switch Block§ Cat. No.
1 N.O.	**800T-XD1R**	**800T-XD1P**	**800T-XD1Y**
1 N.C.	**800T-XD2R**	**800T-XD2P**	**800T-XD2Y**
1 N.O. - 1 N.C.	**800T-XAR**	**800T-XAP**	**800T-XAY**
2 N.O.	**800T-XA2R**	—	**800T-XA2Y**
2 N.C.	**800T-XA4R**	—	**800T-XA4Y**

§ To determine if a conduit seal-off is necessary, see page 10-179 for sealing well information.
♣ Refer to 800T/H section, page 10-35, for additional contact blocks and accessories.

10

Modifications and Accessories, Continued

Replacement Color Caps (Illuminated)

Pilot Light
Cat. No. 800H-N104M

Push-to-Test Pilot Light
Cat. No. 800H-N105M

Illuminated Push Button
Cat. No. 800H-N106M

Illuminated Push-Pull
Cat. No. 800H-NP50M

	Pilot Light	Push-to-Test Pilot Light	Illuminated Push Button	Illuminated Push-Pull
Color	Cat. No.	Cat. No.	Cat. No.	Cat. No.
Multi-color kit	800H-N104M	800H-N105M	800H-N106M	800H-NP50M

Replacement Color Caps (Non-Illuminated)

Momentary Mushroom —Standard (Plastic)
Cat. No. 800T-N246R

Momentary Mushroom —Jumbo (Metal)
Cat. No. 800T-N248R

Push-Pull — Standard (Metal)
Cat. No. 800H-NP51C

Push-Pull — Jumbo (Metal)
Cat. No. 800H-NP52A

	Momentary Mushroom — Standard (Plastic)	Momentary Mushroom — Jumbo (Metal) ∗	Push-Pull Standard (Metal)	Push-Pull Jumbo (Metal)
Color	Cat. No.	Cat. No.	Cat. No.	Cat. No.
Red	**800T-N246R**	**800T-N248R**	800H-NP51A	800H-NP52A
Green	**800T-N246G**	800T-N248G	800H-NP51B	800H-NP52B
Blue	800T-N246BL	800T-N248BL	800H-NP51C	800H-NP52C
Yellow	**800T-N246Y**	800T-N248Y	800H-NP51E	800H-NP52E
Black	**800T-N246B**	800T-N248B	800H-NP51H	800H-NP52H
Grey	800T-N246GR	800T-N248GR	800H-NP51G	—
Natural	—	800T-N248	—	—

∗ To order plastic jumbo mushroom caps, replace **248** with **247**. Plastic not available in natural color.
Example: **Cat. No. 800T-N248R** becomes **Cat. No. 800T-N247R**.

Replacement Knobs and Dual Push Button Assembly

Standard Knob
Cat. No. 800H-N130F

Knob Lever
Cat. No. 800H-131F

Wing Lever
Cat. No. 800H-N138

Dual Push Button
Cat. No. 800H-NP39

	Standard Knob	Knob Lever	Wing Lever❄	Dual Push Button
Color	Cat. No.	Cat. No.	Cat. No.	Cat. No.
White	**800H-N130F**	800H-N131F	—	—
Kit (Complete)‡	800H-N130	800H-N131	—	—
Grey	—	—	800H-N138	—
Red	—	—	800H-N138A	—
Green Red	—	—	—	800H-NP39

❄ Standard finish is grey.
‡ Kit includes knob and packet of inserts (**Cat. No. 800T-N123**). Refer to color insert kits on page 10-179.

10

Modifications and Accessories, Continued

Boots—Non-Illuminated Momentary Contact Push Buttons Units

Note: For Bul. 800H/HL Type 7&9 operators, order one adapter and one boot per operator.

Adapters

Push Button Type	Cat. No.
Flush head	800H-NPAF
Extended head	800H-NPAE

Boots

Boots supplied with control stations and components are made of a chlorosulfonated polyethylene material with stainless steel insert ring. To order boots with silicone, urethane, or ethylene propylene material, see the table below. Material application information shown below.

Cat. No. 800H-N5A

Insert Material	Boot Color	Material			
		Chlorosulfonated Polyethylene‡	Silicone •‡	Urethane ••‡	Ethylene • Propylene ••‡
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
Stainless steel§	Red	**800H-N5A**	**800H-N101R**	**800H-N100R**	800H-N103R
	Green	**800H-N5B**	**800H-N101G**	**800H-N100G**	800H-N103G
	Black	**800H-N5H**	**800H-N101B**	**800H-N100B**	800H-N103B
	Yellow	**800H-N5E**	**800H-N101Y**	800H-N100Y	—
	Blue	**800H-N5C**	800H-N101BL	800H-N100BL	—

❄ May be added to flush or extended head push button units to protect against foreign materials reaching the opening between the button and the locking ring.
§ Series B boots incorporate a stainless steel insert as standard.
‡ Dots printed on the inside of the boot identify the boot material.

Booted Knobs

Booted Standard Knob Selector Switch
Cat. No. 800H-NP5

Booted Knob Lever Selector Switch
Cat. No. 800H-NPE5

Switch Type	Boot Material∗			
	Chlorosulfonated Polyethylene	Silicone •	Urethane ••	Ethylene • Propylene ••
	Cat. No.	Cat. No.	Cat. No.	Cat. No.
Standard Knob Selector Switch❄	800H-NP5	800H-NP101	800H-NP100	800H-NP103
Knob Lever Selector Switch❄	800H-NPE5	800H-NPE101	800H-NPE100	800H-NPE103

∗ Dots printed on the inside of the boot identify the boot material.
❄ Includes color insert kit.

Push Button Guards and Mushroom Push Button Guards

Cat. No. 800H-NP19

Cat. No. 800H-NP13

Cat. No. 800H-NP9

Cat. No. 800H-NP12

Push Buttons, Pilot Lights and Push-to-Test	Extra Long Guard (1 in.) for Push Button	Mushroom	Jumbo Mushroom
Cat. No.	Cat. No.	Cat. No.	Cat. No.
800H-NP19	800H-NP13	800H-NP9	800H-NP12

Protective Rings

Protective Ring for 2-Position Push-Pull
Cat. No. 800H-NP40

Jumbo Protective Ring for 2-Position Push-Pull
Cat. No. 800H-NP40J

Protective Ring for Push-Pull Devices		
Description	Type	Cat. No.
Protective ring for Bul. 800H 2-position non-illuminated push-pull operators. Often used to avoid unintentional tripping of E-stop operators. Available for standard size button (40 mm) or for jumbo button (60 mm).	For standard size button	**800H-NP40**
	For jumbo size button	**800H-NP40J**

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General Accessories

Plugs

	Description	Cat. No.	
 *Cat. No. 800H-NP7*	**Coupler** Used for both horizontal and vertical assembly.	**800H-NP7**	
	Description	**Type**	Cat. No.
 *Cat. No. 800H-NP1 (Operators not included)*	**Closing Plug** Whenever an enclosure with more than the required number of openings is used, this plug can be used to close the unused openings. Includes synthetic O-ring washer.	For Cover Hole	**800H-NP1**
		For Base Coupler Hole	**800H-NP3**
	Description	**Size**	Cat. No.
 *Cat. No. 800H-NP10 (Operators not included)*	**Conduit Entry Plug** This plug can be used to plug unused conduit openings in Type 7 and 9 bases.	3/4 in.	800H-NP10
		1 in.	**800H-NP11**

Locking Attachments

	Description	Cat. No.
 *Cat. No. 800H-NP2 (Padlock not included)*	**Push Button Padlocking Attachments** This device permits locking in the depressed position on extended head push button units only.	800H-NP2
 *Cat. No. 800H-NP17 (Padlock not included)*	**Dual Push Button Extended Head Padlocking Attachments** This device permits locking for dual push button — extended head units only.	800H-NP17

General Accessories, Continued
Locking Attachments

	Description	Cat. No.
 *Cat. No. 800H-NP4 (Padlock not included)*	**Padlocking Cover** Padlocking cover is used for Type 7 and 9 selector switches, non-illuminated push buttons (except mushrooms) and non-illuminated 2-position push-pull units, but not for potentiometer units. **Note:** Push-pull units will only lock in the depressed position. Padlocking cover includes blank legend plate for customer marking. A pre-marked legend plate entitled OPEN COVER TO OPERATE (front view) and PULL-TO-START-PUSH-TO-STOP (rear view) is available. To order legend plate only, specify Cat. No. 800H-W174L.	**800H-NP4**

Miscellaneous

		Description	Style	No. of Wires	Cat. No.
 *Cat. No. 800H-NPRD91*	 *Cat. No. 800H-NPD93*	**Sealing Well with or without Integral Type 3 Flange Seal** These sealing wells can only be used with bases having 1 in. conduit entries. They reduce costs usually necessary with other conduit seal fittings for most installations (subject to applicable codes and laws) while maintaining Type 7 and 9 integrity. When using a sealing well with integral flange seal for Type 3 outdoor applications, an approved drain fitting must be provided. (Refer to National Electrical Code.)	With Integral Flange Seal, Type 3, 7, and 9	2	800H-NPRD90
				4	800H-NPRD91
				6	800H-NPRD92
				8	800H-NPRD93
			Without Integral Flange Seal, Type 7 and 9	2	800H-NPD90
				4	800H-NPD91
				6	800H-NPD92
				8	800H-NPD93

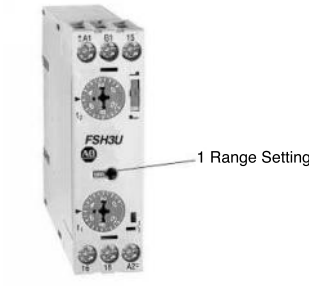
	Description	Style	Cat. No.
 *Cat. No. 800H-NP20*	**Type 3 Flange Seal** This seal provides a Type 3 rating while maintaining Type 7 and 9 integrity. An approved drain (see listing) is required for condensation when using this option (refer to National Electrical Code). For a Type 4 rating, use sealing nuts to seal the push button operators in addition to using the flange seal. Sealing kit is comprised of flange seal and sealing nut. They are used with the Allen-Bradley enclosures listed on page 10-154 for outdoor applications.	Flange Seal	**800H-NP20**
		Drain for 3/4 in. Conduit Opening	**800H-NP21**
		Drain for 1 in. Conduit Opening	800H-NP22
 *Cat. No. 800H-NP21*		Type 4 Sealing Nut	**800H-N479**
		Type 4 Sealing Kit	**800H-N479F**

	Description	Color	Cat. No.
 *Cat. No. 800H-NP23R*	**Color Insert Kit** These color insert kits are used with illuminated push buttons, pilot lights, push-pull, and push-to-test push buttons (order quantity of 1 to receive kit of 5 inserts).	Red	800H-NP23R
		Green	800H-NP23G
		Amber	800H-NP23A
		Blue	800H-NP23B
		White	800H-NP23W
		One of each color	800H-NP23

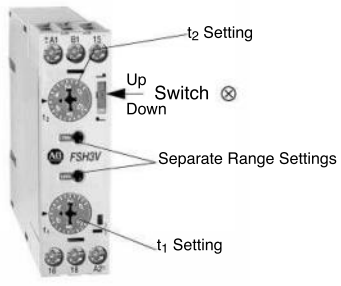
10

Special Function Flasher (Repeat Cycle Starting with Pulse or Pause) Timing Relays

Description



700-FSH3U



700-FSH3V

Supply Voltages (A1/A2)

Z12 12V DC

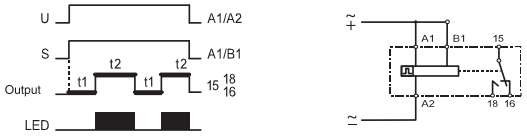
U23 24…48V DC,
24…240V AC, 50/60 Hz

Function Diagram / Connection Diagram

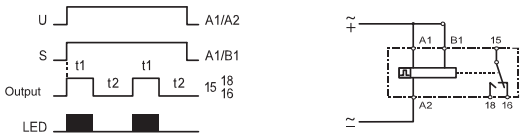
(H) Flasher (Repeat Cycle Starting with Pulse or Pause)
The repeat cycle timer permits different settings for on and off times.
The following operating modes are possible:

- Oscillating mode; repeat cycle starts with voltage applied at A1 and B1, and continues to repeat until voltage is off.
- One cycle mode; started by energizing B1 with voltage on A1 and A2.
- Output starts with pulse or pause (switch ⊗ Up or Down).
- 700-FSH3U provides (1) range setting for t_1 and t_2.
  700-FSH3V provides (2) range settings for t_1 and t_2.

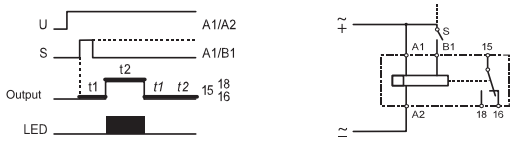
Supply Voltage Controlled, Oscillating Mode Starting with Pause — Switch ⊗ is Up



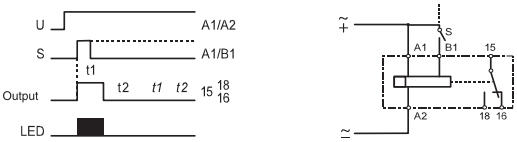
Supply Voltage Controlled, Oscillating Mode Starting with Pulse — Switch ⊗ is Down



Pulse Controlled, Output Starts With Pause (Min. Pulse AC 50 ms — DC 30 ms) — Switch ⊗ is Up One Cycle Mode — Voltage Supplied at A1 and A2, then Pulsing "s" to Energize B1 will Initiate One Cycle.



Pulse Controlled, Output Starts with Pulse (Min. Pulse AC 50 ms — DC 30 ms) — Switch ⊗ is Down One Cycle Mode — Voltage Supplied at A1 and A2, then Pulsing "s" to Energize B1 will Initiate One Cycle.



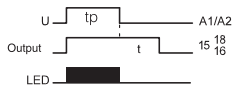
Note: If B1 is pulsed, a one full time cycle consisting of t_1 and t_2 is completed.

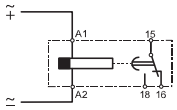
LED Operation Chart Green LED

LED	Output at Shelf State, No Timing – LED Off
LED	Output at Shelf State, Time is Running – LED Flashing
LED	Output NO Contact is Closed, No Timing – LED On
LED	Output NO Contact is Closed, Time is Running – LED Long Flashing

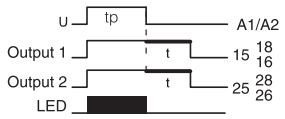
Function Diagram / Connection Diagram

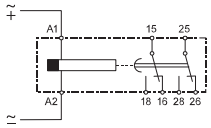
(Q) Off-Delay without Supply Voltage (True Off-Delay) — When input power is turned on, the output contact changes state. When the power is removed, the time delay begins. The output contact returns to shelf state at the end of the time delay.



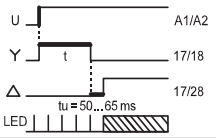


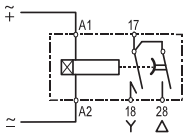
Note: Min. pulse (tp) required:
800 ms





(Y) Star-Delta Timing Relay — When power is applied, the output contact 17/18(Y) changes state. After the time setting, the output contact 17/18(Y) returns to shelf state. After the fixed time (50… 60 ms), the output contact 17/28Δ changes state. Both output contacts return to shelf state whenever the power is removed.





9

Product Selection — 125 A, H-Frame

- UL 489
- CSA 22.2, No. 5
- IEC 60947-2
- CE
- KEMA-KEUR

Note: Terminal box lugs provided as standard

1-Pole 25/18 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]		Interrupting Rating (60 Hz) [kA]		Cat. No.
		220…240V		240V	277V	
15	500	25	25	25	18	**140U-H1C1-C15**
20	500	25	25	25	18	**140U-H1C1-C20**
25	500	25	25	25	18	**140U-H1C1-C25**
30	500	25	25	25	18	**140U-H1C1-C30**
35	500	25	25	25	18	140U-H1C1-C35
40	500	25	25	25	18	140U-H1C1-C40
45	500	25	25	25	18	140U-H1C1-C45
50	500	25	25	25	18	**140U-H1C1-C50**
60	600	25	25	25	18	140U-H1C1-C60
70	700	25	25	25	18	140U-H1C1-C70
80	800	25	25	25	18	140U-H1C1-C80
90	900	25	25	25	18	140U-H1C1-C90
100	1000	25	25	25	18	**140U-H1C1-D10**
110	1100	25	25	25	18	140U-H1C1-D11
125	1250	25	25	25	18	140U-H1C1-D12

2-Pole 25/25 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
		220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C15**
20	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C20**
25	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C25**
30	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C30**
35	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C35**
40	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C40**
45	500	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C45
50	500	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C50**
60	600	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C60**
70	700	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-C70**
80	800	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C80
90	900	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-C90
100	1000	35	35	25	25	—	—	—	—	35	25	18	**140U-H2C2-D10**
110	1100	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-D11
125	1250	35	35	25	25	—	—	—	—	35	25	18	140U-H2C2-D12

Visit our website: www.ab.com/catalogs

Preferred availability cat. nos. are printed in **bold**

2-Pole 40/35 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	**140U-H3C2-C15**
20	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	**140U-H3C2-C20**
25	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C25
30	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C30
35	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C35
40	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C40
45	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C45
50	Fixed	500	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C50
60	Fixed	600	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C60
70	Fixed	700	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C70
80	Fixed	800	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C80
90	Fixed	900	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-C90
100	Fixed	1000	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D10
110	Fixed	1100	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D11
125	Fixed	1250	85	43	40	30	—	—	—	—	85	35	22	140U-H3C2-D12

2-Pole 70/65 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		500V		690V		240V	480V	600/347V	
15	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	**140U-H6C2-C15**
20	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C20
25	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C25
30	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C30
35	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C35
40	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C40
45	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C45
50	Fixed	500	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C50
60	Fixed	600	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C60
70	Fixed	700	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C70
80	Fixed	800	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C80
90	Fixed	900	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-C90
100	Fixed	1000	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D10
110	Fixed	1100	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D11
125	Fixed	1250	100	50	70	35	—	—	—	—	100	65	25	140U-H6C2-D12

3-Pole 25/25 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	15	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C15**
20	20	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C20**
25	25	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C25**
30	30	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C30**
35	35	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C35**
40	40	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C40**
45	40	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C45**
50	50	500	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C50**
60	60	600	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C60**
70	70	700	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C70**
80	80	800	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C80**
90	90	900	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-C90**
100	100	1000	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-D10**
110	110	1100	35	35	25	25	22	17	3	3	35	25	18	**140U-H2C3-D11**
125	125	1250	35	35	25	25	18	17	3	3	35	25	18	**140U-H2C3-D12**

3-Pole 40/35 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	15	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C15**
20	20	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C20**
25	25	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C25**
30	30	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C30**
35	35	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C35**
40	40	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C40**
45	45	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C45**
50	50	500	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C50**
60	60	600	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C60**
70	70	700	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C70**
80	80	800	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C80**
90	90	900	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-C90**
100	100	1000	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D10**
110	110	1100	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D11**
125	125	1250	85	43	40	30	25	18	4	3	85	35	22	**140U-H3C3-D12**

3-Pole 70/65 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.‡
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C15**
20	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C20**
25	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C25**
30	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C30**
40	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C40**
50	Fixed	500	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C50**
60	Fixed	600	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C60**
70	Fixed	700	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C70**
80	Fixed	800	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C80**
90	Fixed	900	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-C90**
100	Fixed	1000	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D10**
110	Fixed	1100	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D11**
125	Fixed	1250	100	100	70	70	25	13	6	3	100	65	25	**140U-H6C3-D12**

‡ Current Limiting

3-Pole 100/100 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.‡
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
15	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C15**
20	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C20**
25	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C25**
30	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C30**
40	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C40**
50	Fixed	500	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C50**
60	Fixed	600	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C60**
70	Fixed	700	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C70**
80	Fixed	800	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C80**
90	Fixed	900	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-C90**
100	Fixed	1000	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D10**
110	Fixed	1100	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D11**
125	Fixed	1250	200	200	100	100	35	18	8	6	200	100	35	**140U-H0C3-D12**

‡ Current Limiting

Molded Case Switch — UL 1087

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Breaking Capacity (50 Hz) I_{cu} / I_{cs} [kA]								Interrupting Rating (60 Hz) [kA]			Cat. No.
			220…240V		380…415V		525V		690V		240V	480V	600/347V	
125	—	1250	100	50	70	35	35	18	6	3	100	65	25	**140U-H6S3-D12**

30.5 mm Push Buttons

Selector Switches, Continued

3-Position Selector Switch Units, Non-Illuminated

Standard Knob Operator
Cat. No. 800T-J2A

Knob Lever Operator
Cat. No. 800T-J17A

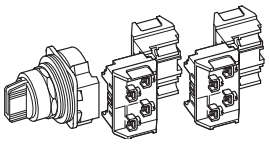
Standard Knob Operator
Cat. No. 800H-JR2A

Contact Type	Operator Position			Operator Type M = Maintained S = Spring Return	Type 4/13 Standard Knob Cat. No.	Type 4/13 Knob Lever Cat. No.	Type 4/4X/13 Standard Knob Cat. No.
				M M M	800T-J2	800T-J17	800H-JR2
				S→M M	800T-J4	800T-J18	800H-JR4
No Contacts	—	—	—	M M←S	800T-J5	800T-J19	800H-JR5
				S→M←S	800T-J91	800T-J20	800H-JR91
				M M M	800T-J2A	800T-J17A	800H-JR2A
				S→M M	800T-J4A	800T-J18A	800H-JR4A
1 N.O. - 1 N.C.	O X	O O	X O	M M←S	800T-J5A	800T-J19A	800H-JR5A
				S→M←S	800T-J91A	800T-J20A	800H-JR91A

Note: X = Closed/O = Open

800 T – J 2 C

a b c d e f



a

Protection Rating	
Code	**Description**
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	**Description**
Blank	No Guards
C	Guards on Terminals

c

Knob Insert Colors		
800T Type 4/13 Code	**Description**	**800H Type 4/4X/13 Code**
J	White	JR
JA	Red	JRA
JB	Green	JRB
JC	Blue	JRC
JE	Yellow	JRE
JF	Orange	JRF
JX	Packet of Colored Inserts ❶	JRX
Metal Wing Lever Colors ❷		
Code	**Color**	**Code**
JA	Red	—
JG	Gray	—

d

Knob/Lever Type Operators	
Standard Knob	
Code	**Operator Function**
2	Maintained
4	Spring Return from Left
5	Spring Return from Right
91	Spring Return from Both
Knob Lever ❷	
Code	**Operator Function**
17	Maintained
18	Spring Return from Left
19	Spring Return from Right
20	Spring Return from Both
Metal Wing Lever ❷	
Code	**Operator Function**
11	Maintained
15	Spring Return from Left
16	Spring Return from Right
141	Spring Return from Both
Coin Slot ❷	
Code	**Operator Function**
10	Spring Return from Both

e

Cam Option ❸	
Code	**Description**
Blank	KB7 Cam (Std.)
KA1	KA1 Cam
KA7	KA7 Cam

Note: See Table 1 for cam selections.

e (cont'd)

Cam Option ❸	
Code	**Description**
KC1	KC1 Cam
KC7	KC7 Cam
KD7	KD7 Cam
KE7 ❹	KE7 Cam
KQ1	KQ1 Cam
KQ7	KQ7 Cam
KR1 ❹	KR1 Cam
KR7 ❹	KR7 Cam
KT1 ❹	KT1 Cam
KT7 ❹	KT7 Cam
KU7 ❹	KU7 Cam

Note: See Table 1 for cam selections.

f

Contact Blocks	
Code	**Description**
Blank	No Contacts on operator
Standard	
A	1 N.O. - 1 N.C. 1-**800T-XA** on white side
B	2 N.O. - 2 N.C. 2-**800T-XA**s — 1 on white side/1 on black side
Pen*TUFF* (Low Voltage)	
AV	1 N.O. - 1 N.C. 1-**800T-XAV** on white side
BV	2 N.O. - 2 N.C. 2-**800T-XAV**s — 1 on white side/1 on black side

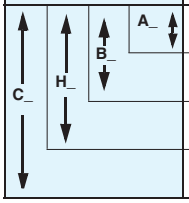
f (cont'd)

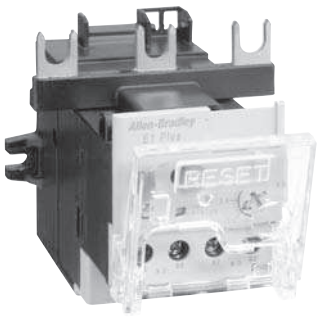
Contact Blocks	
Code	**Description**
Class 1, Div. 2/Zone 2	
Logic Reed	
AR	1 N.O. - 1 N.C. 1-**800T-XAR** on white side
BR	2 N.O. - 2 N.C. 2-**800T-XAR**s — 1 on white side/1 on black side
Sealed Switch	
AP	1 N.O. - 1 N.C. 1-**800T-XAP** on white side
BP	2 N.O. - 2 N.C. 2-**800T-XAP**s — 1 on white side/1 on black side
Stackable Sealed Switch	
AY	1 N.O. - 1 N.C. 1-**800T-XAY** on white side
BY	2 N.O. - 2 N.C. 2-**800T-XAY**s — 1 on white side/1 on black side

Note: Associated targets shown in Table 1.

❶ Packet of colored inserts, one of each color.
❷ Only available on 800T, Type 4/13 operators.
❸ If an overlapping cam is required, consult factory.
❹ Wing levers are not suitable with these cam codes.

Table 1. Cam and Contact Block Functionality Table (**Note:** X = Closed/O = Open)

Contact Block Suffix Code	Contact Block Side	Ckts	Cam Codes: KB7 (Std.)	KA1	KA7	KC1	KC7	KD7	KE7	KQ1	KQ7	KR1	KR7	KT1	KT7	KU7
	White	A	X O O	X O O	O O X	O O X	X O O	O O X	X O O	X O X	X O X	X O X	X O X	O O X	X O O	X O O
		B	O O X	O X O	O X O	O X O	O X O	O X O	O X X	O X O	O X O	O X O	O X O	O X O	O O X	O X O
	Black	A	X O O	X O O	O O X	O O X	X O O	X O O	O O X	X O O	X O O	O O X	O O X	O O X	X O O	O O X
		B	O O X	O X O	O X O	X O O	O O X	O X O	O X X	O X O	O X O	O X O	O X X	O X X	O O X	X X O
	White	A	X O O	X O O	O O X	O O X	X O O	O O X	X O O	X O X	X O X	X O X	X O X	O O X	X O O	X O O
		B	O O X	O X O	O X O	O X O	O X O	O X O	O X X	O X O	O X O	O X O	O X O	O X O	O O X	O X O
	Black	A	X O O	X O O	O O X	O O X	X O O	X O O	O O X	X O O	X O O	O O X	O O X	O O X	X O O	O O X
		B	O O X	O X O	O X O	X O O	O O X	O X O	O X X	O X O	O X O	O X X	O X X	X X O	O X X	X X O



E1 Plus Solid-State Overload Relays

- 0.1 … 90 A Current Range
- Single- and Three-Phase Devices
- Self-Powered
- Phase Loss Protection
- Wide Adjustment Range (5:1)
- Insert-Molded Power Connections
- 1 N.O. and 1 N.C. Isolated Auxiliary Contacts (B600 Rated)
- Low Energy Consumption (150 mW)
- Ambient Temperature Compensation
- Visible Trip Indication
- Selectable Trip Class (10, 15, 20, or 30)
- Selectable Manual/Auto-Manual Reset

Table of Contents

Standards Compliance

IEC EN 60947-4-1
EN 60947-5-1
CSA 22.2, No. 14
UL 508

Certifications

cULus Listed (File No. E14840, Guide No. NKCR, NKCR7)

1

Bulletin 592-EE – Three Phase Devices

- Selectable Trip Class (10, 15, 20, 30)
- Selectable Manual/Auto-Manual Reset

Mounts to Contactor	Adjustment Range	Cat. No.
00	0.1…0.5	592-EEAT
	0.2…1.0	592-EEBT
	1.0…5.0	592-EECT
	3.2…16	592-EEDT
0…2	0.2…1.0	**592-EEBC**
	1.0…5.0	**592-EECC**
	3.2…16	**592-EEDC**
	5.4…27	**592-EEEC**
	9…45	**592-EEFC**
3	9…45	592-EEFD
	18…90	**592-EEGD**
4	30…150	**592-EEHE**
5	60…300	**592-EEKF**

Bulletin 592S-EE – Single-Phase Devices

- Selectable Trip Class (10, 15, 20, 30)
- Selectable Manual/Auto-Manual Reset

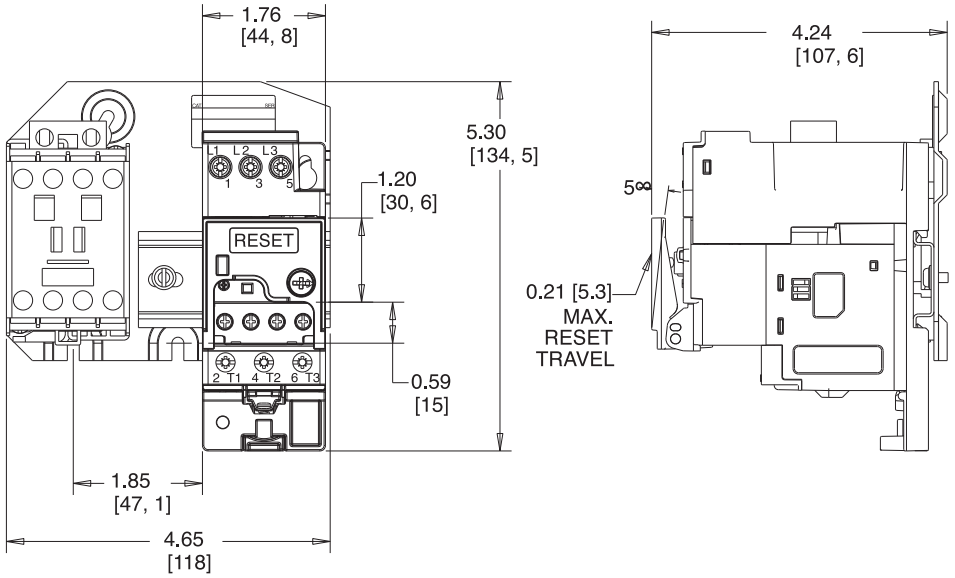
Mounts to Contactor	Adjustment Range	Cat. No.
00	1.0…5.0	592S-EEPT
	3.2…16	592S-EERT
	5.4…27	592S-EEST
0…2	1.0…5.0	592S-EEPC
	3.2…16	592S-EERC
	5.4…27	592S-EESC
	9…45	592S-EETC
3	18…90	592S-EEUD

E1 Plus Solid-State Overload Relays

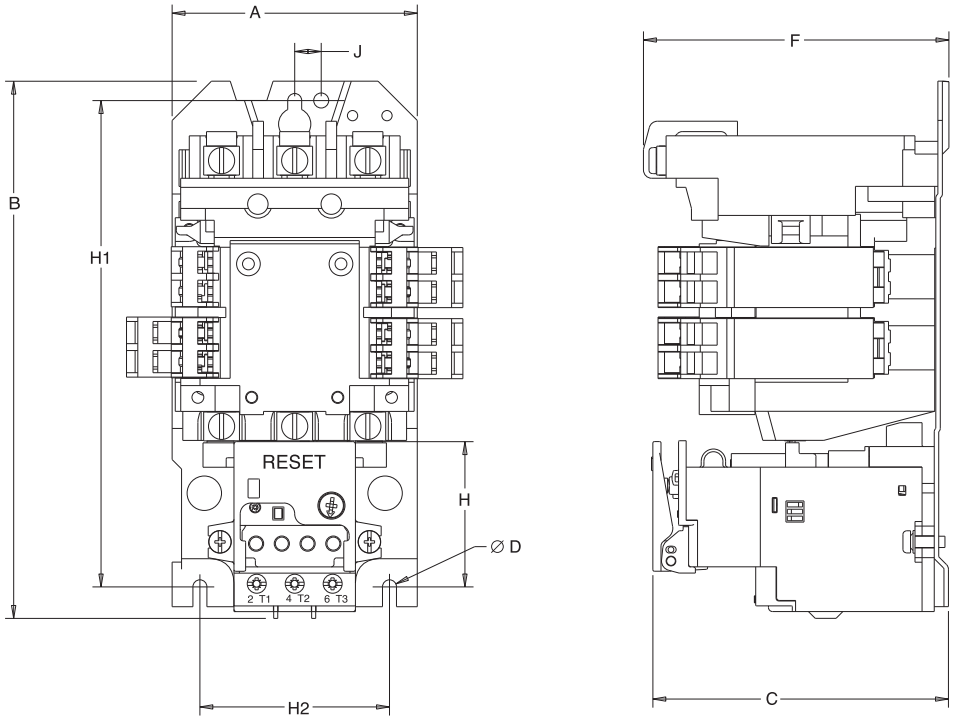
Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended to be used for manufacturing purposes.

Size 00

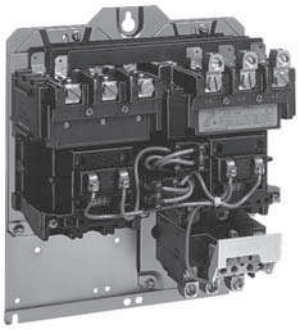


Size 0…3



Overload Cat. No.	Contactor	A	B	C	D	F	H1	H2	J
592-EE__C	Size 0 and 1	91 (3-9/16)	198 (7-25/32)	114 (4-1/2)	5.2 (13/64)	113 (4-7/16)	180 (7-1/16)	70 (2-3/4)	9.8 (3/8)
592-EE__C	Size 2	100 (3-15/16)	233 (9-11/64)	114 (4-1/2)	5.2 (13/64)	119 (4-11/16)	219 (8-5/8)	80 (3-5/32)	9.8 (3/8)
592-EE__D	Size 3	155.5 (6-1/8)	336.7 (13-1/4)	154 (6-1/16)	7.1 (9/32)	150.1 (5-29/32)	219.9 (8-21/32)	139.9 (5-1/2)	19.9 (25/32)

1



Bulletin 505
Size 2, with Solid-State Overload
Open Type without Enclosure

Bulletin 505

- NEMA sizes 00…9
- Exceptional electrical life
- UL Witnessed Type 2 Coordination
- Dependable coil operation
- Eutectic alloy overload relays: Class 10, 20, or 30
- Solid-state overload relays: Class 10, 15, 20, or 30
- Vertically arranged available — Bulletin 505V sizes 0…5
- Enclosure ratings — NEMA Type 1, 3R/12, 4/4X stainless steel, 4/4X fiberglass reinforced, and 7 & 9 hazardous location
- 3-phase and single-phase available
- Reversing contactors also available

Table of Contents

Standards Compliance

- NEMA/EEMAC ICS 2
- UL 508
- CSA C22.2 No.14
- ABS 4/5.115 — American Bureau of Shipping
- UCSG 46 CFR 111.70
- IEEE 45
- EN/IEC 60947-4-1
- CE Marked

Certifications

- CSA Certified (LR1234)
- UL Listed (File No. E3125, Guide No. NLDX)
- Hazardous Location:
  UL Listed (File No. E10314)
  CSA Certified (LR11924)

Description

Bulletin 505 reversing starters are most commonly used for full voltage starting and reversing of polyphase squirrel cage motors. Starters Size 00…9 are electrically and mechanically interlocked to avoid both contactors being closed simultaneously. Bulletin 505V vertically arranged starters are available in Sizes 0…5 in the open type without enclosure construction only. Bulletin 505 reversing starters are available with Bulletin 592 eutectic alloy overload relays as standard and Bulletin 592 solid-state overloads are optional for additional flexibility in motor protection.

Heater Elements — Starters with eutectic alloy overload relays require 3 heater elements. See page 1-177 for heater element selection tables.

3-Phase • 600V AC Maximum • 60 Hz • with 3-Pole Overload Protection

NEMA Size	Continuous Ampere Rating [A]	Maximum Horsepower Rating Full Load Current Must Not Exceed "Continuous Ampere Rating" — Motor Voltage 200V	230V	50 Hz 380…415V	460…575V	Open Type Without Enclosure Cat. No.∗❄	Type 1 General Purpose Enclosure Surface Mounting Cat. No.∗	Type 3R/12, Rainproof, Dusttight Industrial Use Enclosure Cat. No.∗	Type 4/4X Watertight, Corrosion-Resistant Enclosures Stainless Steel Cat. No.∗‡	Type 4X Watertight, Corrosion-Resistant Enclosure Fiberglass-Reinforced Polyester Cat. No.∗‡
00	9	1-1/2	1-1/2	2	2	505-TO⊗-✪	**505-TA⊗-✪**	—	—	—
0	18	3	3	5	5	**505-AO⊗-✪**	**505-AA⊗-✪**	**505-AJ⊗-✪**	**505-AC⊗-✪**	505-AS⊗-✪
1	27	7-1/2	7-1/2	10	10	**505-BO⊗-✪**	505-BA⊗-✪	**505-BJ⊗-✪**	505-BC⊗-✪	505-BS⊗-✪
2	45	10	15	25	25	**505-CO⊗-✪**	505-CA⊗-✪	505-CJ⊗-✪	**505-CC⊗-✪**	505-CS⊗-✪
3	90	25	30	50	50	**505-DO⊗-✪**	505-DA⊗-✪	505-DJ⊗-✪	**505-DC⊗-✪**	
4	135	40	50	75	100	**505-EO⊗-✪**	**505-EA⊗-✪**	**505-EJ⊗-✪**	**505-EC⊗-✪**	
5	270	75	100	150	200	**505-FO⊗-✪**	**505-FA⊗-✪**	**505-FJ⊗-✪**	**505-FC⊗-✪**	
6§♣	540	150	200	300	400	505-GO⊗-✪	505-GA⊗-✪	505-GJ⊗-✪	505-GC⊗-✪	—
7§	810	—	300	600	600	**505-HO⊗-✪**	505-HA⊗-✪	505-HJ⊗-✪	505-HC⊗-✪	
8§	1215	—	450	900	900	505-JO⊗-✪	505-JA⊗-✪	505-JJ⊗-✪	—	
9§	2250	—	800	1600	1600	505-KO⊗-✪	505-KA⊗-✪	—	—	

⊗ Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **Cat. No. 505-AA⊗-✪** becomes **Cat. No. 505-AAD-✪**. For other voltages, please consult your local Rockwell Automation sales office or Allen-Bradley distributor.

[V]		24➢	110V-115	115-120	200-208	220-230	230-240	240	277	380	380-400	415	440-460	460-480	500	550	575-600
Common Control⌘	AC, 50 Hz	—	—	—	—	P♠	—	T	—	N	KN	I	Q	—	M	R	—
	AC, 60 Hz	—	—	—	**H**	—	**A**[11]	—	—	—	—	U	—	**B**	—	—	**C**
Transformer Control	AC, 60 Hz	—	—	—	**H**	—	**A**	—	—	—	—	—	—	**B**	—	—	**C**
Separate Control (without transformer)	AC, 50 Hz	K	S✦	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	AC, 60 Hz	J	—	**D**❖	—	—	—	—	F	—	—	—	—	—	—	—	—

✪ Overload Relay Code

Use to order solid-state overload relay. Do not use when ordering eutectic alloy overload relay. The cat. no. as listed is incomplete. Select an overload relay code from page 1-169 to complete the cat. no. Example: **Cat. No. 505-AAD-✪** becomes **Cat. No. 505-AAD-A2D**.

∗ **Omission of Overload Relays —** Bulletin 505 reversing starters are available without overload protection. Cat. nos. for all starters without overload protection will be the listed cat. no. with the No. **23** added. Example: **Cat. No. 505-AOD-✪** would be **Cat. No. 505-AOD-23**.
❄ **Vertically Arranged —** Full voltage reversing starters, sizes 0…5, open type without enclosure can be supplied in a vertically arranged construction. To order, change the bulletin number in the listed cat. no. from **505** to **505V**. Example: **Cat. No. 505V-AOD-A2D** with solid-state overload relay and **Cat. No. 505V-AOD** with eutectic alloy overload relay.
‡ Fiberglass reinforced polyester hubs are included with each starter. Sizes 6…8 are painted enclosures.
§ Does not include line and load lugs. See page 1-122 for kits.
♣ Price includes control circuit transformer. This applies to NEMA size 6 enclosed, only.
➢ Only available on sizes 00…5. When using 24V coils on size 4 or 5, an interposing relay may be required. See coil VA values on page 1-139.
⌘ When selecting a factory installed control circuit transformer (see Modifications page 1-117), use the common control coil voltage code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 505-BAB-6P** will have a transformer with a 480V primary/120V secondary voltage and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second coil voltage code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 505-BABJ-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.
✦ This coil is optimized for 110…115V, 50 Hz applications, but can be used at 120V, 60 Hz nominal.
❖ This coil is optimized for 115…120V, 60 Hz applications, but can be used at 110V, 50 Hz nominal.
♠ This coil is optimized for 220…230V, 50 Hz applications, but can be used at 240V, 60 Hz nominal.
[11] This coil is optimized for 230…240V, 60 Hz applications, but can be used at 220V, 50 Hz nominal.

Typical Wiring Diagrams — page 1-40
Accessories — page 1-121
Modifications — page 1-116
Specifications — page 1-136
Approximate Dimensions — page 1-144
Heater Element Selection — page 1-177

NEMA Full Voltage Reversing Starters

Product Selection, Continued

Heater Elements — Starters with eutectic alloy overload relay require 3 heater elements. See page 1-177 for heater element selection tables.

3-Phase • 600V AC Maximum • 60 Hz • With 3-Pole Overload Protection								
		Maximum Horsepower Rating Full Load Current Must Not Exceed "Continuous Ampere Rating"				Hazardous Locations		
		Motor Voltage				Unilock Enclosures	Bolted Enclosures	
NEMA Size	Continuous Ampere Rating [A]	200V	230V	50 Hz 380…415V	460…575V	Type 3R, 7 & 9 Class I, Groups C & D Class II, Groups E, F & G — Divisions 1 & 2 — Cat. No.∗❄	Type 7 & 9 Class I, Groups C & D Class II, Groups E, F & G — Divisions 1 & 2 — Cat. No.∗	Type 3R, 7 & 9 Class I, Groups C & D Class II, Groups E, F & G — Divisions 1 & 2 — Cat. No.∗‡
0	18	3	3	5	5	505-AU⊗-✪	505-AE⊗-✪	505-AH⊗-✪
1	27	7-1/2	7-1/2	10	10	505-BU⊗-✪	505-BE⊗-✪	505-BH⊗-✪
2	45	10	15	25	25	—	505-CE⊗-✪	505-CH⊗-✪
3	90	25	30	50	50	—	505-DE⊗-✪	505-DH⊗-✪
4	135	40	50	75	100	—	505-EE⊗-✪	505-EH⊗-✪

⊗ Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **Cat. No. 505-AU⊗-✪** becomes **Cat. No. 505-AUD-✪**. For other voltages, consult your local Rockwell Automation sales office or Allen-Bradley distributor.

[V]		24§	110-115	115-120	200-208	220-230	230-240	240	277	380	380-400	415	440-460	460-480	500	550	575-600
Common Control♣	AC, 50 Hz	—	—	—	—	P✦	—	T	—	N	KN	I	Q	—	M	R	—
	AC, 60 Hz	—	—	—	H	—	A♠	—	—	—	—	U	—	B	—	—	C
Transformer Control	AC, 60 Hz	—	—	—	H	—	A	—	—	—	—	—	—	B	—	—	C
Separate Control (without transformer)	AC, 50 Hz	K	S➢	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	AC, 60 Hz	J	—	D⌘	—	—	—	—	F	—	—	—	—	—	—	—	—

✪ Overload Relay Code

Use to order solid-state overload relay. Do not use when ordering eutectic alloy overload relay. The cat. no. as listed is incomplete. Select an overload relay code from page page 1-169 to complete the cat. no. Example: **Cat. No. 505-AUD-✪** becomes **Cat. No. 505-AUD-A2D**.

∗ **Omission of Overload Relays —** Bulletin 505 reversing starters are available without overload protection. Cat. nos. for all starters without overload protection will be the listed cat. no. with the No. **23** added. Example: **Cat. No. 505-AUD-✪** would be **Cat. No. 505-AUD-23**.
❄ For NEMA Type 3R application it is **necessary** that a drain or breather and drain be **added**. See Factory Modifications or Accessories.
‡ Includes drain and cover gasket.
§ Only available on sizes 00…5. When using 24V coils on size 4 or 5, an interposing relay may be required. See coil VA values on page 1-139.
♣ When selecting a factory-installed control circuit transformer (see Modifications page 1-116), use the common control coil voltage code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 505-BUB-6P** will have a transformer with a 480V primary/120V secondary voltage and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second coil voltage code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 505-BUBJ-6P** will have a transformer with a 480V primary/24V secondary and a 24V starter coil.
➢ This coil is optimized for 110…115V, 50 Hz applications, but can be used at 120V, 60 Hz nominal.
⌘ This coil is optimized for 115…120V, 60 Hz applications, but can be used at 110V, 50 Hz nominal.
✦ This coil is optimized for 220…230V, 50 Hz applications, but can be used at 240V, 60 Hz nominal.
♠ This coil is optimized for 230…240V, 60 Hz applications, but can be used at 220V, 50 Hz nominal.

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Approximate Dimensions — page 1-144
Heater Element Selection — page 1-177

Visit our website: www.ab.com/catalogs
Preferred availability cat. nos. are printed in **bold**

Heater Elements — Starters with eutectic alloy overload relays require one heater element. See page page 1-177 for heater element selection tables.

1-Phase • 2-Pole • 277V AC Maximum • 60 Hz • With 1-Pole Eutectic Overload Protection

NEMA Size	Continuous Ampere Rating [A]	No. of Poles	Type Of Motor	Maximum Horsepower Rating (Each Motor) Full load current of each motor must not exceed "Continuous Ampere Rating" — Motor Voltage 115V	Motor Voltage 230V	Open Type Without Enclosure Cat. No.∗❄	Type 1 General Purpose Enclosure Cat. No.∗❄	Type 3R/12 Rainproof, Dusttight Industrial Use Enclosure Cat. No.∗❄	Type 4/4X Watertight, Corrosion-Resistant Enclosure Stainless Steel Cat. No.∗❄	Hazardous Location Enclosures: Type 7 & 9 Class I, Groups C & D Class II, Groups E, F & G Division 1 & 2 Cat. No.∗❄	Hazardous Location Enclosures: Type 3R, 7 & 9 Class I, Groups C & D Class II, Groups E, F & G Division 1 & 2 Cat. No.∗❄
00	9	2	3 Lead Repulsion Induction	1/3	1	**505-TO⊗-101**	**505-TA⊗-101**	Use Size 0 Starter			
			3 Lead Split Phase			**505-TO⊗-102**	**505-TA⊗-102**				
		3	4 Lead Repulsion Induction			**505-TO⊗-103**	**505-TA⊗-103**				
			4 Lead Split Phase			**505-TO⊗-104**	**505-TA⊗-104**				
0	18	2	3 Lead Repulsion Induction	1	2	505-AO⊗-101	**505-AA⊗-101**	**505-AJ⊗-101**	**505-AC⊗-101**	505-AE⊗-101	505-AH⊗-101
			3 Lead Split Phase			**505-AO⊗-102**	**505-AA⊗-102**	**505-AJ⊗-102**	**505-AC⊗-102**	505-AE⊗-102	505-AH⊗-102
		3	4 Lead Repulsion Induction			505-AO⊗-103	**505-AA⊗-103**	**505-AJ⊗-103**	**505-AC⊗-103**	505-AE⊗-103	505-AH⊗-103
			4 Lead Split Phase			505-AO⊗-104	**505-AA⊗-104**	**505-AJ⊗-104**	**505-AC⊗-104**	505-AE⊗-104	505-AH⊗-104
		4	4 Lead Split Phase (Break all lines)			505-AO⊗-105	**505-AA⊗-105**	**505-AJ⊗-105**	**505-AC⊗-105**	—	—
1	27	2	3 Lead Repulsion Induction	2	3	**505-BO⊗-101**	**505-BA⊗-101**	**505-BJ⊗-101**	**505-BC⊗-101**	505-BE⊗-101	505-BH⊗-101
			3 Lead Split Phase			**505-BO⊗-102**	**505-BA⊗-102**	**505-BJ⊗-102**	**505-BC⊗-102**	505-BE⊗-102	505-BH⊗-102
		3	4 Lead Repulsion Induction			**505-BO⊗-103**	**505-BA⊗-103**	**505-BJ⊗-103**	**505-BC⊗-103**	505-BE⊗-103	505-BH⊗-103
			4 Lead Split Phase			**505-BO⊗-104**	**505-BA⊗-104**	**505-BJ⊗-104**	**505-BC⊗-104**	505-BE⊗-104	505-BH⊗-104
		4	4 Lead Split Phase (Break all lines)			**505-BO⊗-105**	**505-BA⊗-105**	**505-BJ⊗-105**	**505-BC⊗-105**	—	—

⊗ Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no.
Example: **Cat. No. 505-AAX⊗-101** becomes **Cat. No. 505-AAXD-101**. For other voltages, please consult your local Rockwell Automation sales office or Allen-Bradley distributor.

[V]		24‡	110…115	115…120	200…208	220…230	230…240	240	277
Common Control§	AC, 50 Hz	—	XS♣	—	—	XP⌘	—	XT	—
	AC, 60 Hz	—	—	**XD➢**	**XH**	—	**XA✦**	—	XF
Separate Control (without transformer)	AC, 50 Hz	—	XWS♣	—	—	XWP⌘	—	XWT	—
	AC, 60 Hz	XWJ	—	**XWD➢**	**XWH**	—	**XWA✦**	—	XWF

∗ **Ordering Information —** All 1-phase reversing starter orders **must be** accompanied with a circuit diagram of the motor.

❄ **Omission of Overload Relays —** Bulletin 505 reversing starters are available without overload protection. Cat. nos. for all starters without overload protection will be the listed cat. no. with the No. **23** added. Example: **Cat. No. 505-AOXD-101** would be **Cat. No. 505-AOXD-23-101**.

‡ Only available on sizes 00…5. When using 24V coils on size 4 or 5, an interposing relay may be required. See coil VA values on page 1-139.

§ When selecting a factory-installed control circuit transformer (see Modifications page 1-116), use the common control coil voltage code to denote the transformer primary voltage. The starter coil and transformer secondary voltage will both be 120V by default. Example: **Cat. No. 505-BAXA-6P-101** will have a transformer with a 240V primary/120V secondary voltage and a 120V starter coil. If a starter coil voltage other than 120V is desired, a second coil voltage code must be added to denote the coil/transformer secondary voltage. Example: **Cat. No. 505-BAXAJ-6P-101** will have a transformer with a 240V primary/24V secondary and a 24V starter coil.

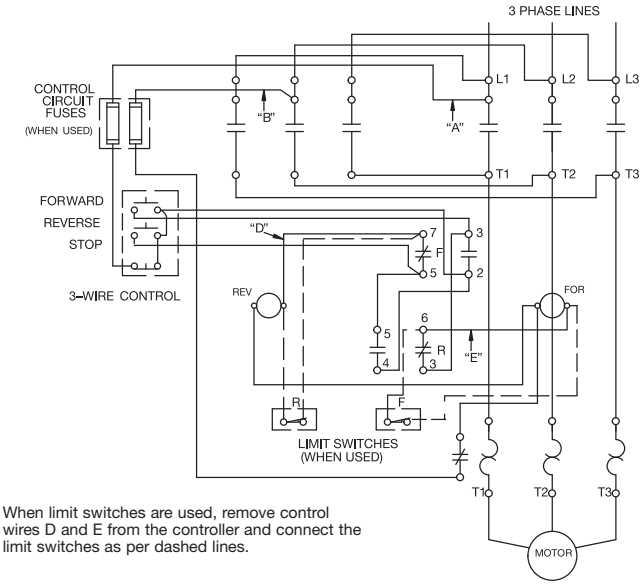
♣ This coil is optimized for 110…115V, 50 Hz applications, but can be used at 120V, 60 Hz nominal.

➢ This coil is optimized for 115…120V, 60 Hz applications, but can be used at 110V, 50 Hz nominal.

⌘ This coil is optimized for 220…230V, 50 Hz applications, but can be used at 240V, 60 Hz nominal.

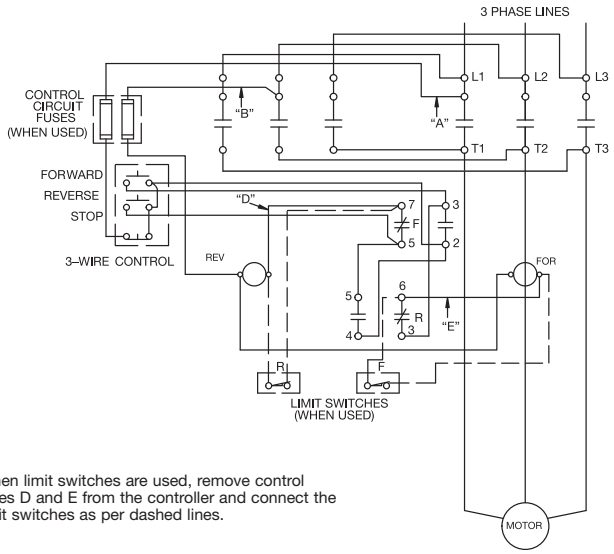
✦ This coil is optimized for 230…240V, 60 Hz applications, but can be used at 220V, 50 Hz nominal.

Typical Wiring Diagrams



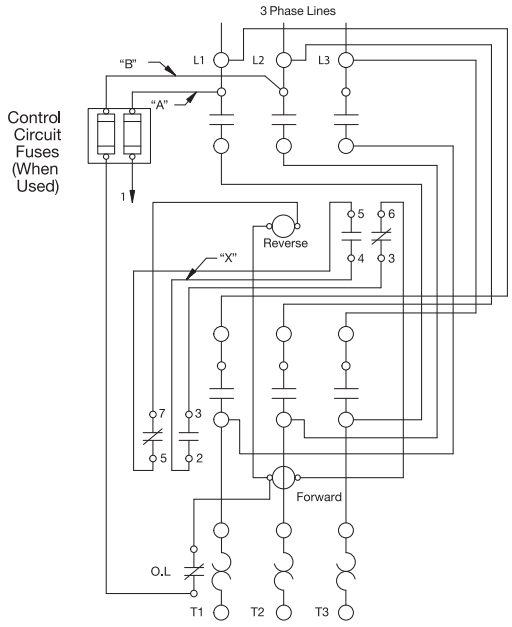
When limit switches are used, remove control wires D and E from the controller and connect the limit switches as per dashed lines.

Bulletin 505
3Ø — 3-Pole
Reversing Starter with Eutectic Alloy Overload Relay and Solid-State Overload Relays



When limit switches are used, remove control wires D and E from the controller and connect the limit switches as per dashed lines.

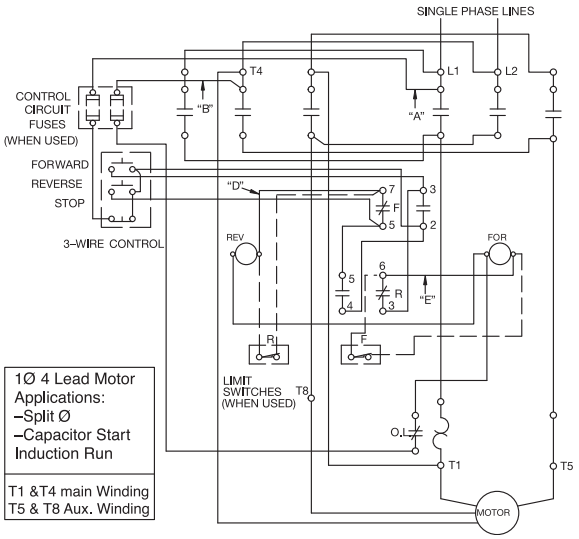
Bulletin 505
3Ø — 3-Pole
Reversing Starter without Overload Relay



Bulletin 505V
3Ø — 3-Pole
Vertical Reversing Starter with Eutectic Alloy Overload Relay, With Solid-State Overload Relays

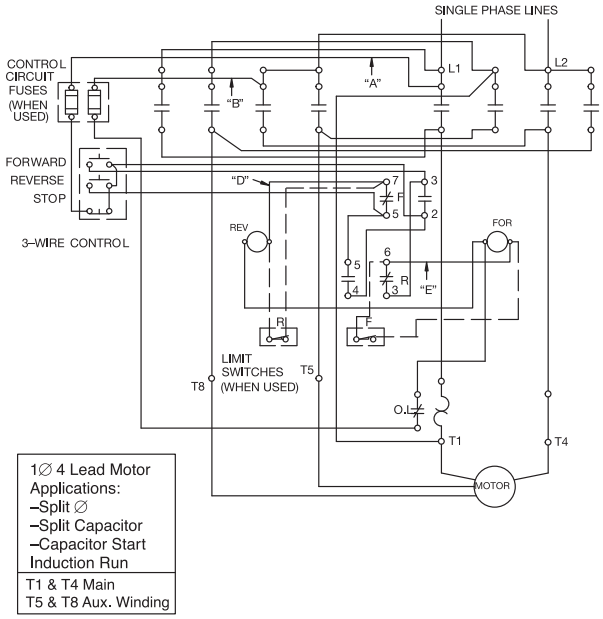
Separate Control Circuit — When the controller coils are to operate on a voltage other than line voltage, check coil rating for compatibility and change coils if necessary. Disconnect wires A and B from lines L1 and L2. Connect wires A and B to the separate control source. Refer to local Electrical Code for control circuit disconnection requirements.

Product Selection — page 1-37

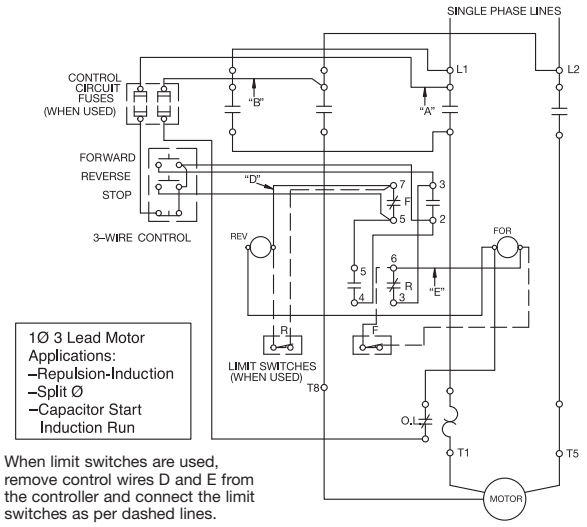


Bulletin 505
1Ø — 3-Pole (Suffix 104)
Reversing Starter with
Eutectic Alloy Overload Relay

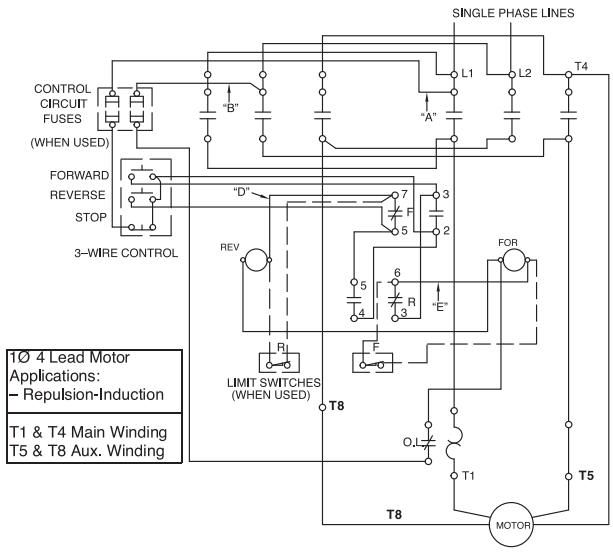
When limit switches are used, remove control wires D and E from the controller and connect the limit switches as per dashed lines.



Bulletin 505
1Ø — 4-Pole (Suffix 105)
Reversing Starter with
Eutectic Alloy Overload Relay



Bulletin 505
1Ø — 2-Pole (Suffix 101 and 102)
Reversing Starter with
Eutectic Alloy Overload Relay



Bulletin 505
1Ø — 3-Pole (Suffix 103)
Reversing Starter with
Eutectic Alloy Overload Relay

Separate Control Circuit — When the controller coils are to operate on a voltage other than line voltage, check coil rating for compatibility and change coils if necessary. Disconnect wires A and B from lines L1 and L2. Connect wires A and B to the separate control source. Refer to local Electrical Code for control circuit disconnection requirements.

Product Selection — page 1-37

2-Position Push-Pull and Push-Pull/Twist Release Units, Non-Illuminated

Note: A jumbo or large legend plate is recommended, if space allows.

2-Position Push-Pull
Cat. No. 800T-FX6D4

2-Position Push-Pull/Twist
Cat. No. 800T-FXT6D4

2-Position Push-Pull/Twist
Cat. No. 800H-FRXT6D4

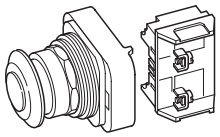
Contact Type	Operator Position		Button Color	Type 4/13		Type 4/4X/13
	Maintained	Maintained		Push-Pull	Push-Pull/ Twist Release	Push-Pull/ Twist Release
	Out	In		Cat. No.	Cat. No.	Cat. No.
N.C.L.B.	X	O	Red	800T-FX6D4 ❷	800T-FXT6D4 ❷	800H-FRXT6D4 ❷
N.O. - N.C.L.B. ❶	O X	X O		800T-FX6A1 ❷	800T-FXT6A1 ❷	800H-FRXT6A1 ❷
N.C.L.B. - N.C.L.B. ❶	X X	O O		800T-FX6A5 ❷	800T-FXT6A5 ❷	800H-FRXT6A5 ❷

Note: X = Closed/O = Open

❶ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

❷ Meets EN-418 and IEC 60947-5-5 standards for emergency stop applications.

800 T — – FX 1 A1
a b c d e



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No Guards
C	Guards on Terminals

c

Head Type ❸		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
FX	Mushroom Head (Push-Pull)	—
FXJ	Jumbo Mushroom Head (Push-Pull)	—
FXT	Push-Pull/Twist to Release	FRXT
FXJT	Jumbo Head Push-Pull w/ Twist to Release	FRXJT

d

Color Cap	
Code	Color
Blank	No Cap ❹
1	Green
2	Black
3	Orange
4	Gray
5	White
6	Red
7	Blue
9	Yellow

e

Contact Block(s)			
Code	Operator Position		Description
	Out	In	
Blank	—	—	No Contacts on operator
Standard			
D1	O	X	1 N.O.
D2	X	O	1 N.C.
D4	X	O	1 N.C.L.B.
A	O X	X O	1 N.O. - 1 N.C.
A1	O X	X O	1 N.O. - 1 N.C.L.B.
A5	X X	O O	2 N.C.L.B.

e (cont'd)

Contact Block(s)			
Code	Operator Position		Description
	Out	In	
Blank	—	—	No Contacts on operator
Pen*TUFF* (Low Voltage)			
D1V	O	X	1 N.O.
D2V	X	O	1 N.C.
D4V	X	O	1 N.C.L.B.
AV	O X	X O	1 N.O. - 1 N.C.
Class 1, Div. 2/Zone 2			
Logic Reed			
D1R	O	X	1 N.O.
D2R	X	O	1 N.C.
AR	O X	X O	1 N.O. - 1 N.C.
Sealed Switch			
D1P	O	X	1 N.O.
D2P	X	O	1 N.C.
AP	O X	X O	1 N.O. 1 N.C.
Stackable Sealed Switch			
D1Y	O	X	1 N.O.
D2Y	X	O	1 N.C.
AY	O X	X O	1 N.O. - 1 N.C.

Note: X = Closed/O = Open

❸ 2-position push-pull and push-pull/twist-to-release devices with N.C.L.B. contacts meet EN-418 and IEC 60947-5-5 standards for emergency stop applications.

❹ Not valid with head Type **J** or **JT**.

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Legend Plates — Page 59
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Pilot Light Devices∗

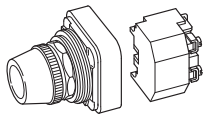
Transformer Type Pilot Light
Cat. No. 800T-P16R

Push-to-Test Pilot Light
Cat. No. 800T-PT16R

Type	Lamp Type	Volts	Color	Type 4/13 Pilot Light Cat. No.	Type 4/13 Push-to-Test∗ Cat. No.	Type 4/4X/13 Pilot Light Cat. No.	Type 4/4X/13 Push-to-Test∗ Cat. No.
Operator Only❄				800T-S00	**800T-SB00XX**	800H-SR00	800H-SRB00XX
Full Voltage‡	Incandescent	24V AC/DC	Red	**800T-Q24R**	**800T-QT24R**	**800H-QR24R**	**800H-QRT24R**
			Green	**800T-Q24G**	**800T-QT24G**	**800H-QR24G**	800H-QRT24G
			Amber	**800T-Q24A**	**800T-QT24A**	**800H-QR24A**	800H-QRT24A
	No Lamp	0…250V AC/DC	No Lens	800T-QN25	800T-QTN25	—	—
Universal‡	LED	12…130 V AC/DC	Red	**800T-QH2R**	**800T-QTH2R**	**800H-QRH2R**	**800H-QRTH2R**
			Green	**800T-QH2G**	**800T-QTH2G**	**800H-QRH2G**	**800H-QRTH2G**
			Amber	**800T-QH2A**	**800T-QTH2A**	**800H-QRH2A**	**800H-QRTH2A**
Transformer‡	Incandescent	120V AC, 50/60 Hz	Red	**800T-P16R**	**800T-PT16R**	**800H-PR16R**	**800H-PRT16R**
			Green	**800T-P16G**	**800T-PT16G**	**800H-PR16G**	**800H-PRT16G**
			Amber	**800T-P16A**	**800T-PT16A**	**800H-PR16A**	**800H-PRT16A**
	LED		Red	**800T-PH16R**	**800T-PTH16R**	**800H-PRH16R**	**800H-PRTH16R**
			Green	**800T-PH16G**	**800T-PTH16G**	**800H-PRH16G**	**800H-PRTH16G**
			Amber	**800T-PH16A**	**800T-PTH16A**	**800H-PRH16A**	**800H-PRTH16A**
	No Lamp		No Lens	800T-PN16	800T-PTN16	—	—

∗ Includes one standard Cat. No. 800T-XA (1 N.O. - 1 N.C.) contact block. For typical pilot light wiring diagrams, see page 10-65.
❄ Operator only supplied without power module, lamp, lens cap, or contact blocks.
‡ All pilot lights except push-to-test without sealed contacts and dual input transformer relay, are rated for Class 1, Division 2 applications.

800	T		–	P	T		16	G	AR (Push-to-Test)
	a	*b*		*c*	*d*	*e*	*f*	*g*	*h*



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Power Module Type		
800T Type 4/13 Code	Description	800H Type 4/4X/13 Code
P	Transformer (or dual input)	PR
Q	Full voltage/ Universal	QR

d

Lamp Test Options	
Code	Description
Blank	No test option
T	Push-to-test
D	Dual input — diode♣
DT	Dual input — transformer relay
Note: Push-to-test supplied with factory jumpered contact block.	

e

Illumination Options	
Code	Description
Blank	Incandescent
H	LED∗

f

Voltage	
Transformer	
Code	Description
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz
Full Voltage — Incandescent	
12	12V AC/DC
24	24V AC/DC
48	48V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
2	12…130V AC/DC
Dual Input	
16	120V AC
24	24V AC/DC (Dual input diode only)

g

Lens Color		
Code	Color	Glass Code ♠
Blank	No lens	Blank
A	Amber	D
B	Blue	E
C	Clear	F
G	Green	H
R	Red	J
W	White	K

h

Contact Blocks (Push-to-test units only)	
Code	Description
Standard	
Blank	1 N.O. - 1 N.C.
Pen*TUFF* (Low Voltage)	
AV	1 N.O. - 1 N.C.
Class 1, Div. 2/Zone 2	
Logic Reed	
AR	1 N.O. - 1 N.C.
Sealed Switch	
AP	1 N.O. - 1 N.C.
Stackable Sealed Switch	
AY	1 N.O. - 1 N.C.

∗ LED illumination option is not available with diode type dual input.
♣ Diode type dual input provides circuit isolation via opposing diodes. Not recommended for use with solid-state outputs.
♠ Glass lens available on 800T pilot lights only. Not available on push-to-test units.

Momentary Contact Push Button Units, Non-Illuminated

Flush Head Unit
Cat. No. 800T-A1A

Extended Head Unit
Cat. No. 800T-B6A

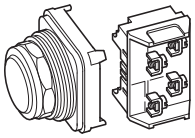
Booted Unit
Cat. No. 800H-R2A

Bootless Flush Head Unit
Cat. No. 800H-AR1A

Contact Type	Button Color	Type 4/13		Type 4/4X/13	
		Flush Head	Extended Head	Booted∗	Bootless Flush Head
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
No Contact	Green	**800T-A1**	**800T-B1**	**800H-R1**	**800H-AR1**
	Black	**800T-A2**	**800T-B2**	**800H-R2**	**800H-AR2**
	Red	**800T-A6**	**800T-B6**	**800H-R6**	**800H-AR6**
1 N.O.	Green	**800T-A1D1**	**800T-B1D1**	**800H-R1D1**	**800H-AR1D1**
	Black	**800T-A2D1**	**800T-B2D1**	**800H-R2D1**	**800H-AR2D1**
	Red	**800T-A6D1**	**800T-B6D1**	800H-R6D1	**800H-AR6D1**
1 N.C.	Green	**800T-A1D2**	**800T-B1D2**	800H-R1D2	800H-AR1D2
	Black	**800T-A2D2**	**800T-B2D2**	800H-R2D2	**800H-AR2D2**
	Red	**800T-A6D2**	**800T-B6D2**	**800H-R6D2**	**800H-AR6D2**
1 N.O. - 1 N.C.	Green	**800T-A1A**	**800T-B1A**	**800H-R1A**	**800H-AR1A**
	Black	**800T-A2A**	**800T-B2A**	**800H-R2A**	**800H-AR2A**
	Red	**800T-A6A**	**800T-B6A**	**800H-R6A**	**800H-AR6A**

800 T [ ] – A 1 [ ] A

a *b* *c* *d* *e* *f*



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No Guards
C	Guards on Terminals

c

Operator Type		
800T Type 4/13 Code	Description	800H Type 4/4X/13 Code
A	Flush Head	AR
B	Extended Head	BR
D	Mushroom Head	DR
DX	Mushroom Head less Color Cap	DRX
—	Bootless Guarded Head	GR
—	Booted Head	R∗

d

Color Cap	
Code	Description
Blank	Used only when ordering Operator Type DX/DRX
1	Green
2	Black
3	Orange❄

d (cont'd)

Color Cap	
Code	Description
4	Gray❄
5	White❄
6	Red
7	Blue
9	Yellow

e

Special Mushroom Head	
Code	Description
J§	Jumbo Mushroom Head — Plastic
L§	Jumbo Mushroom Head — Metal
Note: Special Mushroom Head options only apply to Mushroom Head operator Type Code D/DR.	

f

Contact Block(s)	
Code	Description
Blank	No Contacts
Standard	
D1	1 N.O.
D2	1 N.C.
D3	1 N.O.E.M.
D4	1 N.C.L.B.
D5	1 N.O. (Mini)
D6	1 N.C. (Mini)
A1	1 N.C.L.B. - 1 N.O.
A2	2 N.O.‡
A4	2 N.C.
A7	1 N.C.L.B. - 1 N.C.
A	1 N.O. - 1 N.C.
B	2 N.O. - 2 N.C.

f (cont'd)

Contact Block(s)	
Code	Description
Pen*TUFF* (Low Voltage)	
D1V	1 N.O.
D2V	1 N.C.
D3V	1 N.O.E.M.
D4V	1 N.C.L.B.
AV	1 N.O. - 1 N.C.
BV	2 N.O. - 2 N.C.
Time Delay	
T	1 N.O. Depress close, delayed opening
S	1 N.C. Depress open, delayed closure
Snap Action	
M	1 N.O. - 1 N.C.
N	2 N.O. - 2 N.C.
Class 1, Div. 2/Zone 2	
Logic Reed	
D1R	1 N.O.
D2R	1 N.C.
A2R	2 N.O.‡
A4R	2 N.C.
AR	1 N.O. - 1 N.C.
BR	2 N.O. - 2 N.C.

f (cont'd)

Contact Block(s)	
Code	Description
Class 1, Div. 2/Zone 2	
Sealed Switch	
D1P	1 N.O.
D2P	1 N.C.
A2P	2 N.O.
A4P	2 N.C.
AP	1 N.O. - 1 N.C.
BP	2 N.O. - 2 N.C
Stackable Sealed Switch	
D1Y	1 N.O.
D2Y	1 N.C.
A2Y	2 N.O.
A4Y	2 N.C.
AY	1 N.O. - 1 N.C.
BY	2 N.O. - 2 N.C

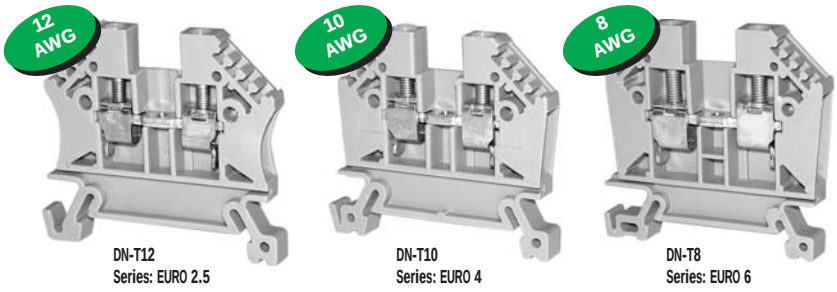
Time Delay Contacts
Series C field installable kits can only be used with Series T or later operators. Adjustable range of 0.5 to 15 s + 25%. Maximum continuous current Ith 5 A.

Snap Action Contacts
Snap action contacts feature a quick make, quick break snap-action mechanism that is only available on factory assembled units. Maximum continuous current I_{th} 10 A.

∗ Underlying operators are "flush head" type, except red which are "extended head". Boot material is hyplon with brass threaded insert.
❄ Not available for booted operators.
‡ A2 and A2R contact blocks cannot be stacked upon, but can stack on other contact blocks.
§ Jumbo mushroom heads not available in white color.

Feed-through Terminal Blocks

Feed-through terminal blocks provide the means to connect two wires together, and are available in sizes suitable for up to 8 AWG wire.

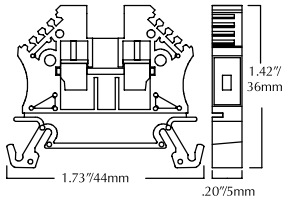


DN-T12
Series: EURO 2.5

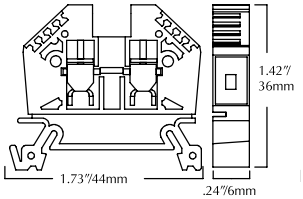
DN-T10
Series: EURO 4

DN-T8
Series: EURO 6

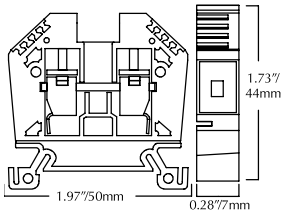
DN-T12



DN-T10



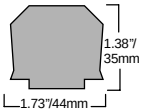
DN-T8



Specifications									
	Part #	Pcs/ Pkg	Price/Pkg	Part #	Pcs/ Pkg	Price/Pkg	Part #	Pcs/ Pkg	Price/Pkg
Gray Term Block	DN-T12	100	<--->	DN-T10	100	<--->	DN-T8	50	<--->
Blue Term Block	DN-T12B	100	<--->	DN-T10B	100	<--->	DN-T8B	50	<--->
Black Term Block	DN-T12BLK	100	<--->	DN-T10BLK	100	<--->	DN-T8BLK	50	<--->
Green Term Block	DN-T12GRN	100	<--->	DN-T10GRN	100	<--->	DN-T8GRN	50	<--->
Orange Term Block	DN-T12ORG	100	<--->	DN-T10ORG	100	<--->	DN-T8ORG	50	<--->
Red Term Block	DN-T12RED	100	<--->	DN-T10RED	100	<--->	DN-T8RED	50	<--->
Yellow Term Block	DN-T12YEL	100	<--->	DN-T10YEL	100	<--->	DN-T8YEL	50	<--->
White Term Block	DN-T12W	100	<--->	DN-T10W	100	<--->	DN-T8W	50	<--->
UL Approval**	600V	20A	24-12AWG	600V	30A	24-10AWG	600V	50A	22-8AWG
CSA Approval	600V	25A	18-12AWG	600V	25A	18-12AWG	600V	55A	18-8AWG
VDE Approval	800V	24A	2.5mm²	750V	35A	4mm²	750V	46A	6mm²
CE Conformity	CE 23/20, CE 23/21			CE 23/20, CE 23/21			CE 23/20, CE 23/21		
Agency File #	E179129, LR84816			E179129, LR84816			E179129, LR84816		
Wire Strip Length	0.39" (10mm)			0.39" (10mm)			0.47" (12mm)		
Tightening Torque	4.5 lb-in (0.5Nm)			5.5 lb-in (0.6Nm)			10.6 lb-in (1.2Nm)		
Density	60 pcs./ft. (200/m)			50 pcs./ft. (166/m)			43 pcs./ft. (142/m)		

Accessories									
	Part #	Pcs/ Pkg	Price/Pkg	Part #	Pcs/ Pkg	Price/Pkg	Part #	Pcs/ Pkg	Price/Pkg
DIN Rail	35mm DIN Rail							10	various
End Bracket*	DN-EB35	50	<--->	DN-EB35	50	<--->	DN-EB35	50	<--->
End Cover*	DN-EC1210	100	<--->	DN-EC1210	100	<--->	DN-EC86	100	<--->
Separator*	DN-S1210	100	<--->	DN-S1210	100	<--->	DN-S86	100	<--->
Jumpers / 2 Pole	DN-2J12	100	<--->	DN-2J10	100	<--->	DN-2J8	100	<--->
/ 3 Pole	DN-3J12	100	<--->	DN-3J10	100	<--->	DN-3J8	100	<--->
/ 4 Pole	DN-4J12	100	<--->	DN-4J10	100	<--->	DN-4J8	100	<--->
/ Multi-pole	DN-100J12 100 pole	1	<--->	DN-82J10 82 pole	1	<--->	DN-70J8 70 pole	1	<--->
Marking Tags	DN-LA or DN-LT series	500/ 100	various	DN-L or DN-LT series	500/ 100	various	DN-L or DN-LT series	500/ 100	various
Angled Support Bracket	DN-ASB1	50	<--->	DN-ASB1	50	<--->	DN-ASB1	50	<--->
Top Cover	DN-C12	100	<--->	DN-C10	100	<--->	DN-C86	100	<--->
Test Plug, Red	-	-	-	DN-TPR	10	<--->	-	-	-
Test Plug, Black	-	-	-	DN-TPB	10	<--->	-	-	-

DN-EC1210

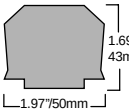


T: 1.5mm (0.06")
L: 44mm (1.73")
H: 35mm (1.38")

DN-S1210

T: 1.5mm (0.06")
L: 55mm (2.17")
H: 44mm (1.73")

DN-EC86



T: 1.5mm (0.06")
L: 50mm (1.97")
H: 43mm (1.69")

DN-S86

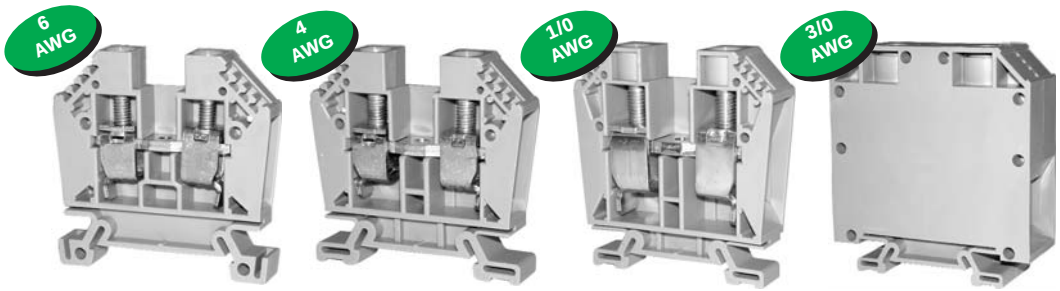
T: 1.5mm (0.06")
L: 55mm (2.17")
H: 49mm (1.93")

**** END BRACKET available in quantity of 20, Part #DN-EB35MN, price <--->. END COVER available in quantity of 25, Part #DN-EC1210MN, price <--->. END COVER available in quantity of 25, Part # DN-EC86MN, price <--->. SEPARATOR available in quantity of 25, Part #DN-S1210MN, price <--->.***

NOTE: for more information on accessories, see pages 25-20 through 25-46.

***** for copper wire only***

Feed-through Terminal Blocks



DN-T6 Series: EURO 10 | DN-T4 Series: EURO 25 | DN-T1/0 Series: EURO 35-50 | DN-T3/0 Series: EURO 70

Specifications

	Part #	Pcs/ Pkg	Price/ Pkg	Part #	Pcs/ Pkg	Price/ Pkg	Part #	Pcs/ Pkg	Price/ Pkg	Part#	Pcs/ Pkg	Price/ Pkg
Gray Term Block	DN-T6	50	<--->	DN-T4	25	<--->	DN-T1/0	25	<--->	DN-T3/0	10	<--->
Blue Term Block	DN-T6B	50	<--->	DN-T4B	25	<--->	DN-T1/0B	25	<--->	-	-	-
UL Approval**	600V	65A	20-6 AWG	600V	85A	14-4 AWG	600V	140A	14-1/0 AWG	600V	160A	4-3/0 AWG
CSA Approval	600V	80A	18-6 AWG	600V	105A	14-4 AWG	600V	140A	14-1/0 AWG	600V	175A	4-3/0 AWG
VDE Approval	750V	63A	10mm²	750V	110A	25mm²	750V	165A	50mm²	750V	192A	70mm²
CE Conformity	CE 23/20, CE 23/21			CE 23/20, CE 23/21			CE 23/20, CE 23/21			CE 23/20, CE 23/21		
Agency File#	E179129, LR84816			E179129, LR84816			E179129, LR84816			E179129, LR84816		
Wire Strip Length	0.47" (12mm)			0.55" (14mm)			0.67" (17mm)			1.02" (26mm)		
Tightening Torque	18.0 lb-in (2.0Nm)			26.5 lb-in (3.0Nm)			44 lb-in (5.0Nm)			89 lb-in (10Nm)		
Density	33 pcs./ft. (111/m)			25 pcs./ft. (83/m)			19 pcs./ft. (62/m)			11 pcs./ft. (38/m)		

Accessories

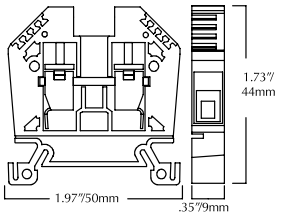
	Part #	Pcs/ Pkg	Price/ Pkg	Part #	Pcs/ Pkg	Price/ Pkg	Part #	Pcs/ Pkg	Price/ Pkg	Part #	Pcs/ Pkg	Price/ Pkg
DIN Rail	35mm DIN Rail										10	various
End Bracket*	DN-EB35										50	<--->
End Cover*	DN-EC86	100	<--->	DN-EC4	50	<--->	DN-EC1/0	50	<--->	Included	-	-
Separator*	DN-S86	100	<--->	-	-	-	-	-	-	-	-	-
Jumpers/ 2 Pole	DN-2J6	100	<--->	-	-	-	-	-	-	-	-	-
/ 3 Pole	DN-3J6	100	<--->	-	-	-	-	-	-	-	-	-
/ 9 Pole	DN-4J6	100	<--->	-	-	-	-	-	-	-	-	-
/ Multi-pole	DN-55J6	1	<--->	-	-	-	-	-	-	-	-	-
Marking Tags	DN-LA or DN-LT series	500/ 100	various	DN-LA or DN-LT series	500/ 100	various	DN-LA or DN-LT series	500/ 100	various	DN-LA or DN-LT series	500/ 100	various
Angled Support Bracket	DN-ASB1										50	<--->

**** END BRACKET available in quantity of 20, Part #DN-EB35MN, price <--->.***
END COVER available in quantity of 25, Part #DN-EC86MN, price <--->.

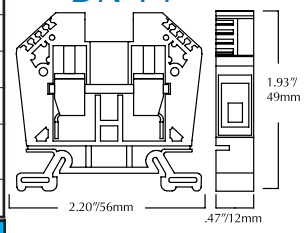
NOTE: for more information on accessories, see pages 25-20 through 25-46.

***** for copper wire only***

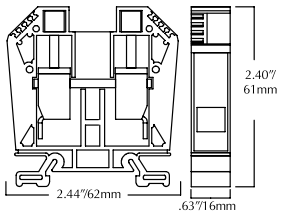
DN-T6



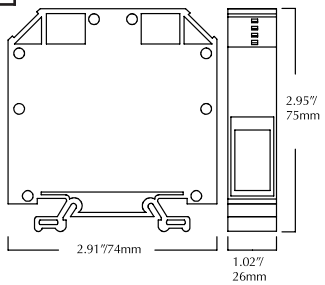
DN-T4



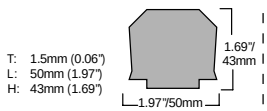
DN-T1/0



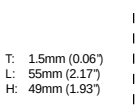
DN-T3/0



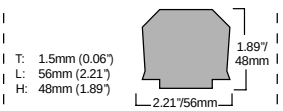
DN-EC86



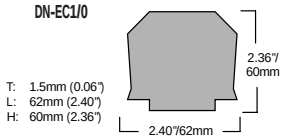
DN-S86



DN-EC4

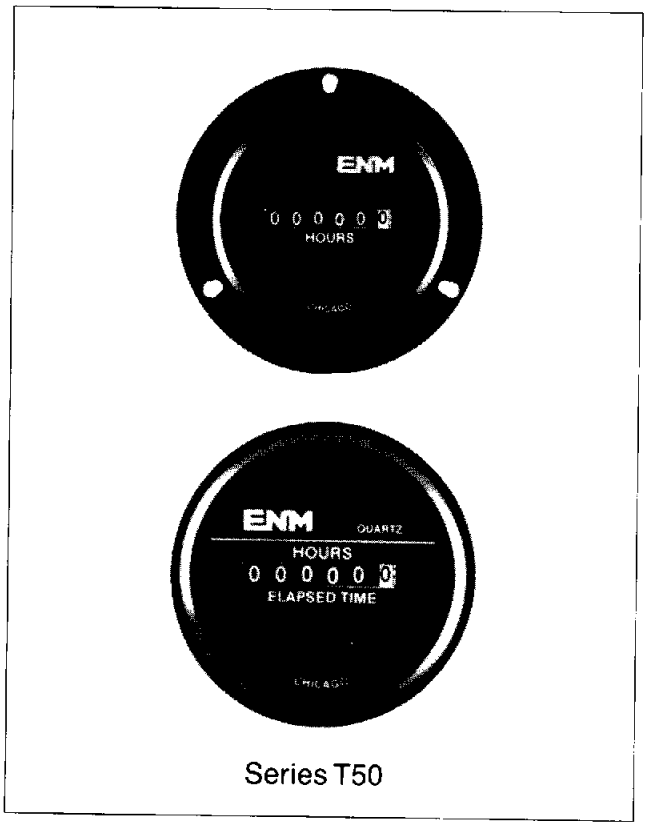


DN-EC1/0



Electronic Hour Meter Technical Data

AC Hour Meter, Series T50 211



Series T50

ENM's Series T50 electronic AC hour meter is a low cost reliable hour meter incorporating the latest state-of-the-art in electonics. It's quartz-crystal time base insures accurate long term time-keeping.

A reliable electromechanical wheel-type indicator is used to store accumulated hours.

This compact tamperproof meter is sealed against the environment to provide years of service.

The T50 elapsed time indicator was designed for use on test and recording equipment, for providing maintenance control, for establishing warranty programs, for measuring machine utilization and production time, or for any application where time-in-use is to be determined.

FEATURES:

- Solid State Electronic Circuit
- Quartz-Crystal for Accurate Timing
- Absolutely Will Not Lose Count
- High Impact, Tamperproof Plastic Case
- Sealed Against Moisture and Dirt
- UL and CSA Recognized
- Indicates Operating Time in Hours and Tenths
- Frequency Insensitive Design
- With Optional Gasket,complies to NEMA 4Xand 12
- **MADE IN THE USA**

SPECIFICATIONS:

Time Scale:	6-digits 99,999.9 Hours Automatic recycle to zero
Figures:	Hours — White on black Tenths — Red on White Height — 0.140"
Operating Voltage:	230,115,24V AC+10% Other Voltage available
Frequency:	50 or 60 Hz
Power Consumption:	Less than 0.4 Watts
Accuracy:	Better than ±0.02% over entire range
Temperature:	From -30° C to 65°
Vibration Resistance:	Withstands 10 to 75 hz at 1 to 8 g's
Termination:	1/4" male blade terminals
Configuration:	Round 3-hole Bezel Round SAE Bezel with new push-on retaining ring

E-MAIL
ENM Co. @ AOL.COM
Toll Free (888) 372-0465

ENM Company
5617 Northwest Highway
Chicago, IL 60646-6135
(773) 775-8400 Fax: (773) 775-5968

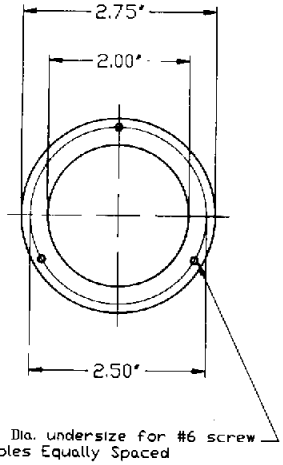
Series T50 AC

Dimensional Data

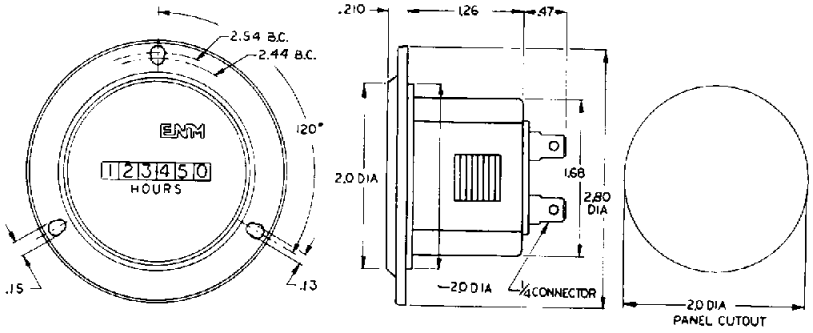
Panel Gasket
UL/NEMA 4X,12

Description	Part No.
NEMA Gasket	A40047-S

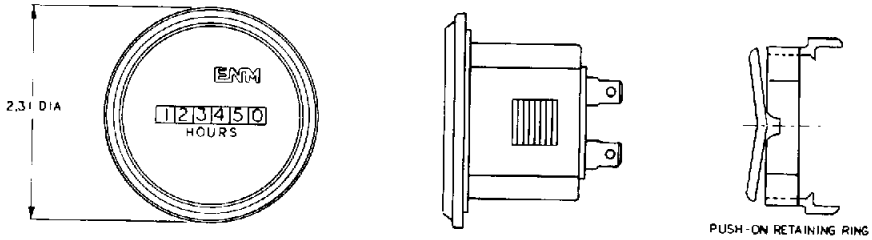
NEMA Gasket
w/ Mounting Hardware B20017



Round 3-Hole Bezel

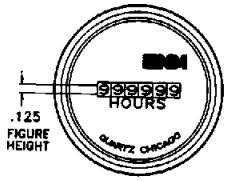


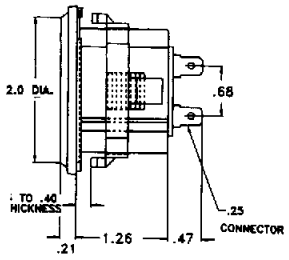
Round SAE Bezel

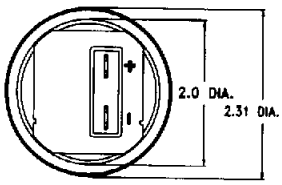


Power: Less than 0.4 Watts

Voltage	Part No.
230 AC	T50A1
115 AC	T50A2
24 AC	T50A4



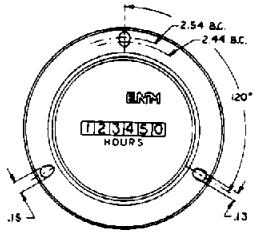


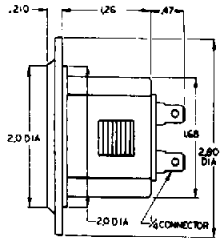


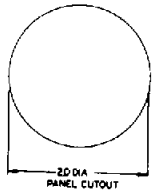
Technical Data Sheet #211

Power: Less than 0.4 Watts

Voltage	Part No.
230 AC	T50B1
115 AC	T50B2
24 AC	T50B4







Technical Data Sheet #211

Limited Warranty/Hour Meters

ENM Company hour meters are warranted to the consumer to be free from defects in material and workmanship for a period of 10,000 operating hours or for a period of 3 years, whichever first occurs.

All ENM products which fall within the warranty period due to defects in material or workmanship will be repaired or replaced, at ENM's option, without charge to the consumer when returned with proof of purchase to any authorized ENM dealer in the United States, transportation charges prepaid, provided there is no evidence of improper installation, tampering, or other abuse.

All implied warranties, including any implied warranty of merchantability or fitness for a particular purpose, shall be limited in duration to the express warranty period specified above.

ENM disclaims any liability for consequential damages due to breach of any written or implied warranty on its hour meters.

ENM Company
5617 Northwest Highway
Chicago, IL 60646-6135
(773) 775-8400 Fax: (773) 775-5968

RR Series Power Relays

SPDT through 4PDT, 10A contacts
Midget power type relays

- Available in pin and blade terminal styles.
- Options include an indicator, check button for test operations and side flange.
- DIN rail, surface and panel mount sockets are available for a wide a variety of mounting applications.

Part Number Selection

Contact	Model	Part Number: Pin Terminal	Part Number: Blade Terminal*	Coil Voltage Code (Standard Stock Items in Bold)
SPDT 	Basic	—	RR1BA-U	AC6V, AC12V, AC24V, AC110V, **AC120V**, AC220V, AC240V, DC6V, DC12V, **DC24V**, DC48V, DC110V
	With Indicator		RR1BA-UL	
	With Check Button		RR1BA-UC	
	With Indicator and Check Button		RR1BA-ULC	
	Side Flange Model		RR1BA-US	
DPDT 	Basic	RR2P-U	RR2BA-U	
	With Indicator	RR2P-UL	RR2BA-UL	
	With Check Button	RR2P-UC	RR2BA-UC	
	With Indicator and Check Button	RR2P-ULC	RR2BA-ULC	
	Side Flange Model	—	RR2BA-US	
3PDT 	Basic	RR3PA-U	RR3B-U	
	With Indicator	RR3PA-UL	RR3B-UL	
	With Check Button	RR3PA-UC	RR3B-UC	
	With Indicator and Check Button	RR3PA-ULC	RR3B-ULC	
	Side Flange Model	—	RR3B-US	

*Blade type not TUV tested or CE marked.

Ordering Information
When ordering, specify the Part No. and coil voltage code:
(example) **RR3B-U** **AC120V**
Part No. — Coil Voltage Code

Sockets

Relays	Standard DIN Rail Mount	Finger-safe DIN Rail Mount	Through Panel Mount
RR2P	SR2P-05 SR2P-06	SR2P-05C	SR2P-51
RR3PA	SR3P-05 SR3P-06	SR3P-05C	SR3P-51
RR1BA RR2BA RR3B	SR3B-05	—	SR3B-51
			

All DIN rail mount sockets shown above can be mounted using DIN rail BNDN1000.

Hold Down Springs & Clips

Appearance	Description	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket	Min Order Qty
	Pullover Wire Spring	RR2P	SR2B-02F1	SR3P-01F1	10 pcs
		RR3PA	SR3B-02F1		
		RR1BA, RR2BA, RR3B	SR3B-02F1	SR3B-02F1	
	Leaf Spring (side latch)	RR2P, RR3PA	SFA-203	–	20 pcs

Accessories

Description	Appearance	Use with	Part No.	Remarks
Aluminum DIN Rail (1 meter length)		All DIN rail sockets	BNDN1000	IDEC offers a low-profile DIN rail (BNDN1000). The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm).
DIN Rail End Stop		DIN rail	BNL5	9.1 mm wide.
Replacement Hold-Down Spring Anchor		Horseshoe clip for sockets SR3B-05, SR2P-06, SR3P-06	Y778-011	For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket.
		Chair clip for sockets SR2P-05(C), SR3P-05(C)	Y703-102	

Specifications

Contact Material		Silver	
Contact Resistance [1]		30 mΩ maximum	
Minimum Applicable Load		1V DC, 10 mA	
Operate Time [2]		25 ms maximum	
Release Time [2]		25 ms maximum	
Power Consumption (approx.)		AC: 3 VA (50 Hz), 2.5 VA (60 Hz) DC: 1.5W	
Insulation Resistance		100 MΩ minimum (500V DC megger)	
Dielectric Strength	**Pin Terminal**	Between live and dead parts:	1500V AC, 1 minute
		Between contact and coil:	1500V AC, 1 minute
		Between contacts of different poles:	1500V AC, 1 minute
		Between contacts of the same pole:	1000V AC, 1 minute
	Blade Terminal	Between live and dead parts:	2000V AC, 1 minute
		Between contact and coil:	2000V AC, 1 minute
		Between contacts of different poles:	2000V AC, 1 minute
		Between contacts of the same pole:	1000V AC, 1 minute
Operating Frequency		Electrical:	1800 operations/h maximum
		Mechanical:	18,000 operations/h maximum
Vibration Resistance		Damage limits:	10 to 55 Hz, amplitude 0.5 mm
		Operating extremes:	10 to 55 Hz, amplitude 0.5 mm
Shock Resistance		Damage limits:	1000 m/s² (100g)
		Operating extremes:	100 m/s² (10G)
Mechanical Life		10,000,000 operations	
Electrical Life		200,000 operations (220V AC, 5A)	
Operating Temperature [3]		–25 to +40°C (no freezing)	
Operating Humidity		5 to 85% RH (no condensation)	
Weight (approx.) (Basic type)		RR2P: 90g, RR3PA: 96g, RR1BA/RR2BA/RR3B: 82g	

1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
3. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve.

Coil Ratings

Rated Voltage (V)		Rated Current (mA) ±15% (at 20°C)		Coil Resistance (Ω) ±10% (at 20°C)	Operating Characteristics (values at 20°C)		
		50 Hz	60 Hz		Maximum Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
AC (50/60 Hz)	6	490	420	4.9	110%	80% maximum	30% minimum
	12	245	210	18			
	24	121	105	79			
	110	27	23	1,680			
	120	24	20.5	2,100			
	240	12.1	10.5	8,330			
DC	6	240		25	110%	80% maximum	10% minimum
	12	120		100			
	24	60		400			
	48	30		1,600			
	110	13		8,460			

Contact Ratings

Maximum Contact Capacity					
Continuous Current	Allowable Contact Power		Rated Load		
	Resistive Load	Inductive Load	Voltage (V)	Res. Load	Ind. Load
10A	1650VA AC 300W DC	1100VA AC 150W DC	110 AC	10A	7.5A
			220 AC	7.5A	5A
			30 DC	10A	5A

Note: Inductive load for the rated load — cos ø = 0.3, L/R = 7 ms

UL Ratings

Voltage	Resistive	General use	Horse Power Rating
240V AC	10A	7A	1/3 HP
120V AC	10A	7.5A	1/4 HP
30V DC	10A	7A	—

CSA Ratings

Voltage	Resistive	General use
240V AC	10A	7A
120V AC	10A	7.5A
100V DC	—	0.5A
30V DC	10A	7.5A

TÜV Ratings

Voltage	
240V AC	10A
30V DC	10A

AC: cos ø = 1.0, DC: L/R = 0 ms

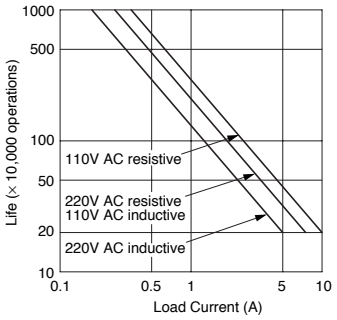
Socket Specifications

	Relays	Terminal	Electrical Rating	Wire Size	Torque
DIN Rail Sockets	SR2P-05	M3 screw with captive wire clamp	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR2P-05C	M3 screw with captive wire clamp, fingersafe	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR2P-06	M3 screw with captive wire clamp	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR3P-05	M3 screw with captive wire clamp	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR3P-05C	M3 screw with captive wire clamp, fingersafe	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR3P-06	M3 screw with captive wire clamp	300V, 10A	2-12 AWG	9 - 11.5in•lbs
	SR3B-05	M3 screw with captive wire clamp	300V, 15A (10A)* (*CSA rating)	2-12 AWG	9 - 11.5in•lbs
Through Panel Mount Sockets	SR2P-51	Solder	300V, 10A	—	—
	SR3P-51	Solder	300V, 10A	—	—
	SR3B-51	Solder	300V, 10A	—	—

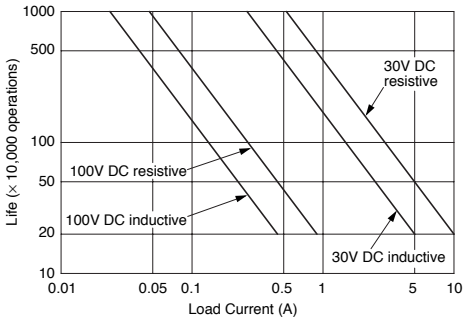
Characteristics (Reference Data)

Electrical Life Curves

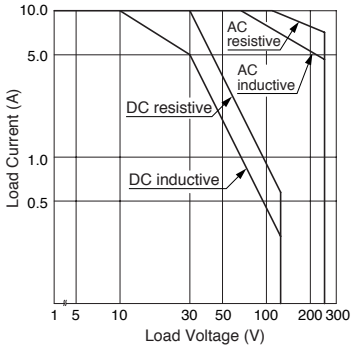
AC Load



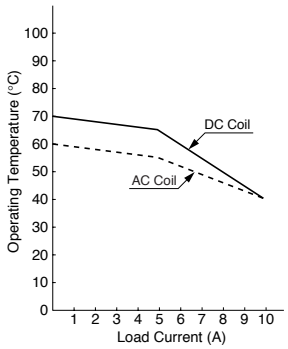
DC Load



Maximum Switching Capacity



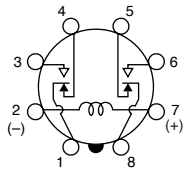
Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Side Flange Type)



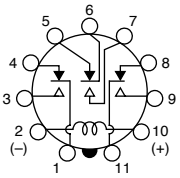
Internal Connection (View from Bottom)

Basic Type

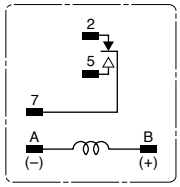
RR2P-U



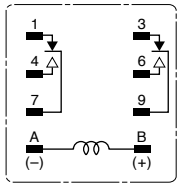
RR3PA-U



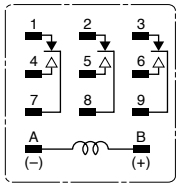
RR1BA-U



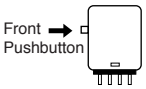
RR2BA-U



RR3B-U

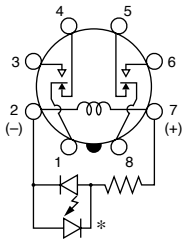
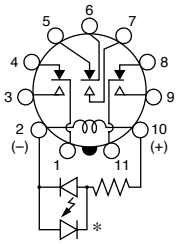
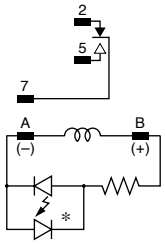
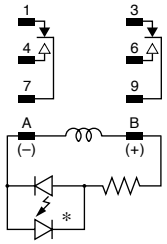
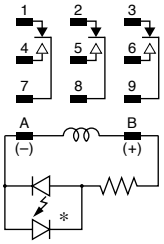
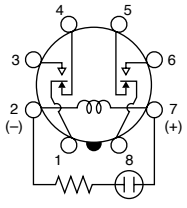
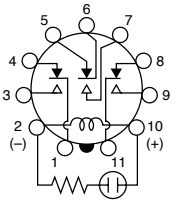
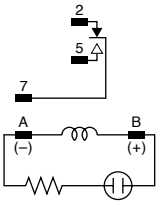
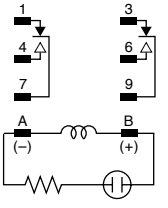
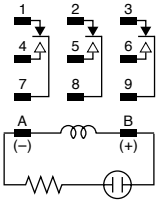


With Check Button



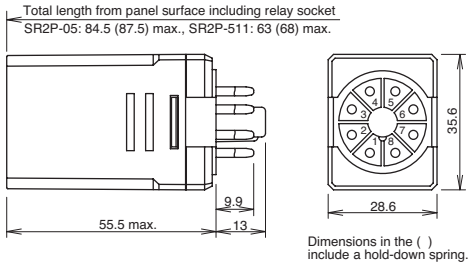
Contacts can be operated by pressing the check button.

With Indicator (-UL type)

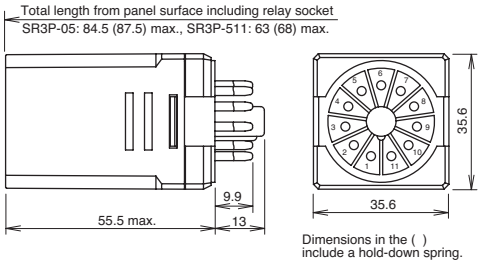
	RR2P	RR3PA	RR1BA	RR2BA	RR3B	
Coil Below 100V AC/DC						When the relay is energized, the indicator goes on. • The LED protection diode is not contained in relay coils below 100V DC. • Coils below 100V use LED indicator while coils above 100V use neon lamp indicator.
Coil 100V AC/DC and over						

Dimensions (mm)

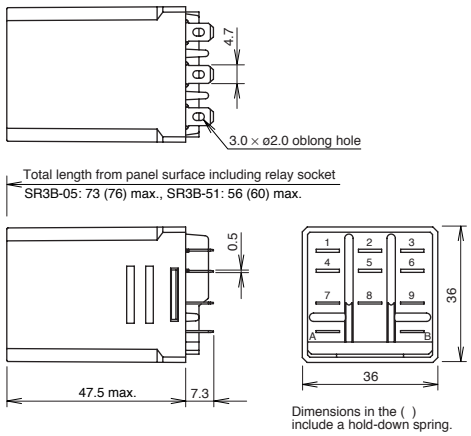
RR2P-U/RR2P-UL



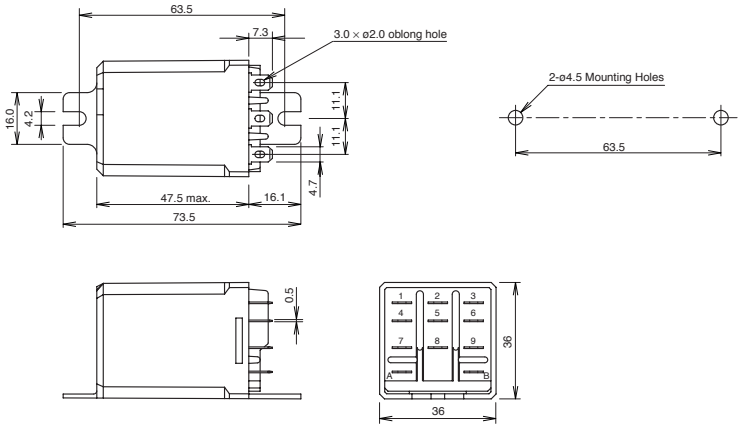
RR3PA-U/RR3PA-UL



RR1BA-U/RR2BA-UL/RR2BA-U
RR2BA-UL/RR3B-U/RR3B-UL

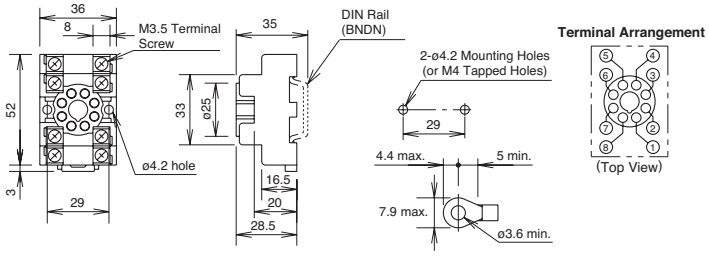


RR1BA-US/RR2BA-US/RR3B-US

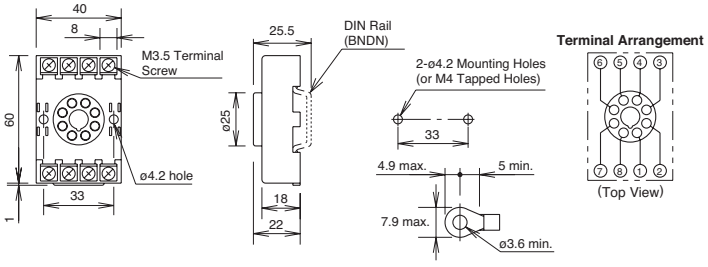


Standard DIN Rail Mount Sockets

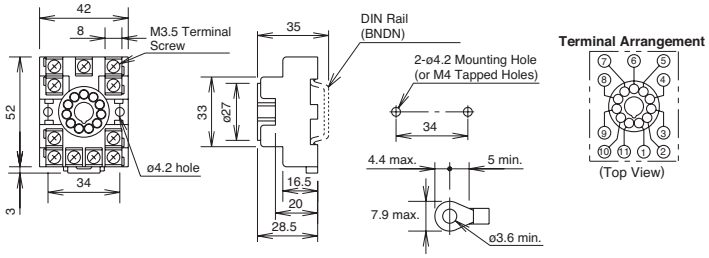
SR2P-05



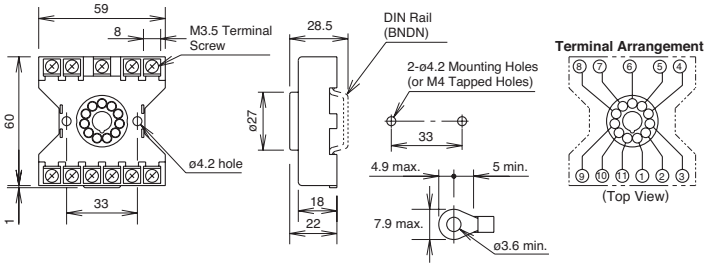
SR2P-06



SR3P-05

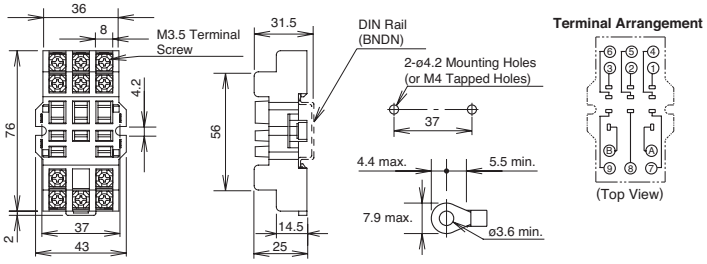


SR3P-06



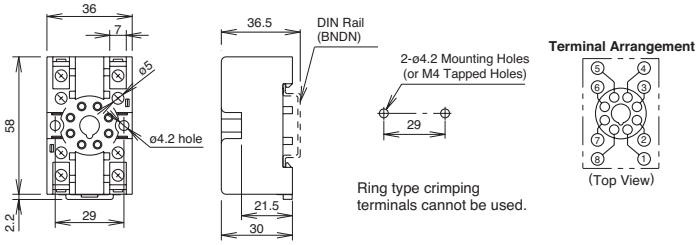
Standard DIN Rail Mount Sockets

SR3B-05

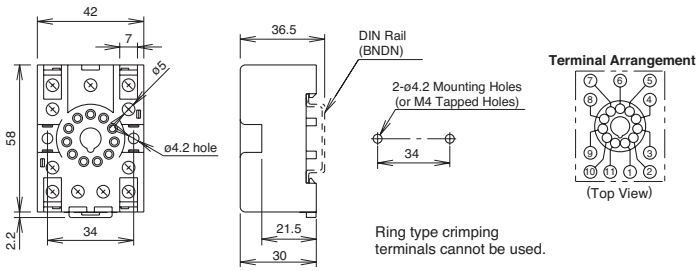


Finger-safe DIN Rail Mount Sockets

SR2P-05C

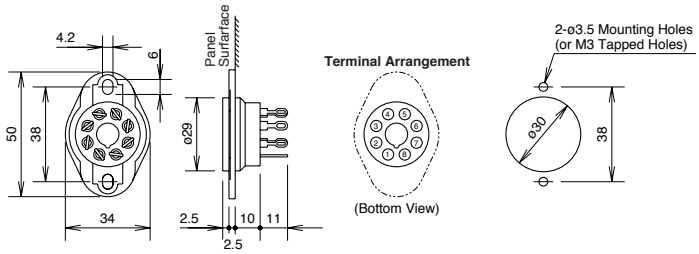


SR3P-05C

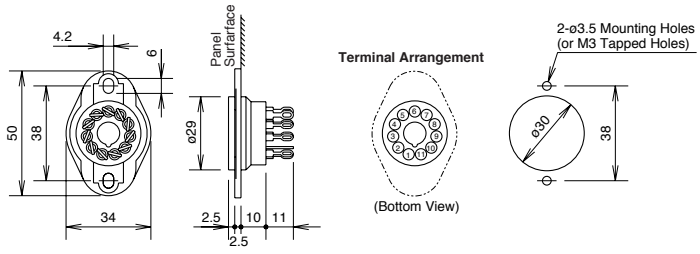


Through Panel Mount Socket

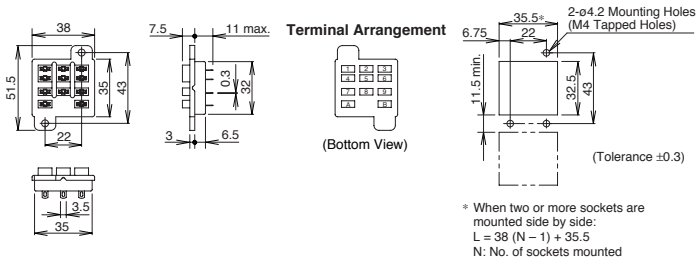
SR2P-51



SR3P-51



SR3B-51

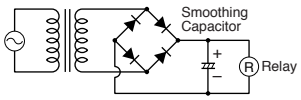


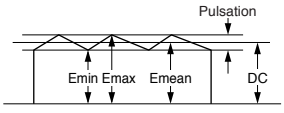
Operating Instructions

Driving Circuit for Relays

1. To ensure correct relay operation, apply rated voltage to the relay coil.

2. Input voltage for the DC coil:
   A complete DC voltage is best for the coil power to make sure of stable relay operation. When using a power supply containing a ripple voltage, suppress the ripple factor within 5%. When power is supplied through a rectification circuit, the relay operating characteristics, such as pickup voltage and dropout voltage, depend on the ripple factor. Connect a smoothing capacitor for better operating characteristics as shown below.



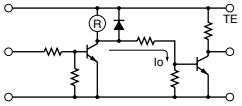


$$\text{Ripple Factor (\%)} \quad \frac{\text{Emax} - \text{Emin}}{\text{Emean}} \times 100\%$$

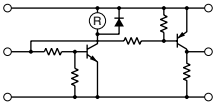
Emax = Maximum of pulsating current
Emin = Minimum of pulsating current
Emean = DC mean value

3. Leakage current while relay is off:
   When driving an element at the same time as the relay operation, special consideration is needed for the circuit design. As shown in the incorrect circuit below, leakage current (Io) flows through the relay coil while the relay is off. Leakage current causes coil release failure or adversely affects the vibration resistance and shock resistance. Design a circuit as shown in the correct example.

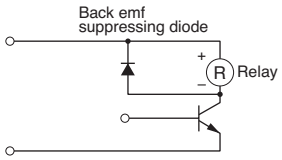
Incorrect



Correct



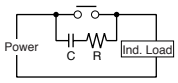
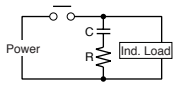
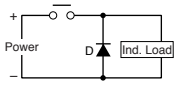
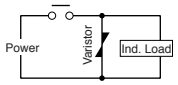
4. Surge suppression for transistor driving circuits:
   When the relay coil is turned off, a high-voltage pulse is generated, causing a transistor to deteriorate and sometimes to break. Be sure to connect a diode to suppress the back electromotive force. Then, the coil release time becomes slightly longer. To shorten the coil release time, connect a Zener diode between the collector and emitter of the transistor. Select a Zener diode with a Zener voltage slightly higher than the power voltage.



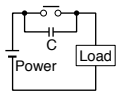
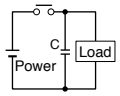
Protection for Relay Contacts

1. The contact ratings show maximum values. Make sure that these values are not exceeded. When an inrush current flows through the load, the contact may become welded. If this is the case, connect a contact protection circuit, such as a current limiting resistor.

2. Contact protection circuit:
   When switching an inductive load, arcing causes carbides to form on the contacts, resulting in increased contact resistance. In consideration of contact reliability, contact life, and noise suppression, use of a surge absorbing circuit is recommended. Note that the release time of the load becomes slightly longer. Check the operation using the actual load. Incorrect use of a contact protection circuit will adversely affect switching characteristics. Four typical examples of contact protection circuits are shown in the following table:

RC		This protection circuit can be used when the load impedance is smaller than the RC impedance in an AC load power circuit. • R: Resistor of approximately the same resistance value as the load • C:0.1 to 1 µF
		This protection circuit can be used for both AC and DC load power circuits. R: Resistor of approximately the same resistance value as the load C: 0.1 to 1 µF
Diode		This protection circuit can be used for DC load power circuits. Use a diode with the following ratings. Reverse withstand voltage: Power voltage of the load circuit x 10 Forward current: More than the load current
Varistor		This protection circuit can be used for both AC and DC load power circuits. For a best result, when using a power voltage of 24 to 48V AC/DC, connect a varistor across the load. When using a power voltage of 100 to 240V AC/DC, connect a varistor across the contacts.

3. Do not use a contact protection circuit as shown below:

	This protection circuit is very effective in arc suppression when opening the contacts. But, the capacitor is charged while the contacts are opened. When the contacts are closed, the capacitor is discharged through the contacts, increasing the possibility of contact welding.
	This protection circuit is very effective in arc suppression when opening the contacts. But, when the contacts are closed, a current flows to charge the capacitor, causing contact welding.

Generally, switching a DC inductive load is more difficult than switching a DC resistive load. Using an appropriate arc suppressor, however, will improve the switching characteristics of a DC inductive load.

Soldering

1. When soldering the relay terminals, use a soldering iron of 30 to 60W, and quickly complete soldering (within approximately 3 seconds).

2. Use a non-corrosive rosin flux.

Operating Instructions con't

Other Precautions

1. General notice:
   To maintain the initial characteristics, do not drop or shock the relay.

   The relay cover cannot be removed from the base during normal operation. To maintain the initial characteristics, do not remove the relay cover.

   Use the relay in environments free from condensation, dust, sulfur dioxide (SO_2), and hydrogen sulfide (H_2S).

   Make sure that the coil voltage does not exceed applicable coil voltage range.

2. UL and CSA ratings may differ from product rated values determined by IDEC.
3. Do not use relays in the vicinity of strong magnetic field, as this may affect relay operation.

Safety Precautions

- Turn off the power to the relay before starting installation, removal, wiring, maintenance, and inspection of the relays. Failure to turn power off may cause electrical shock or fire hazard.
- Observe specifications and rated values, otherwise electrical shock or fire hazard may be caused.
- Use wires of the proper size to meet voltage and current requirements. Tighten the terminal screws on the relay socket to the proper tightening torque.
- Surge absorbing elements on AC relays with RC or DC relays with diode are provided to absorb the back electromotive force generated by the coil. When the relay is subject to an excessive external surge voltage, the surge absorbing element may be damaged. Add another surge absorbing provision to the relay to prevent damage.

Precautions for the RU Relays

- Before operating the latching lever of the RU relay, turn off the power to the RU relay. After checking the circuit, return the latching lever to the original position.
- Do not use the latching lever as a switch. The durability of the latching lever is a minimum of 100 operations.
- When using DC loads on 4PDT relays, apply a positive voltage to terminals of neighboring poles and a negative voltage to the other terminals of neighboring poles to prevent the possibility of short circuits.
- DC relays with a diode have a polarity in the coil terminals. Apply the DC voltage to the correct terminals.

Class CC* Fast-Acting & Slo-Blo® Type Fuses CCMR Series

Fast-acting KLKR fuses provide fast-acting protection to equipment containing surge sensitive components. Use KLKR fuses for non-inductive loads not requiring time delay. CCMR fuses (formerly KLMR) are specifically designed to withstand sustained starting currents of small motors. The CCMR fuses provide short-circuit protection for motor branch-circuits. KLDR fuses are specifically designed to withstand the momentary high magnetizing currents of control transformers, solenoids, and similar inductive loads.

ELECTRICAL CHARACTERISTICS:

% of Ampere Rating	Ampere Rating	Opening Time
110%	1/10–30	15 minutes, **Min**imum
135%	1/10–30	1 hour, **Max**imum

AGENCY APPROVALS: DC ratings are self-certified. KLKR Series: UL listed Fast-Acting Class CC per UL 248 and CSA Certified. KLDR, **CCMR Series:** UL listed Time-Delay Class CC per UL 248 and CSA Certified.
*CCMR 35-60A UL Listed Time-Delay Class CD.

AGENCY FILE NUMBERS: UL E81895, CSA LR 29862.

VOLTAGE RATINGS: AC: 600 Volts
DC: 250 Volts (CCMR 2/10 – 2A)
(CCMR 4 1/2 – 10A)
(CCMR 35 – 60A)
300 Volts (CCMR 2 1/4 – 4A)
300 Volts (KLDR)
300 Volts (KLKR)

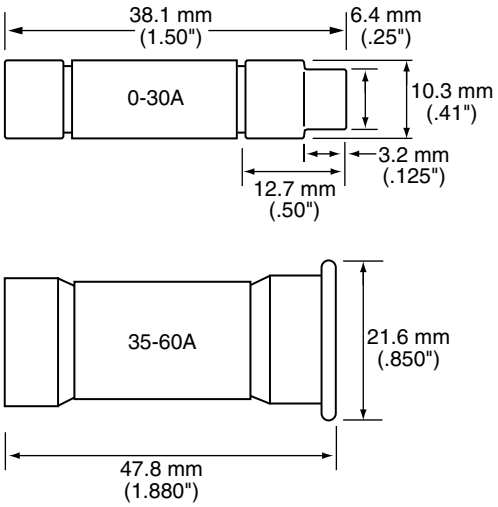
INTERRUPTING RATING:

AC: 200,000 ampere
DC: 20,000 amperes

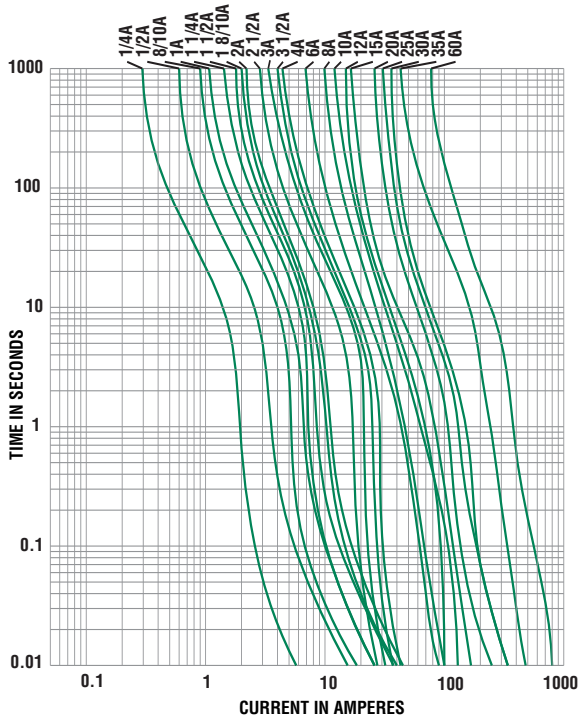
ORDERING INFORMATION:

Ampere Rating	Catalog Number	Nominal Resistance Cold Ohms	Catalog Number	Nominal Resistance Cold Ohms	Catalog Number	Nominal Resistance Cold Ohms
1/10	–	–	**KLDR**.100	246	**KLKR**.100	79.33
1/8	–	–	**KLDR**.125	134.9	**KLKR**.125	56.52
15/100	–	–	**KLDR**.150	96	–	–
3/16	–	–	**KLDR**.187	66.4	–	–
2/10	**CCMR**.200	68.4	**KLDR**.200	57.8	**KLKR**.200	28.21
1/4	**CCMR**.250	43.3	**KLDR**.250	31.61	**KLKR**.250	19.22
3/10	**CCMR**.300	28.6	**KLDR**.300	25.5	**KLKR**.300	15.10
4/10	–	–	**KLDR**.400	13.6	–	–
1/2	**CCMR**.500	7.62	**KLDR**.500	15.9	**KLKR**.500	6.95
6/10	**CCMR**.600	8.2	**KLDR**.600	9.99	–	–
3/4	–	–	**KLDR**.750	6.08	**KLKR**.750	3.581
8/10	**CCMR**.800	4.013	**KLDR**.800	6.2	–	–
1	**CCMR** 001.	2.59	**KLDR** 001.	4.0	**KLKR** 001.	.2342
1 1/8	–	–	**KLDR** 1.12	2.94	–	–
1 1/4	**CCMR** 1.25	1.687	**KLDR** 1.25	2.33	–	–
1 4/10	**CCMR** 01.4	1.33	**KLDR** 01.4	1.5	–	–
1 1/2	**CCMR** 01.5	1.24	**KLDR** 01.5	.898	**KLKR** 01.5	.225
1 6/10	**CCMR** 01.6	.9894	**KLDR** 01.6	.625	–	–
1 8/10	**CCMR** 01.8	.7783	**KLDR** 01.8	.486	–	–
2	**CCMR** 002.	.485	**KLDR** 002.	.55	**KLKR** 002.	.135
2 1/4	**CCMR** 2.25	.4166	**KLDR** 2.25	.52	–	–
2 1/2	**CCMR** 02.5	.3375	**KLDR** 02.5	.333	**KLKR** 02.5	.0906
2 8/10	**CCMR** 02.8	.2400	**KLDR** 02.8	.26	–	–
3	**CCMR** 003.	.2188	**KLDR** 003.	.21	**KLKR** 003.	.0776
3 2/10	**CCMR** 03.2	.1855	**KLDR** 03.2	.171	–	–
3 1/2	**CCMR** 03.5	.1346	**KLDR** 03.5	.239	**KLKR** 03.5	.0562
4	**CCMR** 004.	.1231	**KLDR** 004.	.118	**KLKR** 004.	.0468
4 1/2	**CCMR** 04.5	.093	**KLDR** 04.5	.082	–	–
5	**CCMR** 005.	.0704	**KLDR** 005.	.0399	**KLKR** 005.	.0332
5 6/10	**CCMR** 05.6	.0535	**KLDR** 05.6	.0334	–	–
6	**CCMR** 006.	.0517	**KLDR** 006.	.0315	**KLKR** 006.	.0238
6 1/4	**CCMR** 6.25	.0464	**KLDR** 6.25	.03	–	–
7	**CCMR** 007.	.0369	**KLDR** 007.	.0253	**KLKR** 007.	.0208
7 1/2	**CCMR** 07.5	.027	**KLDR** 07.5	.0205	–	–
8	**CCMR** 008.	.023	**KLDR** 008.	.0193	**KLKR** 008.	.0177
9	**CCMR** 009.	.0193	**KLDR** 009.	.0155	**KLKR** 009.	.0151
10	**CCMR** 010.	.0133	**KLDR** 010.	.0122	**KLKR** 010.	.01325
12	**CCMR** 012.	.0114	**KLDR** 012.	.0114	**KLKR** 012.	.00852
15	**CCMR** 015.	.00708	**KLDR** 015.	.00708	**KLKR** 015.	.0074
17 1/2	**CCMR** 17.5	.00495	**KLDR** 17.5	.00495	–	–
20	**CCMR** 020.	.00360	**KLDR** 020.	.0036	**KLKR** 020.	.00511
25	**CCMR** 025.	.00250	**KLDR** 025.	.0025	**KLKR** 025.	.003775
30	**CCMR** 030.	.00240	**KLDR** 030.	.0024	**KLKR** 030.	.002954
35	**CCMR** 035.	.00426	–	–	–	–
40	**CCMR** 040.	.00286	–	–	–	–
45	**CCMR** 045.	.00246	–	–	–	–
50	**CCMR** 050.	.00182	–	–	–	–
60	**CCMR** 060.	.00118	–	–	–	–

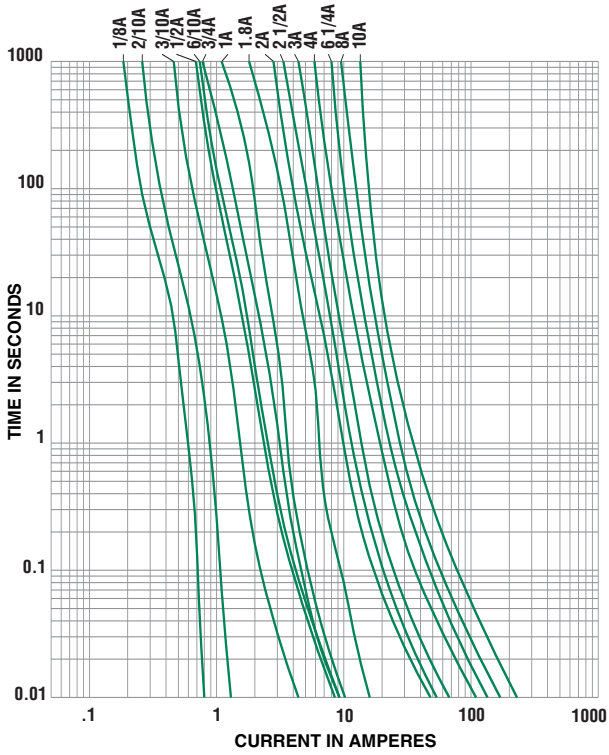
Class CC Fast-Acting & Slo-Blo® Type Fuses



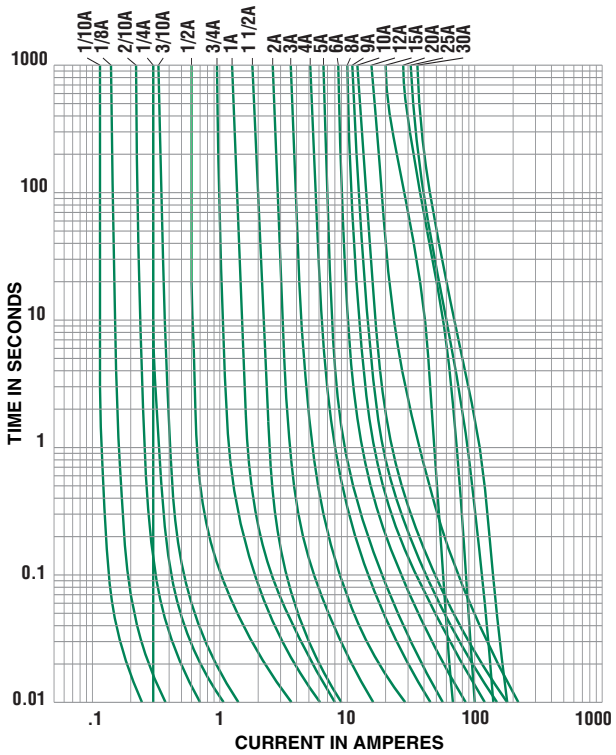
Average Time Current Curve (CCMR)



Average Time Current Curve (KLDR)



Average Time Current Curve (KLKR)



250 Volt Slo-Blo® Type Fuse FLM Series

QPL

ELECTRICAL CHARACTERISTICS:

% of Ampere Rating	Ampere Rating	Opening Time
135%	1/10-30	1 hour, **Max**imum
200%	32/10–30	12 seconds, **Min**imum
	0–3	5 seconds, **Min**imum

AGENCY APPROVALS: Listed by Underwriters Laboratories and Certified by CSA.

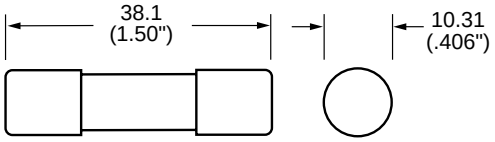
INTERRUPTING RATING: 10,000 amperes at 250 VAC.

FUSES TO MIL SPEC: See F09B type in Military Section.

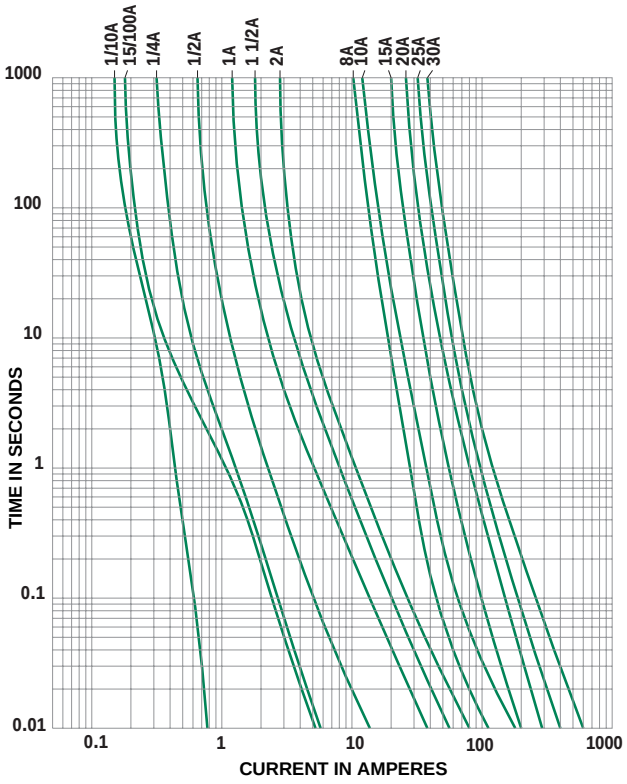
PATENTED

ORDERING INFORMATION:

Cartridge Catalog Number	Ampere Rating	AC Voltage Rating	Nominal Resistance Cold Ohms
FLM 1/10	.100	250	188.0
FLM 15/100	.150	250	87.0
FLM 2/10	.200	250	35.109
FLM 1/4	.250	250	5.413
FLM 3/10	.300	250	3.79
FLM 4/10	.400	250	2.10
FLM 1/2	.500	250	1.54
FLM 6/10	.600	250	1.024
FLM 8/10	.800	250	.623
FLM 1	1	250	.395
FLM 1 1/8	1.125	250	.356
FLM 1 1/4	1.25	250	.286
FLM 1 4/10	1.4	250	.253
FLM 1 1/2	1.5	250	.219
FLM 1 6/10	1.6	250	.184
FLM 1 8/10	1.8	250	.162
FLM 2	2	250	.125
FLM 2 1/4	2.25	250	.102
FLM 2 1/2	2.5	250	.0904
FLM 2 8/10	2.8	250	.0735
FLM 3	3	250	.0700
FLM 3 2/10	3.2	250	.0576
FLM 3 1/2	3.5	250	.0517
FLM 4	4	250	.0426
FLM 4 1/2	4.5	250	.0360
FLM 5	5	250	.0413
FLM 5 6/10	5.6	250	.0326
FLM 6	6	250	.0280
FLM 6 1/4	6.25	250	.0277
FLM 7	7	250	.02133
FLM 8	8	250	.01247
FLM 9	9	250	.01066
FLM 10	10	250	.00903
FLM 12	12	250	.00698
FLM 15	15	250	.00530
FLM 20	20	250	.00385
FLM 25	25	250	.00275
FLM 30	30	250	.00226



Average Time Current Curves



Instruction Manual • February 2004

milltronics

MFA 4P

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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Table of Contents

Milltronics MFA 4p

Milltronics MFA 4p is a highly sensitive, single setpoint motion sensor alarm unit, used with MSP and XPP probes. The probe detects an increase or decrease in the speed of rotating, reciprocating, or conveying equipment and sends the information to the MFA 4p. The MFA 4p works with a pre-amplifier which can be internal to the motion sensing probe, or remote from the motion sensing probe.

Pulses generated from the probe are continually compared to the adjustable setpoint. If the pulse rate is lower than the setpoint, the alarm relays operating in a fail-safe mode will de-energize, indicating failure. The relays will not energize until the pulse rate increases above the setpoint.

Safety Notes

Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.

! **WARNING means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.**

Note: means important information about the product or that part of the operating manual.

The Manual

This instruction manual covers the installation, operation and maintenance of the Milltronics MFA 4p. It is essential that this manual be referred to for proper installation and operation of your unit. Adhering to the installation and operating procedures will insure a quick, trouble free installation and allow for the maximum accuracy and reliability of your motion sensing alarm unit and probes.

If you have any questions, comments, or suggestions about the manual contents, please email us at techpubs@siemens-milltronics.com.

For the complete library of Siemens Milltronics manuals,

go to www.siemens-milltronics.com.

Specifications

Safety

Note: The Milltronics MFA 4p (Motion Failure Alarm) is to be used only in the manner outlined in this manual, otherwise protection provided by the equipment may be impaired.

Power

- 100/115/200/ 230 V AC ±15%, 50/60 Hz, 15 VA

Output

- 2 relays with Form C (S.P.D.T.) fail-safe contacts (relays operate in unison)

Resistive Rating:

- 8 A @ 250 V AC

Repeatability

- ± 1%

Temperature coefficient (setpoint variance)

- 0.018%/ °C (0.01% / °F)

Setpoint adjustment range

- 2 to 3,000 ppm (pulses per minute): standard model
- 0.15 to 15 ppm: slow speed version

Dynamic range

- 0 to 7,200 ppm

Weight

- polycarbonate enclosure: 1.5 kg (3.3 lb.)
- mild steel or stainless steel enclosure: 4.3 kg (9.5 lbs.)

Approvals[1]

- CE, $CSA_{(C/US)}$, FM
- EMC performance available on request

Environmental

- location: Indoor/outdoor
- altitude: 2000 m max.
- ambient temperature: –20 °C to 50 °C (–4 °F to 122 °F)
- relative humidity: suitable for outdoor (Type 4X / NEMA 4X / IP65)*
- installation category: II
- pollution degree: 4

*Type 4/ NEMA 4 /IP65 with mild steel enclosure

Related Equipment	Ambient Temperature Range	Approx wt.
RMA	–40 °C to 60 °C (–40 °F to 140 °F)	2.3 kg (5 lb)
MSP-12	–40 °C to 60 °C (–40 °F to 140 °F)	1.4 kg (3 lb)
XPP-5	–40 °C to 60 °C (–40 °F to 140 °F)	1.8 kg (4 lb)
MSP-1	–40 °C to 80 °C (–40 °F to 180 °F)	0.5 kg (1 lb)
MSP-3	–40 °C to 260 °C (–40 °F to 500 °F)	1.4 kg (3 lb)
MSP-9	–40 °C to 260 °C (–40 °F to 500 °F)	1.8 kg (4 lb)

1. EMC performance available upon request.

Installation

Milltronics MFA 4p

The MFA 4p (and RMA if applicable) must be mounted in a non-hazardous area that is clean, dry, vibration-free, within the ambient temperature range, and non-corrosive to the electronics or its enclosure. The door should be accessible for viewing and to allow calibration of the MFA 4p.

Note: Do not mount MFA 4p in direct sunlight.

Probe

The probe should be mounted onto a vibration free structure using the mounting flange. The gap between probe and target should be large enough to prevent the target from damaging the probe. The probe environment must be within the probe's ambient temperature range and non-corrosive to the probe's body. Refer to Applications drawings on page 23.

The probe design detects a changing magnetic field, typically caused by a ferromagnetic target disturbing the probe's magnetic field. Extremely strong magnetic fields (like those produced by the 30A/m requirements of 1EC 60004-8, Power Frequency Magnetic Field Immunity test) will be detected and will result in loss of functionality.

Functionality loss indicators:

- alarm conditions by relay trip
- false pulse readings in LED1

Consider the probe location carefully before installation. Avoid strong magnetic fields (50/60 Hz) from nearby power transformers, heater elements, or large industrial motors, because these can affect the probe's performance.

Wiring

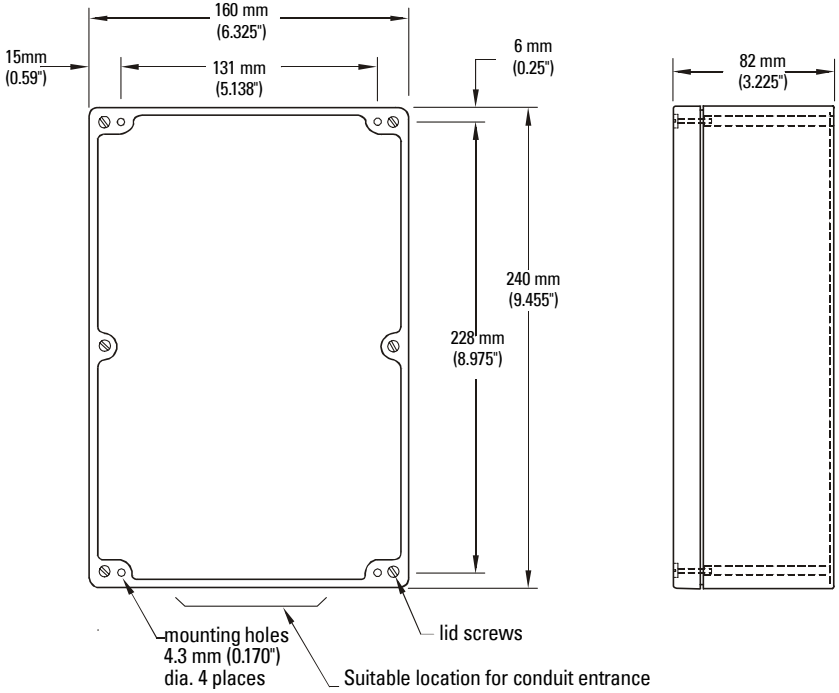
Where possible, the probe components should be interconnected via flexible conduit. This allows for easier removal or adjustment of the probe and mounting flange assembly.

Note: Installation shall only be performed by qualified personnel and in accordance with local governing regulations.

Dimensions

MFA 4p

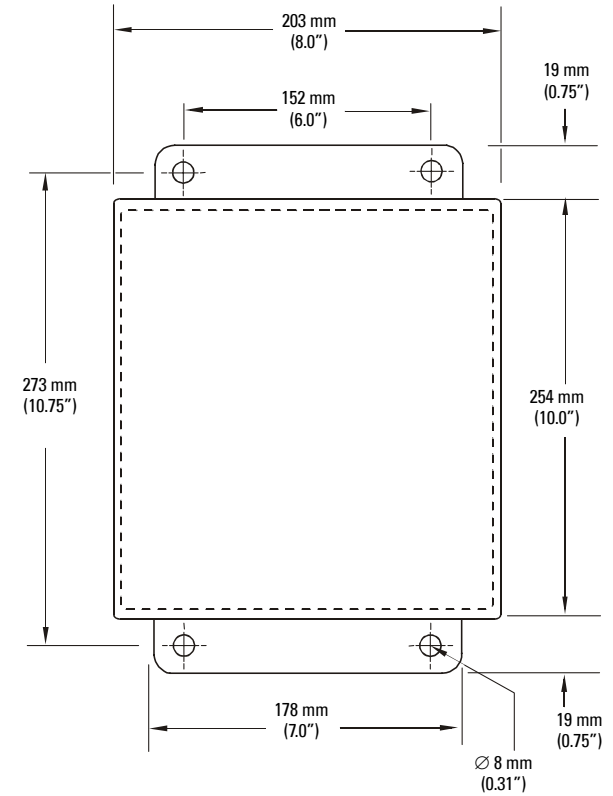
Type 4X / NEMA 4X / IP65 Polycarbonate Enclosure

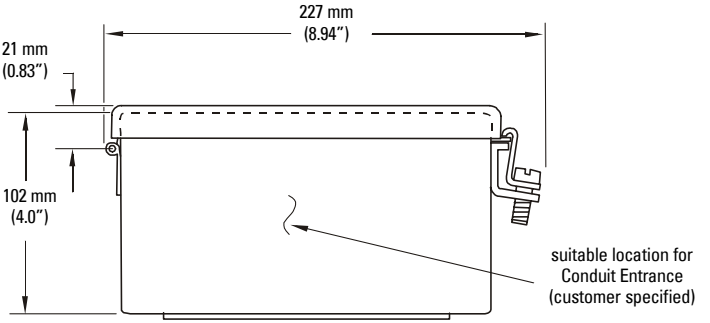


Notes:

- Non-metallic enclosure does not provide grounding between conduit connections: use grounding type bushings and jumpers.
- Use only approved, suitable size hubs for watertight application.

Type 4 / NEMA 4 / IP65 Painted Steel Enclosure & Type 4X / NEMA 4X / IP65 Stainless Steel Enclosure



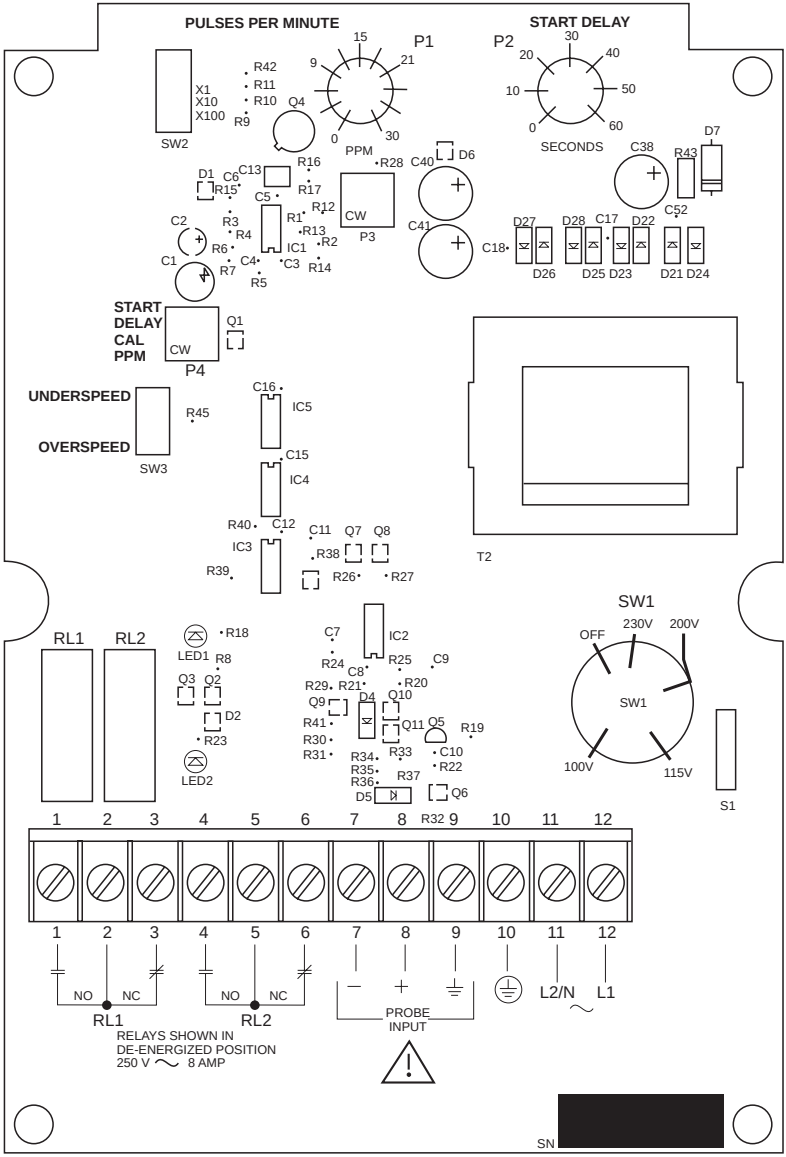


Notes:

- Painted steel enclosure does not provide grounding between conduit connections: use grounding type bushings and jumpers.
- Use only approved, suitable size hubs for watertight application.

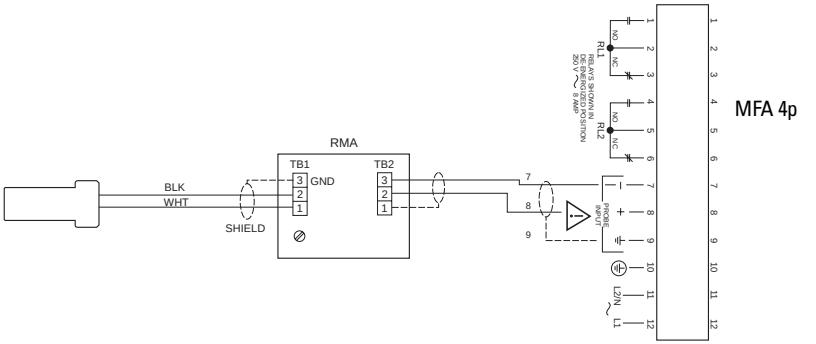
Layout

MFA 4p Circuit Board



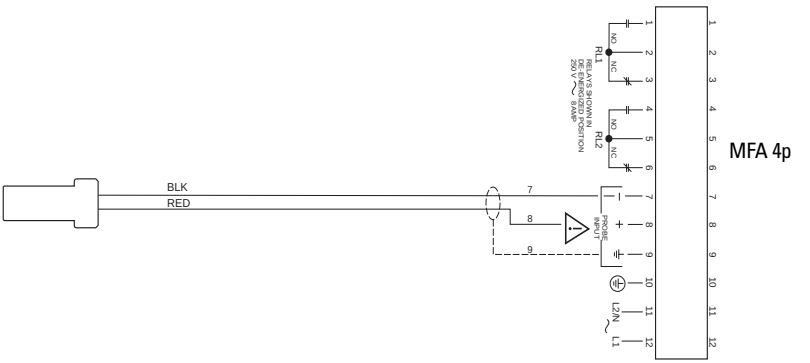
Interconnection

MSP-1, 3, or 9 Probe with RMA (remote mounted pre-amplifier)



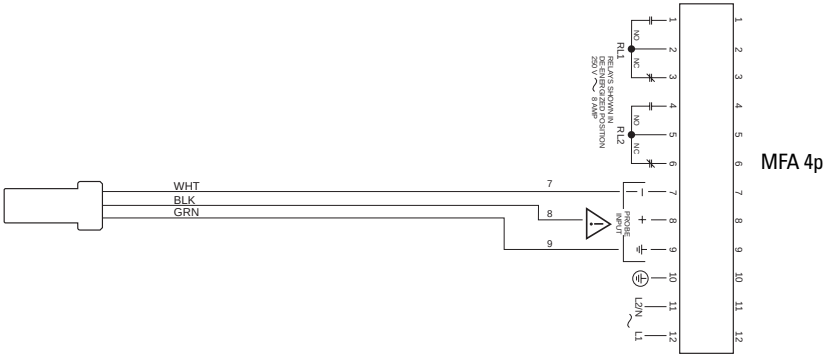
Maximum cable length from probe to RMA is 30 m / 100 ft of shielded cable, 18 ga. wire. See table on page 9 for cable lengths from RMA to main group.

MSP-12 Probe with IMA (internally mounted pre-amplifier)



Wire can be run in conduit common to motor supply or control wiring. Connection to probe leads can be made under probe cap. See table on page 9 for lengths from probe at MFA 4p.

XPP-5 with IMA (internally mounted pre-amplifier)



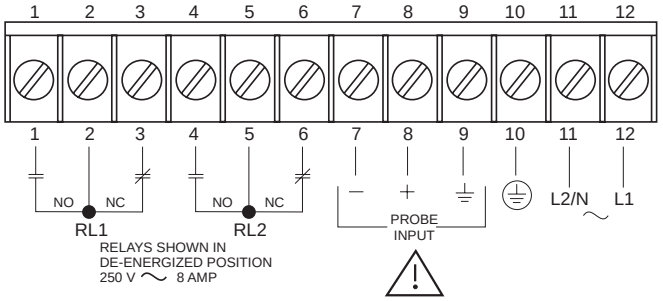
XPP-5 cable must be run in dedicated, approved metal conduit, boxes and fittings and to procedures in accordance with all governing regulations. See table below for lengths from probe at MFA 4p.

Note: Refer to Interconnection Diagram for the XPP-5 (drawing number 23650131) on page 21**.**

Cable length from RMA or IMA to MFA 4p

Wire gauge	Length in feet	Length in metres
22 AWG (0.34 mm^2)	2500	760
18 AWG (0.75 mm^2)	5000	1520
12 AWG (4 mm^2)	25000	7600

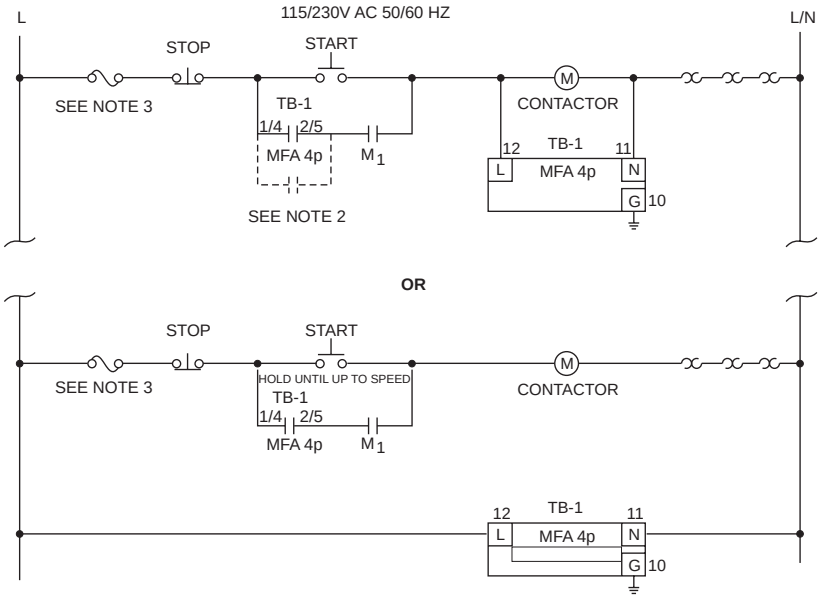
Connection to power:



- Terminal 10 ⏚ must be connected to reliable ground.
- The equipment must be protected by a 15A fuse or circuit breaker in the building installation.
- A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.
- AC input circuit, relay circuits, min. 14 AWG copper wire
- Recommended torque on terminal clamping screws, 7 in.lbs. max.

! WARNING: All field wiring must have insulation suitable for at least 250 V.

MFA 4p Wiring for Automatic Start Delay



Notes:

1. Interlocks and Safety Pull Switches are not shown.
2. If **START** is initiated by programmable logic controller, closure time may be too brief to allow MFA 4p contact to latch. In this case, program a timer contact into the circuit.
3. CSA requires an 8A or less fuse to protect contacts. For 240 V AC, protect the contacts with a 1500 VA transformer as well.

Should the **Time Delay** feature on start-up not be required, power should be applied continuously from a separate source and the potentiometer turned to zero. This is usually necessary for automatic up-stream start up of conveying devices after the down-stream drive has reached its operation speed.

Operating Principles

MFA 4p

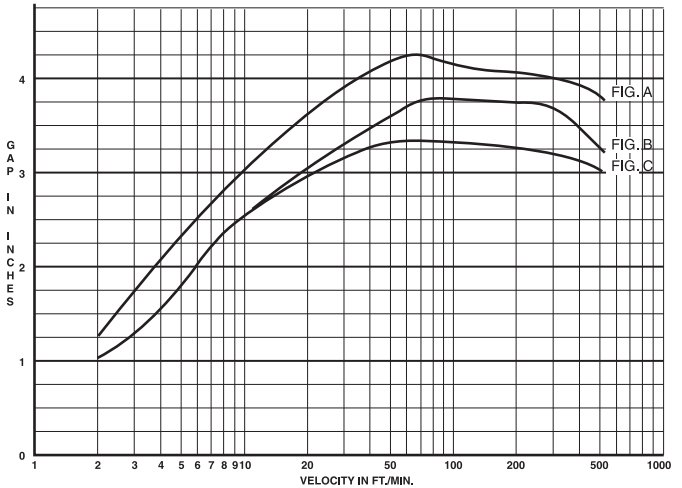
Milltronics MFA 4p is a highly sensitive, single setpoint motion sensor alarm unit, used with MSP and XPP probes. The probe detects an increase or decrease in the speed of rotating, reciprocating, or conveying equipment and sends the information to the MFA 4p. The MFA 4p works with a pre-amplifier which can be internal to the motion sensing probe, or remote from the motion sensing probe.

Pulses generated from the probe are continually compared to the adjustable setpoint. If the pulse rate is lower than the setpoint, the alarm relays operating in a fail-safe mode will de-energize, indicating failure. The relays will not energize until the pulse rate increases above the setpoint.

Probe

The Milltronics probes work on the principle of Faraday's Laws of Electromagnetic Induction. When a ferromagnetic object enters the probe's permanent magnetic field, it distorts the flux causing it to cut the coil windings and generate a voltage. This voltage is proportional to the strength of the magnet and the number of wire turns in the coil (constant in the Milltronics probes) and the speed at which the ferrous target passes through the flux. The generated voltage is also inversely proportional to the square of the distance between the target and the probe.

The relationship between speed and gap of a standard probe:



(25.4 mm = 1 inch and 305 mm = 1 foot)

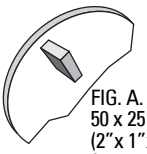


FIG. A.
50 x 25 x 50 mm
(2"x 1"x 2")
ferrous block

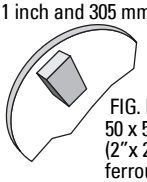


FIG. B
50 x 50 x 25 mm
(2"x 2"x 1")
ferrous block

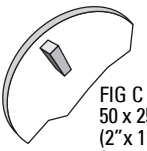


FIG C
50 x 25 x 25 mm
(2"x 1"x 1")
ferrous block

The resultant line indicates the threshold tolerance of the accompanying MFA 4p electronics. For example, in **FIG. A**, a 100 mm (4") gap requires a minimum velocity of about 10 m / minute (35 ft / minute): with a velocity of 0.61 m / minute (2 ft / minute), a maximum gap of 31 mm (1.25") is possible.

Note: 25.4 mm = 1 inch and 0.305 m = 1 foot

The graph was plotted from tests using four ferrous blocks set equidistantly on a 406 mm (16") diameter circle on a non-ferrous disc.

The physical shape of the ferrous target generally becomes important at low velocities or large gaps. At these points, tests indicate that a cubic shape gives the best results due to the sudden change it causes in the magnetic field.

An increase in block size beyond 50 x 50 x 25 mm (2" X 2" X 1") is generally not as effective as minimizing the gap, except at very low velocities.

The Milltronics Mini Sensing Probe, MSP-1

- The MSP-1 is approximately one-quarter the size of the standard probe with about one-eighth the sensitivity.
- Divide all operating values by 0.125 to obtain the specifications of the MSP-1. For example, with a gap of 12 mm (0.5"), the minimum velocity is approximately 60 m / min. (200 ft / min.), and with a velocity of 0.6 m / min. (2 ft / min.) a maximum gap of 0.125" (3 mm) is possible.

Milltronics manufactures probes to suit a wide variety of environments: low temperature, high temperature, corrosive, and Class I, II and III applications.

Pre-Amplifier (IMA and RMA)

The pre-amplifier accepts the voltage pulses generated by the probe and converts them into noise-immune current pulses. Current levels are 12 mA low and 45 mA high. The pre-amplifier comes internally mounted in the probe, or in an enclosure for remote mounting.

Internally mounted pre-amplifiers are called IMAs. Remote mounted pre-amplifiers are called RMAs.

MFA 4p Operation

The MFA 4p provides a short circuit protected, +24 V DC unregulated supply to the pre-amp. In the event that the interconnecting wiring is shorted, output current from the MFA 4p is automatically limited and the on-board alarm relays are de-energized to indicate failure.

The output current pulses from the pre-amp are super-imposed onto the dc current supply. These are monitored by Probe LED 1, which is illuminated at the rate of the incoming pulses and is useful for positioning the probe.

The rate at which the pulses are received by the MFA 4p is compared to a setpoint reference signal from the time base generator.

Although two pulses within range are required to energize the relays, as long as the frequency of the incoming pulses exceeds the setpoint frequency (or is less than that of the setpoint in the case of overspeed detection), the MFA 4p keeps the alarm relays energized. The reference generator is frequency adjustable by the pulses per minute (ppm) switch and potentiometer.

The alarm relays will de-energize after two time constants of the setpoint when the frequency of the incoming pulses falls below that of the setpoint (or exceeds that of the setpoint in the case of overspeed detection). The relay status is indicated by Relay LED 2, which is illuminated when the relays are energized (normal).

The MFA 4p has a 0 to 60 second time delay feature, allowing the monitored device to accelerate to normal running speed before monitoring begins.

This feature is activated when power is applied to the MFA 4p in parallel with the motor starter contact coil. The time delay circuit simulates normal operating conditions for the amount of time as set by the **Start Delay** potentiometer, keeping the alarm relays energized. If the monitored device does not reach normal speed before the set time period, the relays will de-energize giving an alarm condition. This feature is not applicable in the overspeed detection mode.

Calibration

The probe and pre-amplifier require no calibration.

Connect the probe, pre-amp, and MFA 4p as shown in the Interconnection diagrams on pages 8 and 9. Connect the MFA 4p to power as shown in the Power Connection diagram on page 10, and if applicable, as shown for Automatic Start Delay on page 11.

Note: To help the calibration procedure, short N.O. contacts of relays to prevent motor shut-down (terminals 1 to 2 and/or 4 to 5). This allows the system to run uninterrupted until an operating setpoint is established.

MFA 4p (Refer to MFA 4p Circuit Board layout on page 7.)

1. Operate monitored equipment at its normal operating speed.
2. Confirm that Probe LED 1 is pulsing at a regular frequency.
3. Set **Start Delay** fully counter-clockwise **(CCW)** to **0** seconds.

Underspeed

1. Set switch **SW3** to **Underspeed**.
2. Set **pulses per minute (ppm)** switch **SW2** to **X 100** position.
3. Turn **ppm** potentiometer fully clockwise **(CW)** to **30**.
4. Determine incoming pulse rate by slowly turning **ppm** potentiometer **CCW** until relay LED 2 goes on. As the MFA 4p requires 2 pulses within range before energizing relays, low **ppm** applications (e.g. **2 ppm**) may require stepping of potentiometer at appropriate time intervals.

5. If no response is obtained when you set the **ppm** potentiometer to **3** (below this stability suffers), reset potentiometer fully **CW**, set switch **SW2** to **X 10** and then **X 1** if required, and repeat step 4.

6. When Relay LED 2 goes on, indicating the incoming pulse rate, turn potentiometer **CCW** slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations. For 50% of full speed, set potentiometer (and **SW2** if required) to halfway between incoming pulse rate of normal speed and **0** ppm.

7. Set **Start Delay** by adjusting potentiometer so that equipment being monitored can attain normal operating speed before LED 2 can turn off.

Overspeed

1. Set switch **SW3** to **Overspeed**.

2. Set **ppm** switch **SW2** to **X 1** position.

3. Set **ppm** potentiometer fully **CCW** to **0**.

4. Determine incoming pulse rate by slowly turning **ppm** potentiometer **CW** until Relay LED 2 goes on. Because the MFA 4p requires 2 pulses within range before energizing relays, low **ppm** applications (e.g. **2 ppm**) may require stepping of potentiometer at appropriate time intervals.

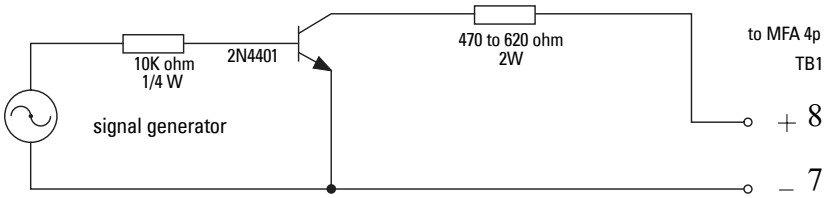
5. If no response is obtained when you set the **ppm** potentiometer to **3,** (below this stability suffers), re-set potentiometer fully **CCW** and set switch **SW2** to **X 10,** and then **X 1** if required, and repeat step 4.

6. When Relay LED 2 goes on, indicating the incoming pulse rate, turn potentiometer **CW** slightly past this point to obtain an operating setpoint that allows for normal fluctuations due to load and voltage variations.

Remember:
If N.O. contacts were shorted as described in final note of calibration preamble, remove them now as calibration is complete.

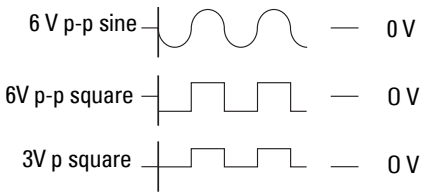
Signal Generator Interface

The following circuit may be used for calibrating or for troubleshooting the MFA 4p.



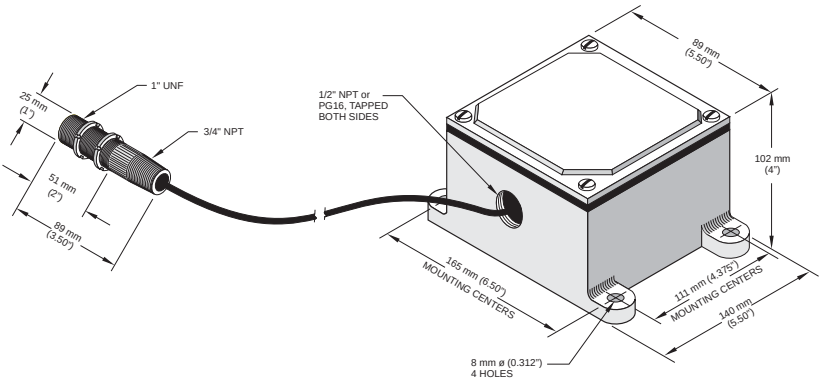
Circuit substitutes operating probe and pre-amp.

Set signal generator for:



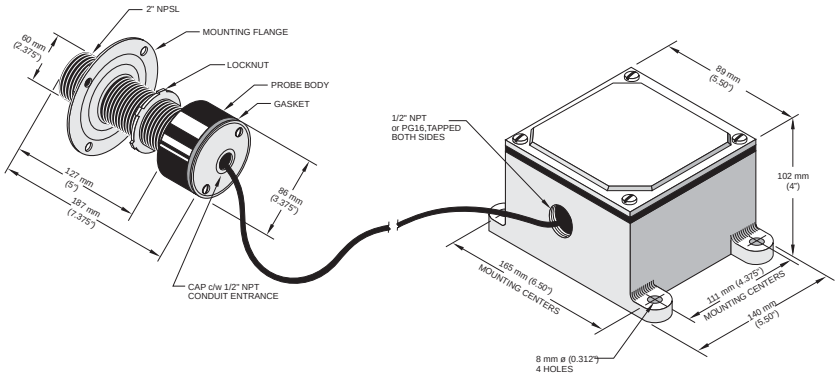
Probes

Mini Sensing Probe MSP-1



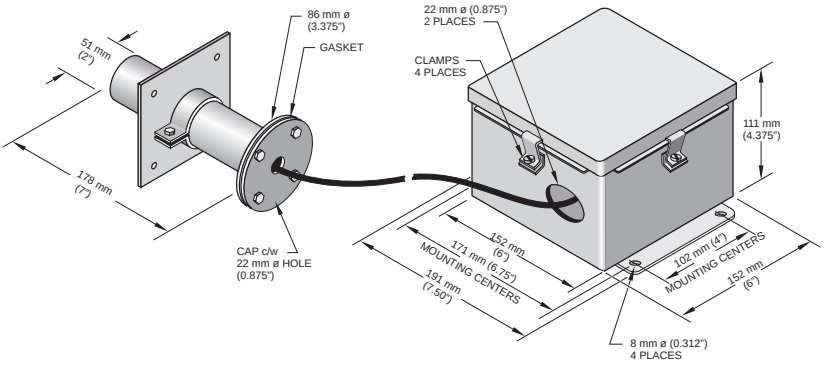
- CPVC body comes with 2 CPVC locknuts
- 180 cm (6 ft.) of Belden 8760 supplied potted in probe
- Remote mounted pre-amp in NEMA 4 cast aluminum enclosure.

High Temperature Probe MSP-3

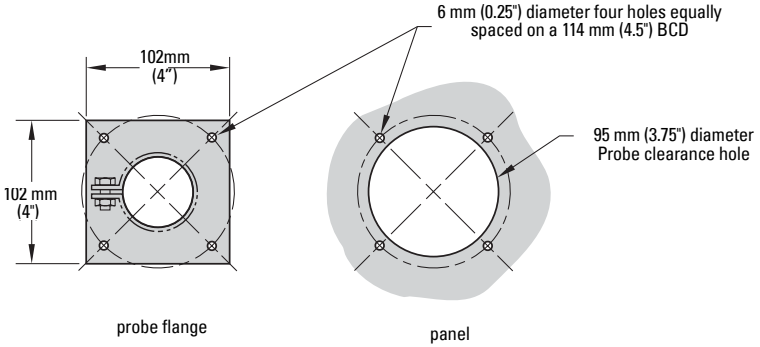


- Cast aluminum body comes with cast aluminum cap and zinc flange, zinc plated locknut, and silicone rubber gasket
- See page 22 for Flange and Mounting Details
- Pre-amp is mounted in a NEMA 4 cast aluminum enclosure

Stainless Steel Probe MSP-9



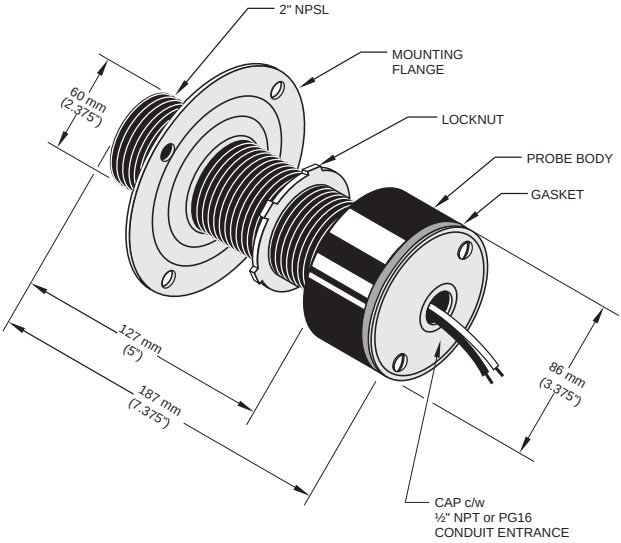
Mounting Details



- For high temperature and corrosion resistance applications
- 304 stainless steel body comes with stainless steel clamp and silicone gasket
- 1.5 m (5 ft.) Belden 83321 Teflon®[1] cable potted in probe
- Pre-amp is mounted in an enamel painted steel Hammond 1414N4E enclosure

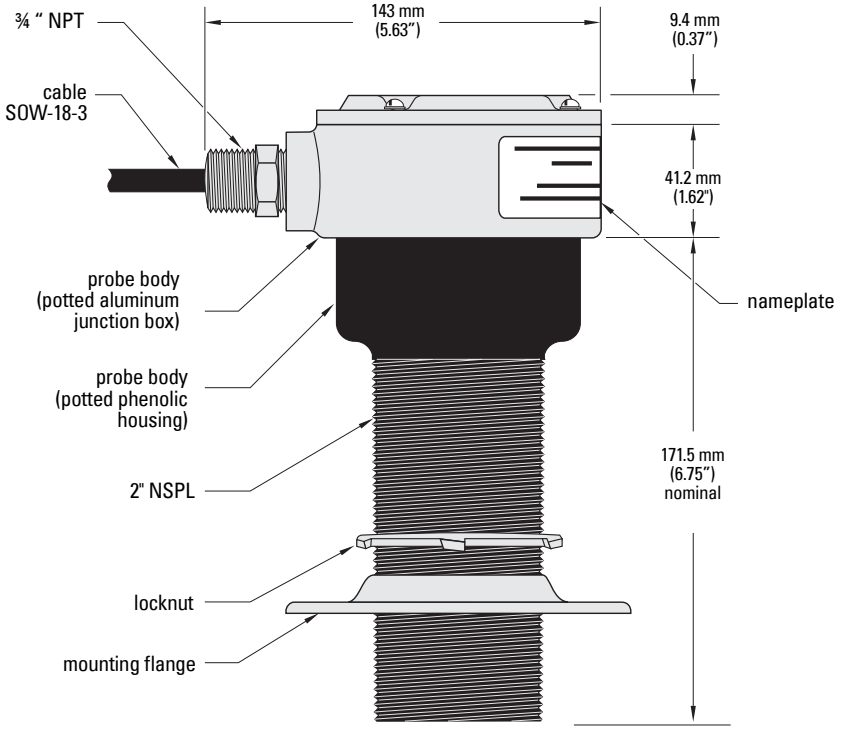
1. Teflon is a registered trademark of E.I. du Pont de Nemours and Company

Standard Probe MSP-12



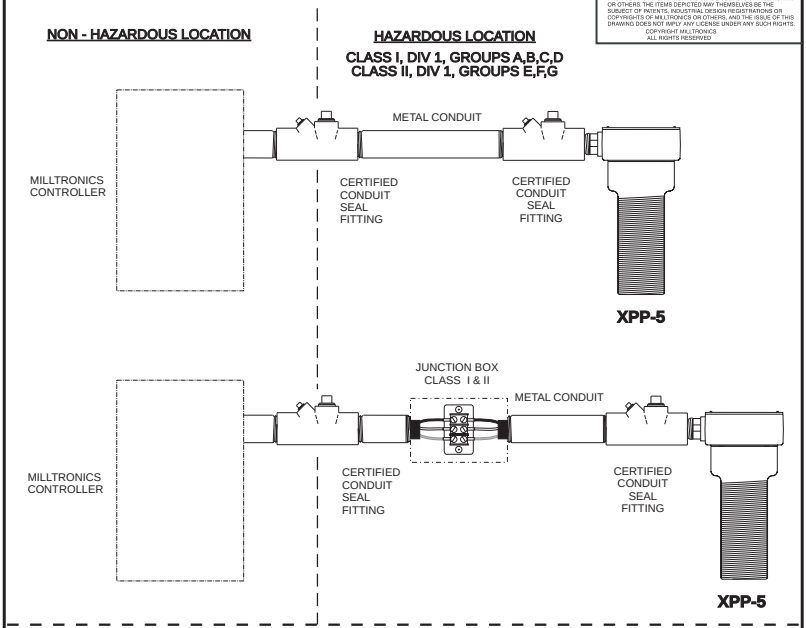
- Phenolic body comes with die-cast aluminum cap and zinc flange, zinc plated locknut, and neoprene gasket
- See page 22 for Flange and Mounting Details
- Pre-amp is potted in the probe body and comes with two 127 mm (5") long hook-up wires

Hazardous Locations XPP-5



- C.S.A Approved for:
  Class I, Div.1, Gr. A, B, C & D
  Class II, Div 1, Gr. E, F & G
  Class III
- phenolic/aluminum body with die-cast flange and zinc-plated locknut
- see page 22 for mounting details, and pages 9 and 21 for interconnection information.
- pre-amp and cable potted in the probe's body

Interconnection Diagram for the XPP-5



NOTES :

1) THE XPP-5 CABLE MUST BE TERMINATED IN AN AREA EXTERNAL TO HAZARDOUS LOCATIONS, CLASS I, DIV 1, GR. A,B,C,D & CLASS II, DIV 1, GR. E,F,G.

2) A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE XPP-5 CONDUIT HUB FOR CLASS I, DIV. 1 HAZARDOUS LOCATION ONLY.

3) INSTALLATION SHALL BE DONE IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE PART 1 REQUIREMENTS.

4) DO NOT EXPOSE THE XPP-5 TO DIRECT SUNLIGHT, OTHERWISE PROVIDE SUN SHIELD.

5) STATIC HAZARD, DO NOT RUB WITH DRY CLOTH.

No.	REVISION DESCRIPTION	DWG BY	APPRO.	DATE
2	REVISED HOUSING THREADS PER ECN #00-000-0-0070	RWG	SN	JULY 11/00
1	REVISED CABLE AND TERMINAL CONNECTOR PER ECN #00-000-0-0037	RWG	SN	APRIL 18/00
0	FOR CONSTRUCTION	RWG	SN	MARCH 27/00

USE DIMENSIONS ONLY - DO NOT SCALE

DRAWING SCALE	N. T. S.
DRAWN BY	B. GRAY
CHECKED BY	R. CLOSS
APPROVED BY	S. NGUYEN

TOLERANCES UNLESS OTHERWISE NOTED
1 PLACE DECIMAL ±0.030" FRACTIONS ±0.030"
2 PLACE DECIMAL ±0.010" ANGLES ±0.5°
3 PLACE DECIMAL ±0.002"

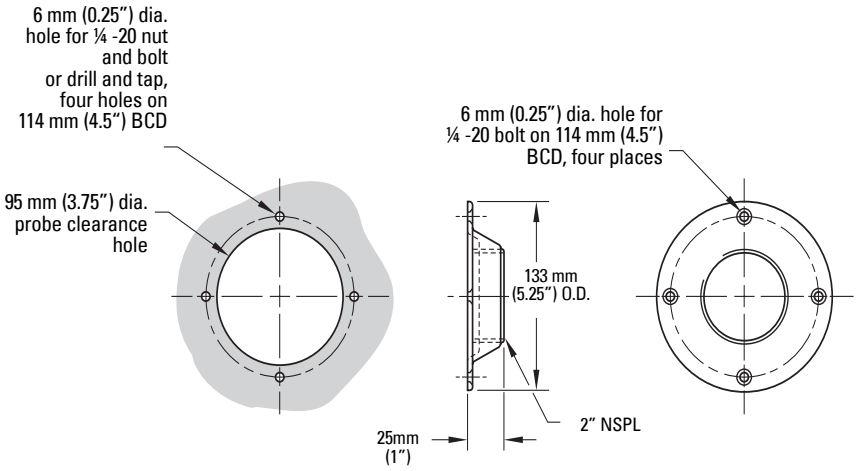
THIRD ANGLE PROJECTION

TITLE
XPP-5
INTERCONNECTION DIAGRAM

MILLTRONICS
Mass Dynamics Division

FILE No. 2365013102 | SIZE A | DRAWING No. 23650131 | REV. 2
PLOT AT 1=1
JOB No.
SHEET 1 OF 1

Mounting Details



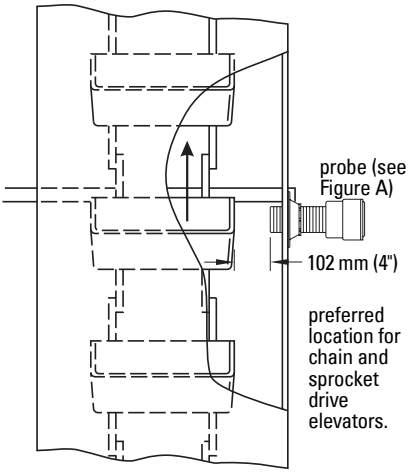
Mounting Flange

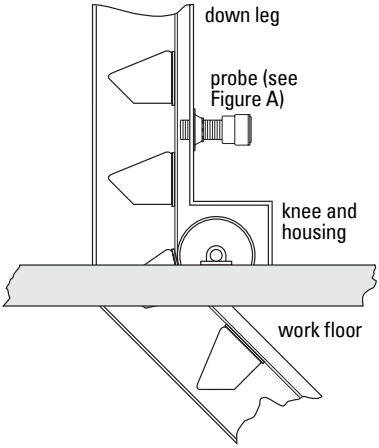
APPLICABLE TO ALL PROBES

EXCEPT MSP-1 AND MSP-9

Applications

Bucket Elevators



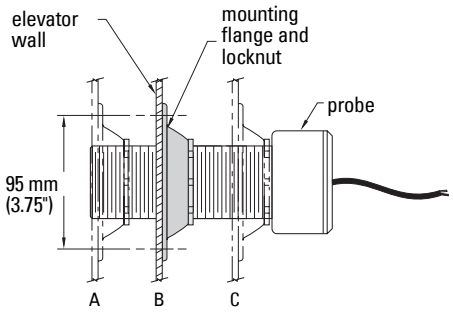


For chain and sprocket drive elevators, place the probe so that the gap between the bucket and the probe does not exceed 102 mm (4"). To prevent damage to the probe from eccentric bucket motion, ensure that the gap is not less than 12.5 mm (0.5") in the worst condition.

Preferred location for belt-driven elevators with ferrous bucket spacing greater than 76 mm (3"), and non-ferrous buckets with ferrous bolts.

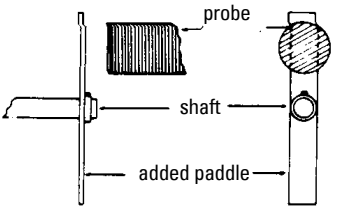
For ferrous buckets with spacings less than 76 mm (3") locate probe on the front of the leg.

Figure A

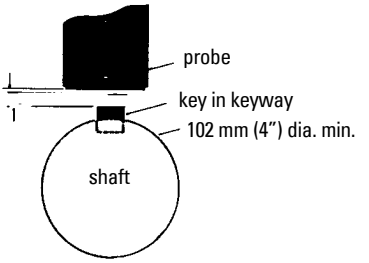


For elevators with ferrous walls, cut 88 mm to 95 mm (3.5" to 3.75") hole in the elevator wall. Any position from A to C may be used to maintain the gap.

Shafts



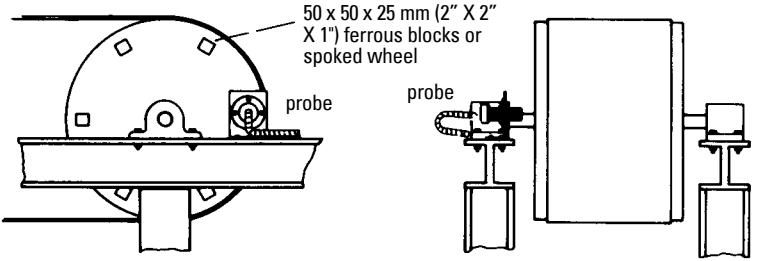
safety shield not shown



These methods are viable if the speed is such that the blades or key will provide the number of pulses required at a minimum velocity of 1.5 m / minute (5 ft. / minute). In applications where exposed moving parts are required, safety shields and precautions should be applied.

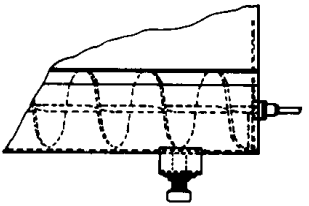
Where conditions prevent the sensing of buckets, a belt pulley or paddle mounted on an exposed shaft end, preferably the tail pulley, may be used.

Belt Conveyors

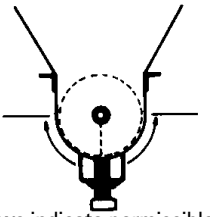


Potential for damage in each application governs the minimum gap allowable. Maximum gap for operation is 102 mm (4"), optimum 25 mm to 50 mm (1" to 2").

Screw Conveyors



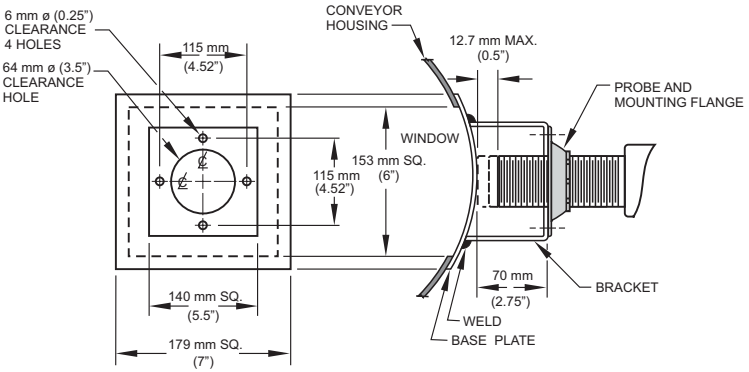
The probe should be located at the idler end (usually feed end)



Arrows indicate permissible placement range of the probe

A ferrous mass added behind the flight of a screw conveyor, where it passes the probe aids Borderline Operation. This mass must be added for all non-ferrous screws.

Non-Ferrous Window

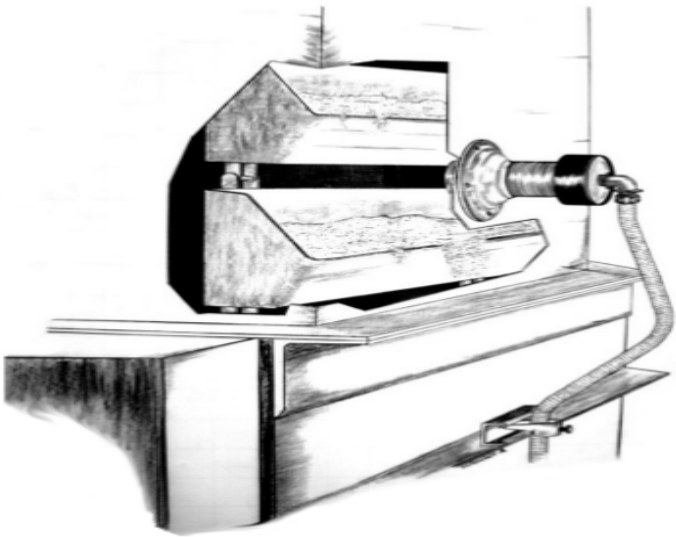


MINIMUM RECOMMENDED DIMENSIONS SHOWN

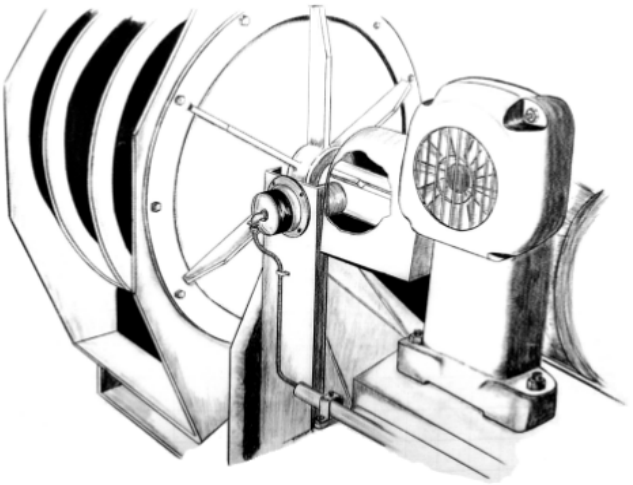
For screw conveyor with trough over 3.1 mm (0.125") thick or for high temperature applications. The dimensions shown for the base, window, and bracket are the minimum recommended with tolerances of ± 0.8 mm (0.031"). Use 305, 310, or 316 stainless steel, brass, or aluminum.

The probe may not touch the window if temperatures are in excess of 60 °C (140 °F) when using the low temperature probes or 260 °C (500 °F) when using the high temperature probes.

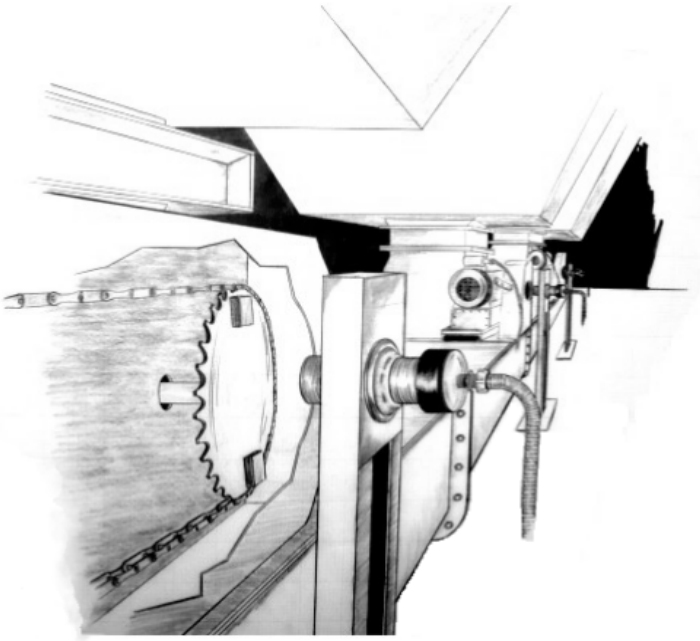
Bucket Elevator



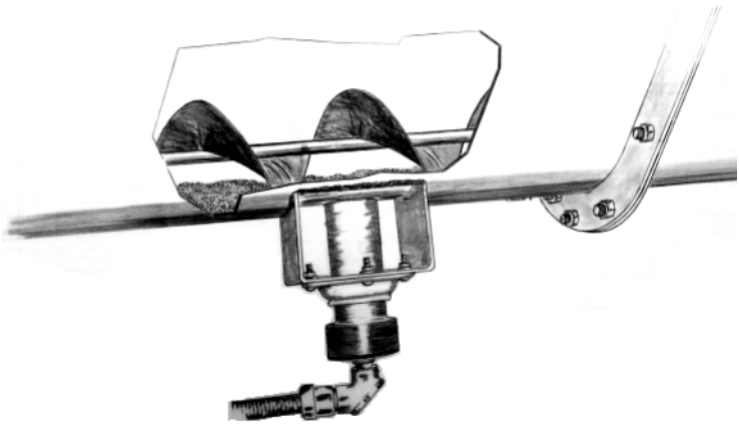
Rotating Shaft of Rotary Feeder



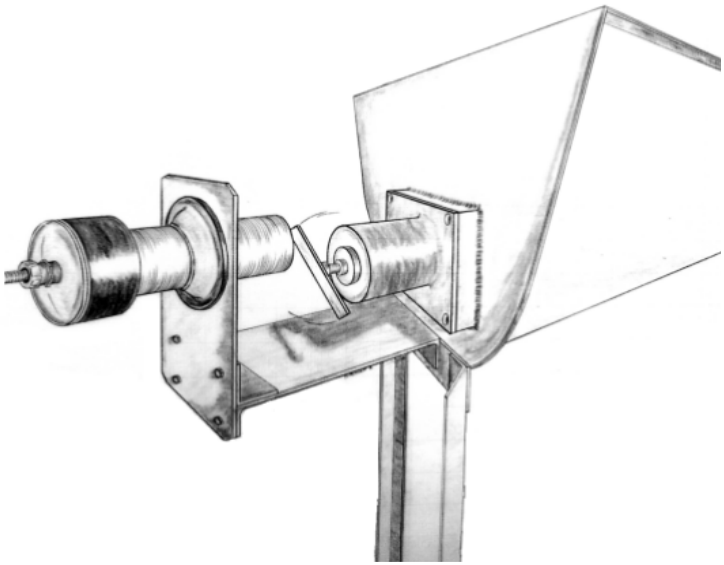
Drive Sprocket on Rotary Feeder



Screw Conveyor Flights



End Bearing on Screw Conveyor



Troubleshooting

	LED 1	LED 2	term 7/8 (note 1)	C8	term 1/2 relay 1 out	term 4/5 relay 2 out
normal	pulsing	on	24 V	27 V	closed	closed
alarm	pulsing	off	24 V	27 V	open	open
probe reversed polarity	on	off	20 V	27 V	open	open
probe wiring open circuit	off	off	27 V	27 V	open	open
probe wiring short circuit	off	off	0 V	27 V	open	open
relay defective	pulsing	on	24 V	27 V	open	open

Notes:

- Voltage levels are dc, nominal values, and may appear to be pulsing, coincidental with LED 1.
- If diagnosis does not solve the malfunction, the probe, pre-amp or MFA 4p may be defective.
- If no spare circuit boards or probes are available for interchanging, the MFA 4p may be tested as follows in order to determine which section is defective:

  a. To find out if the MFA 4p is defective:
     i. Disconnect the pre-amp.
     ii. Set ppm switch **SW2** to **X 1** position and turn potentiometer to **15**.
     iii. Connect one lead of a 530 ohm, 1 watt resistor to terminal 7 and then momentarily contact terminal 8 at a rate of once per second. If the MFA 4p is functional, the relays will energize after two pulses and de-energize approximately 8 seconds after last pulse.

  b.To find out if the RMA is defective:
     i. Disconnect pre-amp from the MFA 4p. Attach probe across terminals TB1 1/2 and a 24Vdc (floating) power supply across terminals TB2 3/2, according to the RMA Interconnectiondiagram on page 8.
     ii. Run equipment to be monitored at normal operating speed or pass a ferrous object in front of and as close to probe as possible at a continuous rate.
     iii. With an oscilloscope, look for approximately 6V peak to peak pulses or alternating hi/lo levels across ground and link 3. Or with an amp meter connected in series between the RMA and the 24Vdc power supply, look for hi/lo levels of approximately 12mA/40mA alternating at the rate of the passing ferrous objects.

c.To find out if the probe is defective (non-IMA type only; i.e. MSP-1 , MSP-3, and MSP-9):

i. Disconnect probe from pre-amp.

ii. Connect an ohmmeter across the black and white leads.

iii. Nominal probe impedances are as follows

MSP-1	115 ohms
MSP- 3 and MSP- 9	750 ohms

If impedance deviates substantially from these values, an open or short circuit condition is indicated.

Maintenance

The Motion Failure Alarm MFA 4p requires no maintenance: however, we recommend a program of periodic checks.

If it is necessary to clean the enclosure and circuit boards:

1. First, make sure the power is disconnected at the main breaker.
2. Use a vacuum cleaner and a clean, dry paint brush.
3. Check all electrical contacts for corrosion and arcing.

It is a good idea to periodically check the face of the probe: it should be free of material build-up, corrosion or deformation.

Index

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Siemens Milltronics Process Instruments Inc.
1954 Technology Drive, P.O. Box 4225
Peterborough, ON, Canada K9J 7B1
Tel: (705) 745-2431 Fax: (705) 741-0466
Email: techpubs@siemens-milltronics.com

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Printed in Canada

Rev. 1.1

SAGINAW CONTROL & ENGINEERING

Your Enclosure Source®

Part Information - SCE-36XEL3110SSLP

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- Installation Manual
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Part Details - SCE-36XEL3110SSLP

Printable Version

Part Number: SCE-36XEL3110SSLP
Description: S.S. XEL Enclosure
Height: 36.00 inches
Width: 31.38 inches
Depth: 10.00 inches
Page Number: 205
List Price: $1,457.80
Panel: SCE-36P30 -
Product Code: S5
Est. Shipweight: 96.00 lbs.
NEMA Rating: 12, 4, & 4X

Detailed Drawing (PDF)
Downloadable Drawing (ZIP)

Having trouble downloading drawings? Click Here for help.

Construction -

- 0.075 In. stainless steel Type 304.
- Seams continuously welded and ground smooth.
- Flange trough collar around all sides of door opening.

Application -

operating mechanism.
- Concealed hinge.
- Doors are interchangeable and easily removed by pulling hinge pin.
- 3-point latching mechanism.
- Latches are opened or closed with screwdriver (optional tamper-resistant inserts available).
- Mounting holes in back of enclosure.
- Mounting hardware, sealing washer and hole plug included.
- Ground studs on door and body.
- Black zinc die cast coinproof/padlocking handle.

Similar Partnumbers -
- SCE-24XEL2108SSLP
- SCE-24XEL2508SSLP
- SCE-24XEL2510SSLP
- SCE-30XEL2508SSLP
- SCE-30XEL2510SSLP
- SCE-36XEL2508SSLP
- SCE-36XEL3112SSLP
- SCE-42XEL3110SSLP
- SCE-42XEL3112SSLP
- SCE-42XEL3712SSLP
- SCE-42XEL3716SSLP
- SCE-48XEL3710SSLP
- SCE-48XEL3712SSLP
- SCE-48XEL3716SSLP

Installation Information -
- Mechanical Defeater (Variable Depth)

- Mechanical Defeater (Cable Operated)

- Cutler-Hammer Flange Mounted, Disconnects and Circuit Breakers

- Allen-Bradley Flange Mounted, Disconnects and Circuit Breakers

- Bussmann Flange Mounted, Disconnects and Circuit Breakers

- ABB Flange Mounted, Disconnects and Circuit Breakers

- GE Flange Mounted, Disconnects and Circuit Breakers

- Gould Flange Mounted, Disconnects and Circuit Breakers

- Moller Flange Mounted, Disconnects and Circuit Breakers

- Siemens Flange Mounted, Disconnects and Circuit Breakers

- Square D Flange Mounted,

disconnect installation information, consult our Installation Instruction Handbook. For outdoor application a drip shield is recommended.

Finish -
#4 brushed finish on all exterior surfaces. Optional panels are powder coated white epoxy polyester.

Options -
*Can be special ordered in Type 316 Stainless Steel.
*Panels can be special ordered in Stainless Steel up to 48P36 size.

Industry Standards -
NEMA Type 4, 4X, 12 & 13
UL Listed Type 4, 4X & 12
CSA Type 4, 4X & 12
IEC 60529 IP 66

Notes -
Interchangeable latches and handles found on pages 147 & 148.

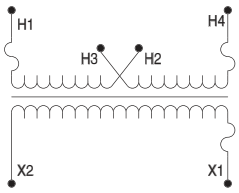
Disconnects and Circuit Breakers

95 Midland Road - Saginaw, MI 48638-5770
(989)799-6871 - Fax: (989)799-4524

120 Volt Control Secondary—Primary and Secondary Fuse Block

Voltage and Connection Options

Voltage Code	Voltages		Connections	
	Primary	Secondary	Primary	Secondary
D1	220 x 440 230 x 460 240 x 480	110 115 120	220 or 230 or 240: Connect to H1 and H4 Jumper H1 with H3 Jumper H2 with H4 440 or 460 or 480: Connect to H1 and H4 Jumper H2 with H3	Connect to X1 and X2



Dimensions

VA		Catalog Number	Fig.	Acc. Key	A		B		C		E		F		Slots	
UL	CE				IN	mm	IN	mm	IN	mm	IN	mm	IN	mm	IN	mm
25	25	9070TF25D1	7	I	3.09	79	3.00	76	4.00	102	2.00	51	2.50	64	0.20 x 0.38	5 x 10
50	50	9070TF50D1	7	I	3.09	79	3.00	76	4.00	102	2.00	51	2.50	64	0.20 x 0.38	5 x 10
75	75	9070TF75D1	7	I	3.34	85	3.38	86	4.18	106	2.38	61	2.81	71	0.20 x 0.48	5 x 12
100	100	9070TF100D1	7	I	3.34	85	3.38	86	4.18	106	2.38	61	2.81	71	0.20 x 0.48	5 x 12
150	150	9070TF150D1	7	I	3.59	91	3.75	95	4.50	114	2.88	73	3.13	80	0.20 x 0.38	5 x 10
200	200	9070TF200D1	7	I	3.59	91	3.75	95	4.50	114	2.88	73	3.13	80	0.20 x 0.38	5 x 10
250	160	9070TF250D1	8	I	5.30	135	3.75	95	4.50	114	2.88	73	3.13	80	0.20 x 0.38	5 x 10
300	200	9070TF300D1	8	I	4.74	120	4.50	114	5.13	130	2.56	65	3.75	95	0.20 x 0.38	5 x 10
350	250	9070TF350D1	8	I	5.11	130	4.50	114	5.13	130	3.00	76	3.75	95	0.20 x 0.38	5 x 10
500	300	9070TF500D1	8	I	5.49	139	4.50	114	5.13	130	3.56	90	3.75	95	0.20 x 0.38	5 x 10
750	500	9070TF750D1	8	I	5.61	143	5.25	133	5.80	147	3.43	87	4.38	111	0.28 x 0.56	7 x 14
1000	630	9070TF1000D1	8	I	6.30	160	5.25	133	5.80	147	4.31	109	4.38	111	0.28 x 0.56	7 x 14
1500	1000	9070TF1500D1	8	I	5.92	150	7.06	179	7.46	190	4.13	105	5.81	148	0.28 x 0.56	7 x 14
2000	1500	9070TF2000D1	8	I	7.17	182	7.06	179	7.46	190	4.56	116	5.81	148	0.28 x 0.56	7 x 14

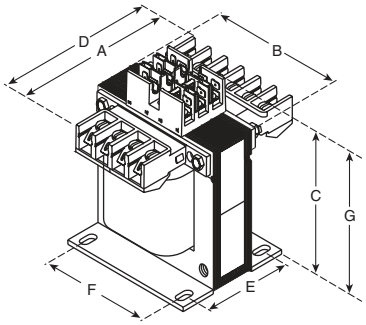


Figure 7

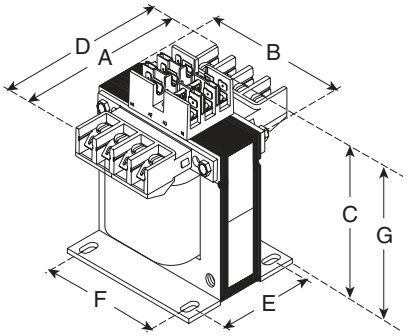


Figure 8

The TDM Series is a delay-on-make timer that combines accurate digital circuitry with isolated, DPDT relay contacts in an industry standard 8-pin plug-in package. DIP switch adjustment allows precise selection of the time delay over the full time delay range. The TDM Series is the product of choice for custom control panel and OEM designers.

Operation (Delay-on-Make):
Upon application of input voltage, the time delay begins. The output is de-energized before and during the time delay. At the end of the time delay, the output relay energizes and remains energized until input voltage is removed.
Reset: Removing input voltage resets the time delay and output.

For more information see:
Appendix A, pages 156-164 for function descriptions and diagrams.
Appendix B, page 165, Figure 8 for dimensional drawing.

Features:

- Switch settable time delay
- Three time ranges from 0.1s - 10,230s
- ±0.1% repeat accuracy
- ±2% setting accuracy
- 10A, DPDT output contacts
- LED indication

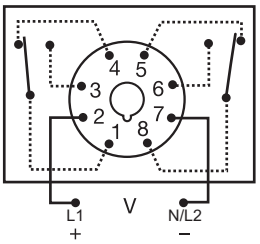
Approvals:

8-pin models UL listed when used in combination with P1011-6 socket only.

Auxiliary Products:

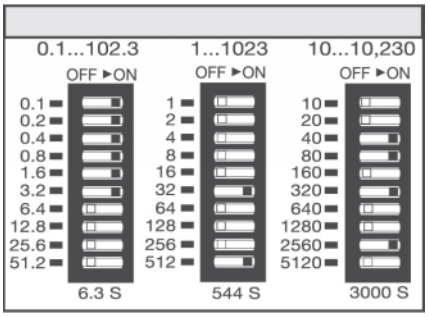
- **Panel mount kit:** P/N: BZ1
- **8-pin socket:** P/N: NDS-8
- **Hold-down clips (sold in pairs):** P/N: PSC8 (NDS-8)
- **Octal socket for UL listing:** P/N: P1011-6
- **DIN rail:** P/N: C103PM (Al)

Connection:



Relay contacts are isolated.

Digi-Set Binary Switch Operation:



Available Models:

TDM120AL	TDMH24DL
TDM12DL	TDML110DL
TDM230AL	TDML120AL
TDM24AL	TDML12DL
TDM24DL	TDML230AL
TDMH120AL	TDML24DL
TDMH24AL	

If desired part number is not listed, please call us to see if it is technically possible to build.

Order Table:

TDM - 1 - 1023s in 1s increments
TDMH - 10 - 10,230s in 10s increments
TDML - 0.1 - 102.3s in 0.1s increments

X — **Input Voltage**
- **12D** - 12VDC
- **24A** - 24VAC
- **24D** - 24VDC/28VDC
- **110D** - 110VDC
- **120A** - 120VAC
- **230A** - 230VAC

X — **LED Indication**
- **L**

Specifications

Time Delay
Type . . . . . Digital integrated circuitry
Range* . . . . . 0.1 - 102.3s in 0.1s increments
1 - 1023s in 1s increments
10 - 10,230s in 10s increments
Repeat Accuracy . . . . . ±0.1% or 20ms, whichever is greater
Setting Accuracy . . . . . ±2% or 50ms, whichever is greater
Reset Time . . . . . ≤ 50ms
Recycle Time . . . . . During Timing - TDMH: ≤ 500ms
TDM, TDML: ≤ 300ms
Time Delay vs Temp. & Voltage . . . . . ±2%
Indicator . . . . . LED glows during timing; relay is de-energized

Input
Voltage . . . . . 12, 24, or 110 VDC; 24, 120, or 230VAC
Tolerance 12VDC & 24VDC/AC . . . . . -15% - 20%
110VAC/DC to 230VAC . . . . . -20% - 10%
AC Line Frequency . . . . . 50/60 Hz
Power Consumption . . . . . ≤ 2.25W

Output
Type . . . . . Electromechanical relay
Form . . . . . DPDT
Rating . . . . . 10A resistive @ 120/240VAC & 28VDC; 1/3 hp @ 120/240VAC
Life . . . . . Mechanical - 1 x10^7; Electrical - 1 x 10^6

Protection
Polarity . . . . . DC units are reverse polarity protected
Isolation Voltage . . . . . ≥ 1500V RMS input to output

Mechanical
Mounting . . . . . Plug-in socket
Dimensions . . . . . 3.2 x 2.39 x 1.78 in. (81.3 x 60.7 x 45.2 mm)
Termination . . . . . Octal 8-pin plug-in

Environmental
Operating / Storage Temperature . . . . . -20° to 65°C / -30° to 85°C
Weight . . . . . ≅ 6 oz (170 g)

*For CE approved applications, power must be removed from the unit when a switch position is changed.

Appendix A - Timer Functions

Selecting a Timer's Function

Selecting one of the five most common timing functions can be as easy as answering three questions on the chart below. If you have trouble answering these questions, try drawing a connection diagram that shows how the timer and load are connected. Time diagrams and written descriptions of the five most popular functions, plus other common functions. Instantaneous contacts, accumulation, pause timing functions, and flashing LED's are included in some units to expand the versatility of the timer. These expanded operations are explained on the product's catalog page. Time diagrams are used on these pages along with text and international symbols for functions.

Function Selection Guide

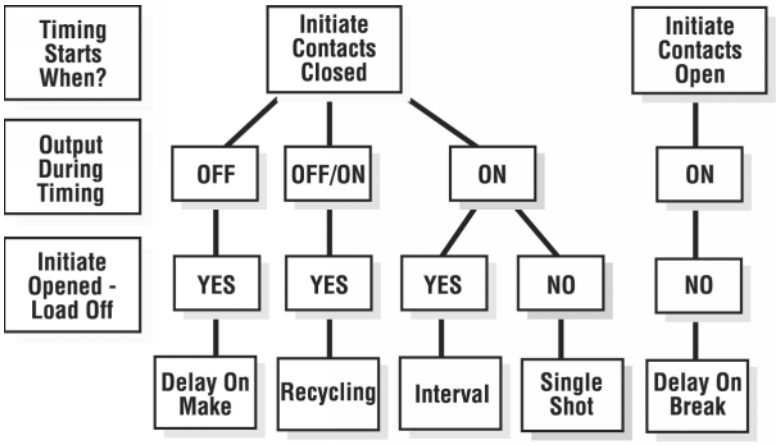
Selection Questions

1) The timing starts when the initiate (starting) contacts are:
   A) Closed B) Opened

2) What is the status of the output (or load) during timing:
   A) On B) Off C) On/Off

3) Will the load de-energize (or remain de-energized) if the initiate (starting) contacts are opened during timing:
   A) Yes B) No

THE FIVE MOST USED FUNCTIONS

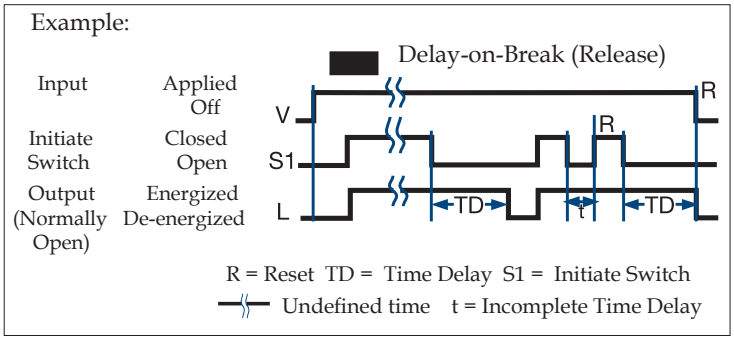


Understanding Time Diagrams

Time diagrams are used to show the relative operation of switches, controls, and loads as time progresses. Time begins at the first vertical boundary. There may be a line indicating the start of the operation or it may just begin with the transition of the device that starts the operation. Each row in the time diagram represents a separate component. These rows will be labeled with the name of the device or its terminal connection numbers. In a bistable or digital system, the switches, controls, or loads can only be ON or OFF. The time lines are drawn to represent these two possible conditions. Vertical lines are used to define important starting or ending points in the operation.

The example to the right is the most common type of time diagram in use in North America. It shows the energizing of loads, and the closing of switches and contacts by an ascending vertical transition of the time line. Opening switches or contacts or de-energizing loads are represented by descending vertical transitions.

TIME DIAGRAM

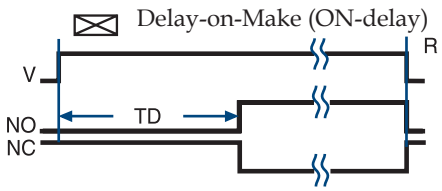


INTERNATIONAL TIMING FUNCTION SYMBOLS

= Delay-on-Make; ON-delay
= Delay-on-Break; OFF-delay
= Delay-on-Make & Break; ON and OFF-delay
= Interval; Impulse-ON
= Trailing Edge Interval; Impulse-OFF
= Single Shot; Pulse Former
= Flasher - ON Time First; Recycling Equal Times - ON First
= Flasher - OFF Time First; Recycling Equal Times - OFF First
= Recycling - Unequal Times; Pulse Generator
= Recycling - Unequal Times Starting with ON or OFF
= Delay-on-Make & Interval; Single Pulse Generator

Delay-on-Make: (ProgramaCube® Function M)

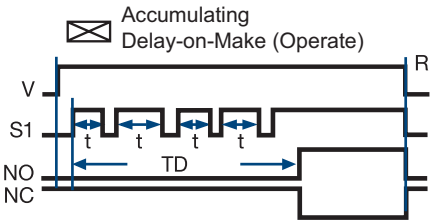
(ON-delay, Delay on Operate, On Delay, Operate Delay, Delay On, Prepurge Delay)
OPERATION: Upon application of input voltage, the time delay begins. The output (relay or solid state) is de-energized before and during the time delay. At the end of the time delay, the output energizes and remains energized until input voltage is removed.
RESET: Removing input voltage resets the time delay and output.
See: HRPS, KRPS, KSPS, KSPU, NHPS, NHPU, TDM, TRDU



Extra Functions Included in Some Delay-on-Make (DOM) Timers:

Accumulating Time Delay Feature: (ProgramaCube® Function AM)

Some DOM timers allow the time delay to be stopped and held and then resumed by opening and closing an external switch. The total time delay, TD is the sum of the accumulated partial time delays, "t".
See: KRPD, KRPS, HRPS, NHPS, KSPD, KSPS, TRDU

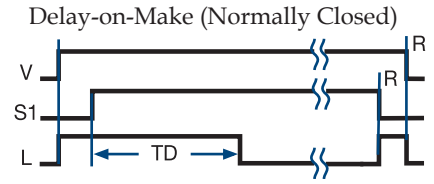


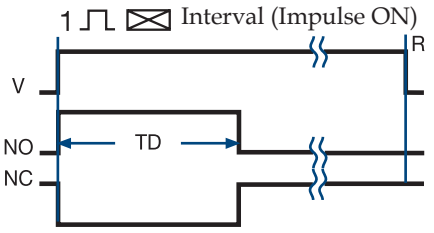
Instantaneous Contacts:

Some DOM timers have a set of instantaneous contacts in addition to the delayed contacts. Instantaneous contacts energize when input voltage is applied and remain until voltage is removed.

Delay-on-Make, Normally Closed Output:

All relay output delay-on-make timers with normally closed contacts include this function. (See Delay-on-Make NC Contacts) This function is also available in solid-state output timers. The solid-state output energizes when input voltage is applied. The time delay begins when an optional initiate switch S1 is closed (timing starts when voltage is applied if S1 is not used). The output de-energizes at the end of the time delay.
Reset: Opening S1 resets the time delay and the output immediately energizes (or remains energized). Removing input voltage resets the time delay and de-energizes the output.
See: KSD4, THD4, TS4, TSD4





Interval: (ProgramaCube® Function I)

(Impulse-ON, Single Pulse on Operate, On Interval, Interval On, Pulse Shaping, Bypass Timing)
OPERATION: Upon application of input voltage, the time delay begins. The output (relay or solid state) energizes during the time delay. At the end of time delay the output de-energizes and remains de-energized until input voltage is removed.
RESET: Removing input voltage resets the time delay and output.
See: HRPS, KRPS, KSPS, KSPU, NHPS, NHPU, TDI, TSD2

Extra Functions Included on Some Interval Timers:

Instantaneous Contacts:

Some Interval timers have a set of intantaneous contacts in addition to the delayed contacts. Intantaneous contacts energize when input voltage is applied and remain until voltage is removed.

Legend

V = Voltage
R = Reset
TD = Time Delay
S1 = Initiate Switch
NO = Normally Open Contact
NC = Normally Closed Contact
t = Incomplete (Partial) Time Delay
L = Load
= Undefined time

Timer Functions
Popular Functions

Recycling: (ProgramaCube®Functions RE, RD, RXE, RXD)

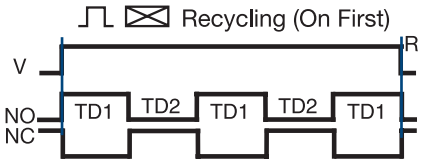
(Flasher, Pulse Generator, Recycle Timing, Repeat Cycle, Duty Cycling)

OPERATION: Upon application of input voltage, the output (relay or solid state) energizes and the ON time begins. At the end of the ON time, the output de-energizes and the OFF time begins. At the end of the OFF time, the output energizes and the cycle repeats as long as input voltage is applied. The OFF time may be the first delay in some recycling timers.

RESET: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.

The time delays in some recycling timers are equal TD1=TD2. Flashers are an example of this type of recycling timer. Others have separately selectable time delays.

See: HRPD, HRPS, KRPD, KRPS, KSPD, KSPS, KSPU, NHPD, NHPS, NHPU, TDR



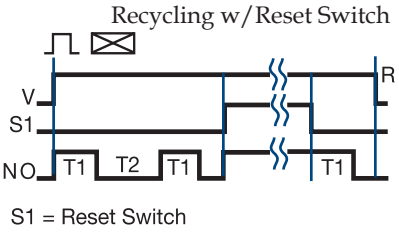
Extra Functions Included in Some Recycling Timers:

Instantaneous Contacts:

Some Recycling timers have a set of instantaneous contacts in addition to the delayed contacts. Instantaneous contacts energize when input voltage is applied and remain until voltage is removed.

RESET SWITCH: Closing an external switch transfers the output and resets the sequence to the first delay.

See: HRDR



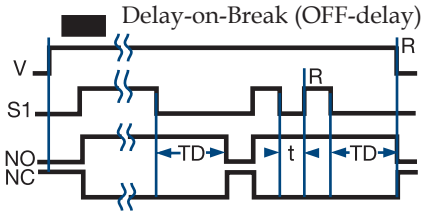
Delay-on-Break: (ProgramaCube® Function B)

(Delay on Release, OFF-delay, Release Delay, Postpurge Delay)

OPERATION: Input voltage must be applied before and during timing. Upon closure of the initiate switch, the output (relay or solid state) energizes. The time delay begins when the initiate switch is opened. The output remains energized during timing. At the end of the time delay, the output de-energizes. The output will energize if the initiate switch is closed when input voltage is applied.

RESET: Reclosing the initiate switch during timing resets the time delay. Removing input voltage resets the time delay and output.

See: HRPS, HRPU, KRPS, KSPS, KSPU, NHPS, NHPU, TRDU, TDB



Extra Functions Included in Some Delay-on-Break (DOB) Timers:

Instantaneous Contacts:

Some DOB timers have a set of instantaneous contacts in addition to the delayed contacts. Instantaneous contacts energize when input voltage is applied and remain until voltage is removed.

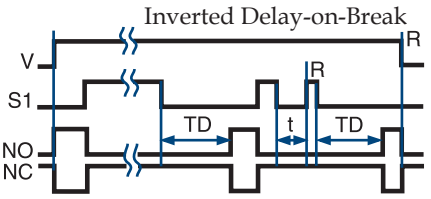
Related Functions:

Inverted Delay-on-Break: (ProgramaCube® Function UB)

OPERATION: Input voltage must be applied before and during timing. Upon closure of the initiate switch S1, the output (relay or solid state) de-energizes. The time delay begins when S1 is opened. The output remains de-energized during timing. At the end of the time delay, the output energizes. The output remains de-energized if S1 is closed when input voltage is applied

RESET: Reclosing S1 during timing resets the time delay. Removing input voltage resets the time delay and output.

See: HRPS, HRPU, KRPS, KSPS, KSPU, NHPS, NHPU, TRDU

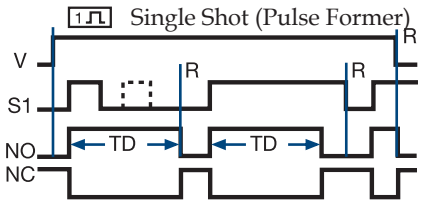


Legend

V = Voltage	NO = Normally Open Contact
R = Reset	NC = Normally Closed Contact
T1 = ON Time	t = Incomplete Time Delay
T2 = OFF Time	TD, TD1, TD2 = Time Delay
S1 =Initiate Switch	= Undefined Time

Single Shot: (ProgramaCube® Functions S or SD)

(Pulse Former, One Shot Relay, Single Shot Interval, Pulse Shaping)
OPERATION: Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch, the output (relay or solid state) energizes and the time delay begins. At the end of the delay, the output de-energizes. Opening or reclosing the initiate switch during timing has no effect on the time delay. Note (for most single shot timers): If the initiate switch is closed when input voltage is applied, the output energizes and the time delay begins.
RESET: Reset occurs when the time delay is complete and the initiate switch is opened. Removing input voltage resets the time delay and output.
See: HRPS, HRPU, KRPS, KSPS, KSPU, NHPS, NHPU, TDS, TSDS, TRDU



Extra Functions Included in Some Single Shot Timers:

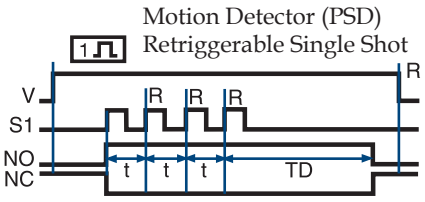
Instantaneous Contacts:

Some Single Shot timers have a set of instantaneous contacts in addition to the delayed contacts. Instantaneous contacts energize when input voltage is applied and remain until voltage is removed.

Related Functions:

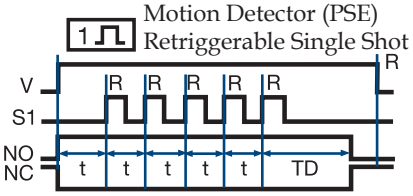
Retriggerable Single Shot (Motion Detector): (ProgramaCube® Function PSD)

(Motion Detector, Zero Speed Switch, Watchdog Timer, Missing Pulse Timer)
OPERATION: Input voltage must be applied prior to and during timing. The output (relay or solid state) is de-energized. When the initiate switch S1 closes momentarily or maintained, the output energizes and the time delay begins. Upon completion of the delay, the output de-energizes.
RESET: Reclosing S1 resets the time delay and restarts timing. Removing input voltage resets the time delay and output.
See: HRD9, HRPS, HRPU, KRD9, KRPS, KSPS, KSPU, NHPS, NHPU, TRDU, TRU



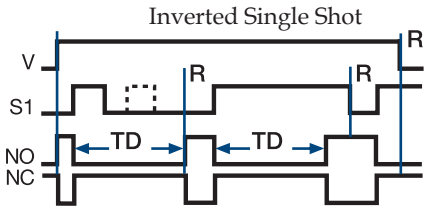
Retriggerable Single Shot (Motion Detector): (ProgramaCube® Function PSE)

OPERATION: Similar to retriggerable single shot function PSD above except, when input voltage is applied, the output (relay or solid state) immediately energizes and timing begins. At the end of the time delay, the output de-energizes. The unit will timeout as long as S1 remains open or closed for a full time delay period.
RESET: During timing, reclosing S1 resets and restarts the time delay and the output remains energized. After timeout, reclosing S1 starts a new operation. Removing input voltage resets the time delay and the output.
See: KRD9



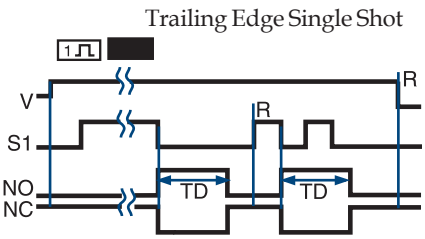
Inverted Single Shot: (ProgramaCube® Function US)

OPERATION: Input voltage must be applied before and during timing. Upon momentary or maintained closure of the initiate switch S1, the output (relay or solid state) de-energizes. At the end of the time delay, the output energizes. Opening or reclosing S1 during timing has no affect on the time delay. The output will remain de-energized if S1 is closed when input voltage is applied.
RESET: Reset occurs when the time delay is complete and S1 is open. Removing input voltage resets the time delay and output.
See: HRPS, HRPU, KRPS, KSPS, KSPU, NHPS, NHPU, TRDU



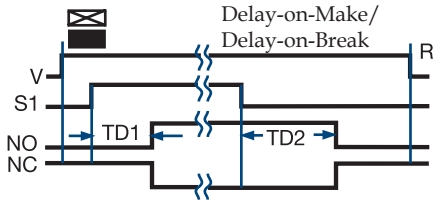
Trailing Edge Single Shot (Impulse-OFF): (ProgramaCube® Function TS)

OPERATION: Input voltage must be applied before and during timing. When the initiate switch S1 opens, the output (relay or solid state) energizes. At the end of the time delay, the output de-energizes. Reclosing and opening S1 during timing has no affect on the time delay. The output will not energize if S1 is open when input voltage is applied.
RESET: Reset occurs when the time delay is complete and S1 is closed. Removing input voltage resets the time delay and output.See: HRPS, KRPS, KSPS, KSPU, NHPU, TRDU



Timer Functions
Two Functions in One Timer

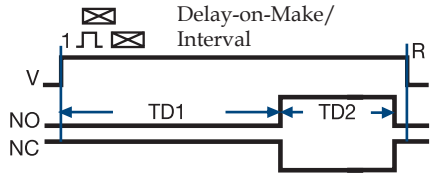
Delay-on-Make/Delay-on-Break: (ProgramaCube® Function MB)
(ON-delay/OFF-delay, Delay on Operate/Delay on Release, Sequencing ON & OFF, Fan Delay, Prepurge & Postpurge)
OPERATION: Input voltage must be applied at all times. The output (relay or solid state) is de-energized. Upon closure of the S1 initiate switch, the delay-on-make time delay (TD1) begins. At the end of TD1, the output (relay or solid state) energizes. Opening S1 starts the delay-on-break time delay (TD2). At the end of TD2, the output de-energizes.
RESET: Removing input voltage resets time delays and the output.If S1 is a) opened during TD1, then TD1 is reset and the output remains de-energized. b) reclosed during TD2, then TD2 is reset and the output remains energized.
See: HRPD, KRPD, KSPD, NHPD



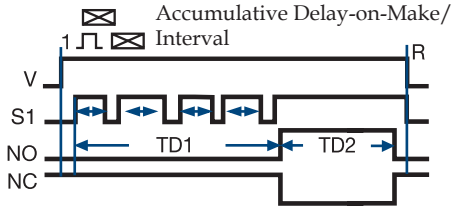
Extra Functions Included in Some Delay-on-Make/Delay-on-Break Timers:

Instantaneous Contacts:
Some DOM/DOB timers have a set of instantaneous contacts in addition to the delayed contacts. Instantaneous contacts energize when input voltage is applied and remain until voltage is removed.

Delay-on-Make/Interval: (ProgramaCube® Function MI)
(Single Pulse Generator, Delayed Interval, Delay on Operate/Single Pulse on Operate)
OPERATION: Upon application of input voltage, the delay-on-make time delay (TD1) begins, the output remains de-energized. At the end of this delay, the output (relay or solid state) energizes and the interval delay (TD2) begins. At the end of the interval delay (TD2), the output de-energizes.
RESET: Removing input voltage resets the output, the time delays and returns the sequence to the first delay.
See: ESD5, HRPD, KRPD, KSPD, NHPD, TRDU



Accumulative Delay-on-Make/Interval: (ProgramaCube® Function AMI)
OPERATION: Input voltage must be applied before and during timing. The output is de-energized before and during the TD1 time delay. Each time S1 closes, the time delay progresses; when it opens, timing stops. When the amount of time S1 is closed equals the full TD1 delay, the output (relay or solid state) energizes for TD2. Upon completion of TD2, the output relay de-energizes. Opening S1 during TD2 has no affect.
RESET: Removing input voltage resets the time delay, output relay, and the sequence to the first delay.
See: HRPD, KRPD, KSPD, NHPD



Legend

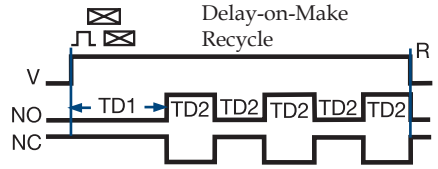
V = Voltage	TD1, TD2 = Time Delay
S1 = Initiate Switch	NO = Normally Open
R = Reset	NC = Normally Closed

≀≀ = Undefined Time

Timer Functions
Two Functions in One Timer

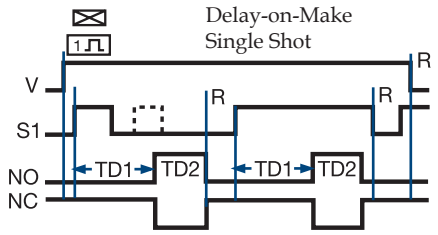
Delay-on-Make/Recycle: (ProgramaCube® Function MRE)

OPERATION: Upon application of input voltage, TD1 begins and the output (relay or solid state) remains de-energized. At the end of TD1, the TD2 recycle function begins and the output (relay or solid state) cycles ON and OFF for equal delays. This cycle continues until input voltage is removed.
RESET: Removing input voltage resets the output and time delays, and returns the sequence to the first delay.
See: KSPD, KRPD, NHPD, HRPD, TRDU



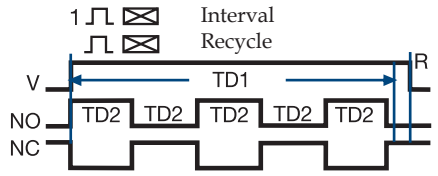
Delay-on-Make/Single Shot: (ProgramaCube® Function MS)

OPERATION: Upon application of input voltage and the closure of S1, TD1 begins and the output (relay or solid state) remains de-energized. The output (relay or solid state) energizes at the end of TD1, and TD2 begins. At the end of TD2, the output (relay or solid state) de-energizes. Opening or reclosing S1 during timing has no affect on the time delays.
RESET: Reset occurs when the time delay is complete and S1 is open. Removing input voltage resets the time delay, output, and the sequence to the first delay.
See: KSPD, KRPD, NHPD, HRPD, TRDU



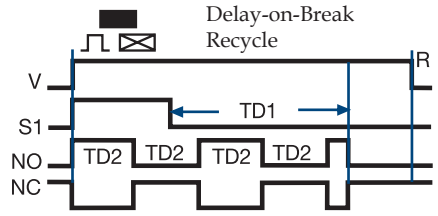
Interval/Recycle: (ProgramaCube® Function IRE)

OPERATION: Upon application of input voltage TD1 begins. At the same time, the TD2 ON time begins and the output (relay or solid state) energizes. At the end of the ON time, the TD2 OFF time begins and the output de-energizes. The equal ON time OFF time cycle continues until TD1 is completed at which time the output de-energizes.
RESET: Removing input voltage resets the time delays, output, and the sequence to the Interval function.
See: KSPD, KRPD, NHPD, HRPD, TRDU



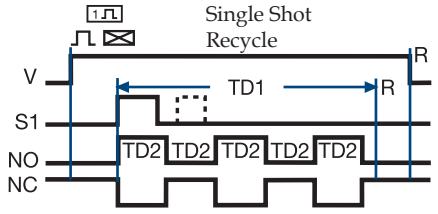
Delay-on-Break/Recycle: (ProgramaCube® Function BRE)

OPERATION: Upon application of input voltage and the closure of S1, the TD2 ON time begins and the output (relay or solid state) energizes. Upon completion of the ON time, the output de-energizes for the TD2 OFF time. At the end of the OFF time, the equal ON/OFF cycle repeats. When S1 opens, the TD1 delay begins. TD1 and TD2 run concurrently until the completion of TD1 at which time, the TD2 ON/OFF cycle terminates and the output de-energizes. The output energizes if S1 is closed when input voltage is applied.
RESET: Reclosing S1 during timing resets the TD1 time delay. Removing input voltage resets the time delay, output, and the sequence to the Delay-on-Break function.
See: KSPD, KRPD, NHPD, HRPD, TRDU



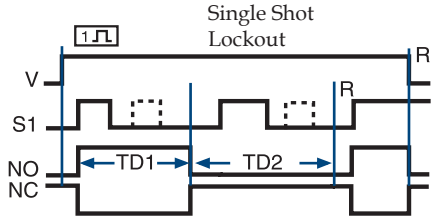
Single Shot/Recycle: (ProgramaCube® Function SRE)

OPERATION: Upon application of input voltage and the closure of S1, TD1 begins. At the same time, the TD2 ON time begins and the output (relay or solid state) energizes. Upon completion of the ON time, the output de-energizes for the TD2 OFF time. At the end of the OFF time, the equal ON/OFF cycle repeats. TD1 and TD2 run concurrently until the completion of TD1 at which time, the TD2 ON/OFF cycle terminates and the output de-energizes. Opening or reclosing S1 during timing has no affect on the time delays. The output will energize if S1 is closed when input voltage is applied.
RESET: Removing input voltage resets the time delay, output, and the sequence to the first delay.
See: HRPD, KRPD, KSPD, NHPD, TRDU



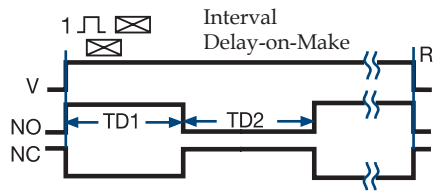
Single Shot/Lockout: (ProgramaCube® Function SL)

OPERATION: Upon application of input voltage and momentary or maintained closure of S1, the output (relay or solid state) energizes and TD1 single shot time delay begins. The output relay de-energizes at the end of TD1 and the TD2 lockout time delay begins. During TD2 (and TD1) closing switch S1 has no effect on the operation. After TD2 is complete, closing S1 starts another operation. If S1 is closed when input voltage is applied, the output energizes and the TD1 time delay begins.
RESET: Removing input voltage resets the time delays and the output and returns the cycle to the first delay.



Interval/Delay-on-Make: (ProgramaCube® Function IM)

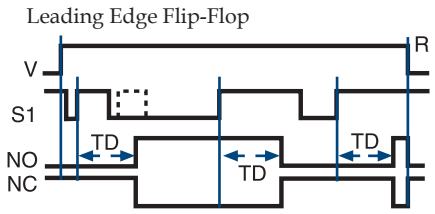
OPERATION: Upon application of input voltage, the output (relay or solid state) energizes and TD1 begins. At the end of TD1, the output de-energizes and TD2 begins. At the end of TD2, the output energizes.
RESET: Removing input voltage resets the time delays, output, and the sequence to the first delay.
See: HRPD, KRPD, KSPD, NHPD, TRDU



Timer Functions
Counting and Switching Functions

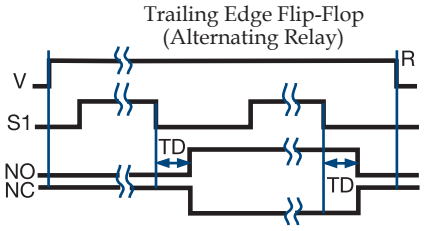
Leading edge flip-flop: (ProgramaCube® Function F)

OPERATION: Input voltage must be applied before and during operation. The operation begins with the output (relay or solid state) de-energized. Upon momentary or maintained closure (leading edge triggered) of the initiate switch S1, the time delay begins. At the end of the time delay, the output energizes and remains energized. Opening or re-closing S1 during timing has no affect. After the output transfers, the next closure of S1 starts a new operation. Each time an S1 closure is recognized, the time delay occurs and then the output transfers, ON to OFF, OFF to ON, ON to OFF. The first operation will occur if S1 is closed when input voltage is applied.
RESET: Removing input voltage resets the time delay and the output to the de-energized state.
Function can be applied to ProgramaCube Series: HRPS, KRPS, KSPS



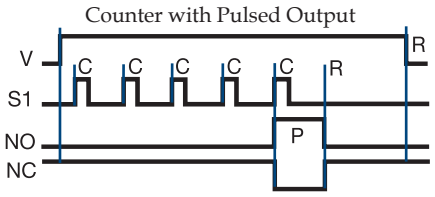
Alternating Relay (Trailing edge flip-flop): (ProgramaCube® Function FT)

OPERATION: Input voltage must be applied at all times for proper operation. The operation begins with the output (relay or solid state) de-energized. Closing S1 enables the next alternating operation. When S1 opens (trailing edge triggered), the time delay begins. At the end of the time delay, the output energizes and remains energized until S1 is (re-closed and) re-opened. Then the output relay de-energizes and remains until S1 opens again. Each time S1 opens the time delay occurs and the output transfers.
RESET: Removing input voltage resets the output and the time delay.
See: ARP, HRPS, KRPS



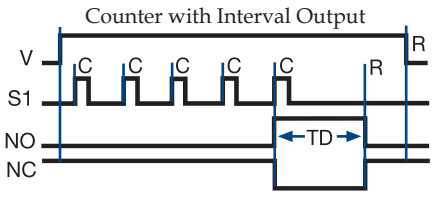
Counter with Pulsed Output: (ProgramaCube® Function C)

Function Limited to Switch Adjustable ProgramaCubes®
OPERATION: Input voltage must be applied before and during operation. Each time S1 is closed, a count is added. When the total number of S1 closures equals the total count selected on the unit, the output energizes. The output remains energized for the pulse duration specified for the product, and then de-energizes. If S1 is closed while the output is energized, a count is not added. If S1 is closed when input voltage is applied, a count is not added.
RESET: The unit automatically resets at the end of each operation. Removing input voltage resets the output, counter, and pulse delay.
See: HRPU, KSPU, NHPU



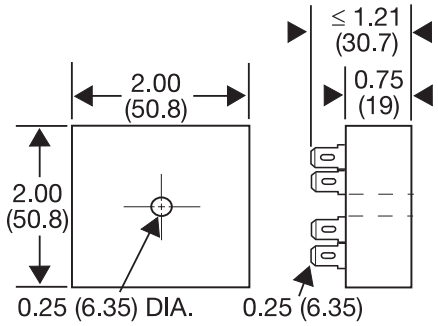
Counter with Interval Output: (ProgramaCube® Function CI)

Function Limited to Switch Adjustable ProgramaCubes®
OPERATION: Input voltage must be applied before and during operation. Each time S1 is closed, a count is added. When the total number of S1 closures equals the total count selected on the unit, the output energizes and the interval time delay begins. The output de-energizes at the end of the time delay. If S1 is closed during the time delay, a count is not added. If S1 is closed when input voltage is applied, a count is not added.
RESET: The counter is reset during the time delay, the unit automatically resets at the end of the interval time delay. Removing input voltage resets the output, counter, and time delay.
See: HRPU, HRV, HSPZ, KSPU, NHPU



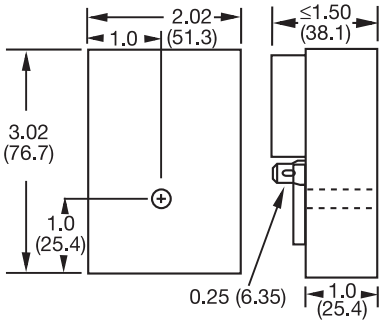
Legend
V = Voltage
R = Reset
S1 = Initiate Switch
Td, TD1, TD2 = Time Delay
NO = Normally Open Contact
NC = Normally Closed Contact
C = Count
P = Pulse Duration
⫽ = Undefined Time

FIGURE 1



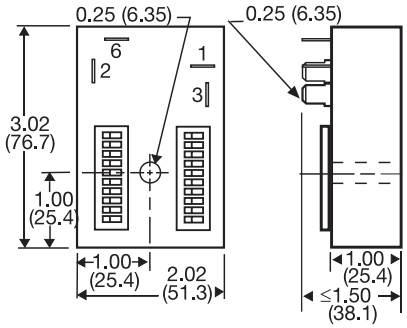
CT; ESD5; ESDR; FS100; FS200; FS300; KRD3; KRD9; KRDB; KRDI; KRDM; KRDR; KRDS; KRPD; KRPS; KSD1; KSD2; KSD3; KSD4; KSDB; KSDR; KSDS; KSDU; KSPD; KSPS; KSPU; KVM; T2D; TA; TAC1; TAC4; TDU; TDUB; TDUI; TDUS; TL; TMV8000; TS1; TS2; TS4; TS6; TSB; TSD1; TSD2; TSD3; TSD4; TSD6; TSD7; TSDB; TSDR; TSDS; TSS; TSU2000

FIGURE 2



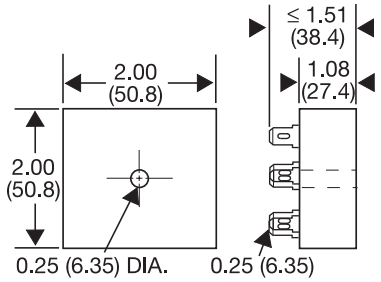
HLV; HRD3; HRD9; HRDB; HRDI; HRDM; HRDR; HRDS; HRID; HRIS; HRIU; HRPD; HRPS; HRPU; HRV; RS

FIGURE 3



HSPZ

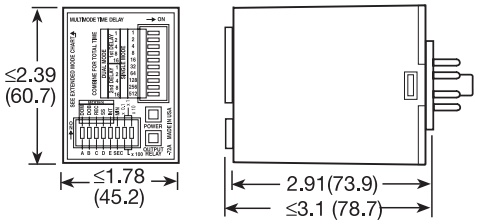
FIGURE 4



FA; FS; FSU1000*; NHPD; NHPS; NHPU; NLF1*; NLF2*; PHS*; PTHF*; SIR1; SIR2; SLR1*; SLR2*; TH1; TH2; THC; THD1; THD2; THD3; THD4; THD7; THDB; THDM; THDS; THS

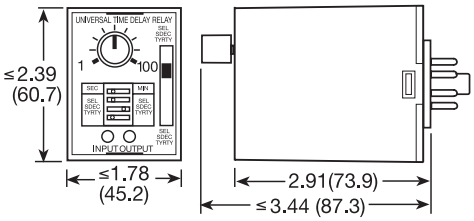
*If unit is rated @ 1A, see Figure 1

FIGURE 5



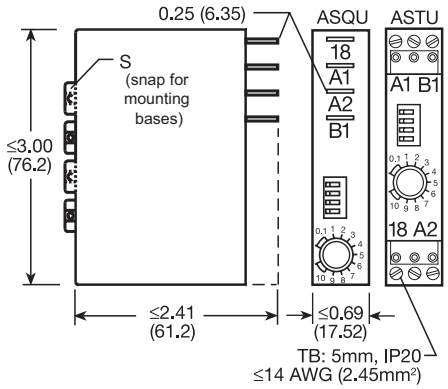
TRDU

FIGURE 6



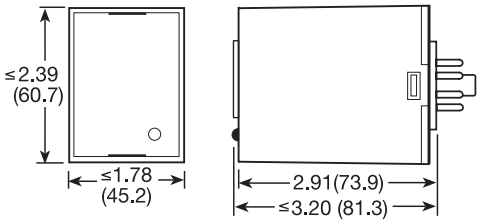
TRU

FIGURE 7



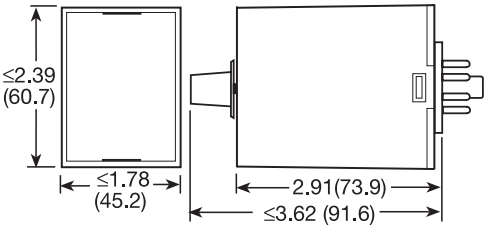
ASQU; ASTU; DSQU; DSTU

FIGURE 8



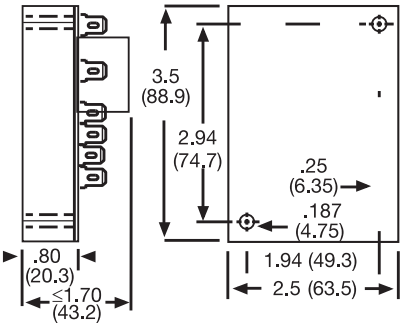
PLM; PLR; TDB; TDBH; TDBL; TDI; TDIH; TDIL; TDM; TDMB; TDMH; TDML; TDR; TDS; TDSH; TDSL

FIGURE 9



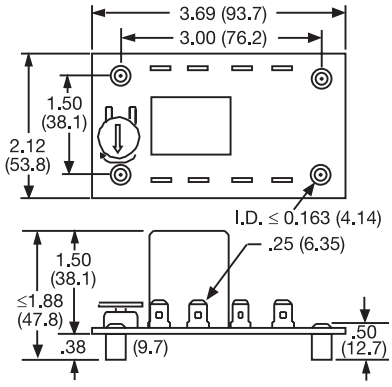
FS500; PRLB; PRLM; PRLS; TRB; TRM; TRS

FIGURE 10



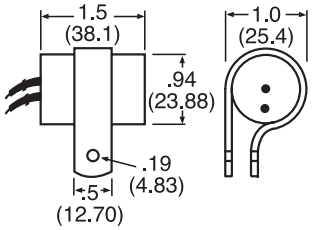
ERD3; ERDI; ERDM

FIGURE 11



ORB; ORM; ORS

FIGURE 12



FS100; FS400

inches (millimeters)

Taylor®

Wiring Duct and Accessories

Narrow Slot Flush Profile Duct – Vinyl

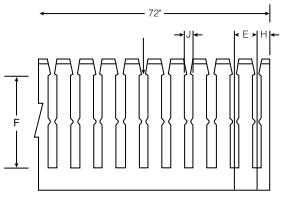
Cat. No.	Cover Cat. No.	Nom. Size		Dimensions-Inches								
Vinyl Duct	Cover	W	H	A	B	C	D	E	F	G	H	J
T.5 X .5HD+	T.5C+	.50	.50	.68	.72	.79	.78	.39	.28	on ctr.	.20	.15
T.5 X 1HD+		.50	1.00	.68	1.10	.79	1.16	.39	.48	on ctr.	.20	.15
T.75 X .75HD+	T.75C+	.75	.75	.79	.71	.79	.77	.39	.375	on ctr.	.20	.15
T.75 X 1.5HD+		.75	1.50	.79	1.49	.79	1.55	.39	1.03	on ctr.	.20	.15
T1 X 1 HD+	T1C+	1.00	1.00	.98	1.13	.98	1.19	.39	.70	on ctr.	.20	.15
T1 X 1.5HD+		1.00	1.50	.98	1.52	.98	1.58	.39	1.07	on ctr.	.20	.15
T1 X 2HD+		1.00	2.00	.98	2.25	.98	2.31	.39	1.25	on ctr.	.20	.15
T1 X 3HD+		1.00	3.00	.98	3.05	.98	3.11	.39	2.50	on ctr.	.20	.15
T1 X 4HD+		1.00	4.00	.98	3.85	.98	3.91	.39	3.26	on ctr.	.20	.15
T1.5 X 1HD+	T1.5C+	1.50	1.00	1.57	1.13	1.57	1.19	.39	.70	on ctr.	.20	.15
T1.5 X 1.5HD+		1.50	1.50	1.57	1.52	1.57	1.58	.39	1.07	on ctr.	.20	.15
T1.5 X 2HD+		1.50	2.00	1.57	2.25	1.57	2.31	.39	1.25	on ctr.	.20	.15
T1.5 X 3HD+		1.50	3.00	1.57	3.05	1.57	3.11	.39	2.50	on ctr.	.20	.15
T1.5 X 4HD+		1.50	4.00	1.57	3.85	1.57	3.91	.39	3.26	on ctr.	.20	.15
T2 X 1HD+	T2C+	2.00	1.00	1.97	1.13	1.97	1.19	.39	.70	.50	.20	.15
T2 X 1.5HD+		2.00	1.50	1.97	1.52	1.97	1.98	.39	1.07	.50	.20	.15
T2 X 2HD+		2.00	2.00	1.97	2.25	1.97	2.31	.39	1.25	.50	.20	.15
T2 X 3HD+		2.00	3.00	1.97	3.05	1.97	3.11	.39	2.50	.50	.20	.15
T2 X 4HD+		2.00	4.00	1.97	3.85	1.97	3.91	.39	3.26	.50	.20	.15
T2 X 5HD+		2.00	5.00	1.97	5.04	1.97	5.10	.39	4.38	.50	.20	.15
T2.25 X 1.5HD+	T2.25C+	2.25	1.50	2.36	1.52	2.36	1.58	.39	1.07	.50	.20	.15
T2.25 X 2HD+		2.25	2.00	2.36	2.25	2.36	2.31	.39	1.25	.50	.20	.15
T2.25 X 3HD+		2.25	3.00	2.36	3.05	2.36	3.11	.39	2.50	.50	.20	.15
T2.25 X 4HD+		2.25	4.00	2.36	3.85	2.36	3.91	.39	3.26	.50	.20	.15
T3 X 1HD+	T3C+	3.00	1.00	2.95	1.13	2.95	1.19	.39	.70	1.00	.20	.15
T3 X 2HD+		3.00	2.00	2.95	2.25	2.95	2.31	.39	1.25	1.00	.20	.15
T3 X 3HD+		3.00	3.00	2.95	3.05	2.95	3.11	.39	2.50	1.00	.20	.15
T3 X 4HD+		3.00	4.00	2.95	3.85	2.95	3.91	.39	3.26	1.00	.20	.15
T3 X 5HD+		3.00	5.00	2.95	5.04	2.95	5.10	.39	4.38	1.00	.20	.15
T3.15 X 2HD+	T3.15C+	3.15	2.00	3.15	2.25	3.15	2.31	.39	1.25	1.00	.20	.15
T3.15 X 3HD+		3.15	3.00	3.15	3.05	3.15	3.11	.39	2.50	1.00	.20	.15
T3.15 X 4HD+		3.15	4.00	3.15	3.85	3.15	3.91	.39	3.26	1.00	.20	.15
T4 X 2HD+	T4C+	4.00	2.00	3.94	2.25	3.94	2.31	.39	1.25	1.50	.20	.15
T4 X 3HD+		4.00	3.00	3.94	3.05	3.94	3.11	.39	2.50	1.50	.20	.15
T4 X 4HD+		4.00	4.00	3.94	3.85	3.94	3.91	.39	3.26	1.50	.20	.15
T4 X 5HD+		4.00	5.00	3.94	5.04	3.94	5.10	.39	4.38	1.50	.20	.15
T6 X 4HD+	T6C+	6.00	4.00	5.91	3.85	5.91	3.91	.39	3.26	2.50	.20	.15

• Standard lengths are 6 feet

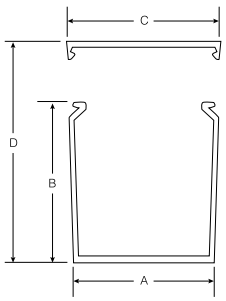
+ Catalog Number must be completed by adding suffix G for Gray, W for White, B for Blue, BK for Black. Example: T2 x 2HD is a 2" x 2" gray duct.
To order duct without mounting holes, add suffix –NM to catalog number. Example: T2 x 2TG-NM is a 2" x 2" gray duct with no mounting holes.

To order Adhesive-backed Duct, add suffix -A to Catalog Number. Example: T2x2HDG-A is a 2" x 2" gray duct with adhesive backing. Shelf life for adhesive is 1 year.

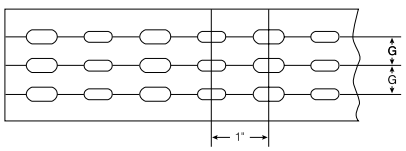
Note: Noryl® duct is available in oyster white only.
Noryl® is a registered trademark of General Electric Co.
Vinyl duct is UL Recognized ,
CSA Certified and meets the JIC requirements.



Typical Side View



Overall Height Cover Installed



Bottom Mounting Holes, ½ x 3/16

Q

Tayor®

Thomas&Betts

 www.tnb.com

Tsubaki Overload Protection Devices

TGM series

Maintenance free and
dust prevention type

TGX series

High precision and
high rigidity type

TGZ series

High speed and
ON-OFF clutch capability

Axial overload
protection type

TSBSD series

Digital multi function

Tsubaki has developed various series of Overload Protection Devices to meet any industrial demands. Expect for the series mentioned in these brochures you may need additional technical solutions to comply with your specific application. Please do not hesitate to contact us for advice or further documentation.

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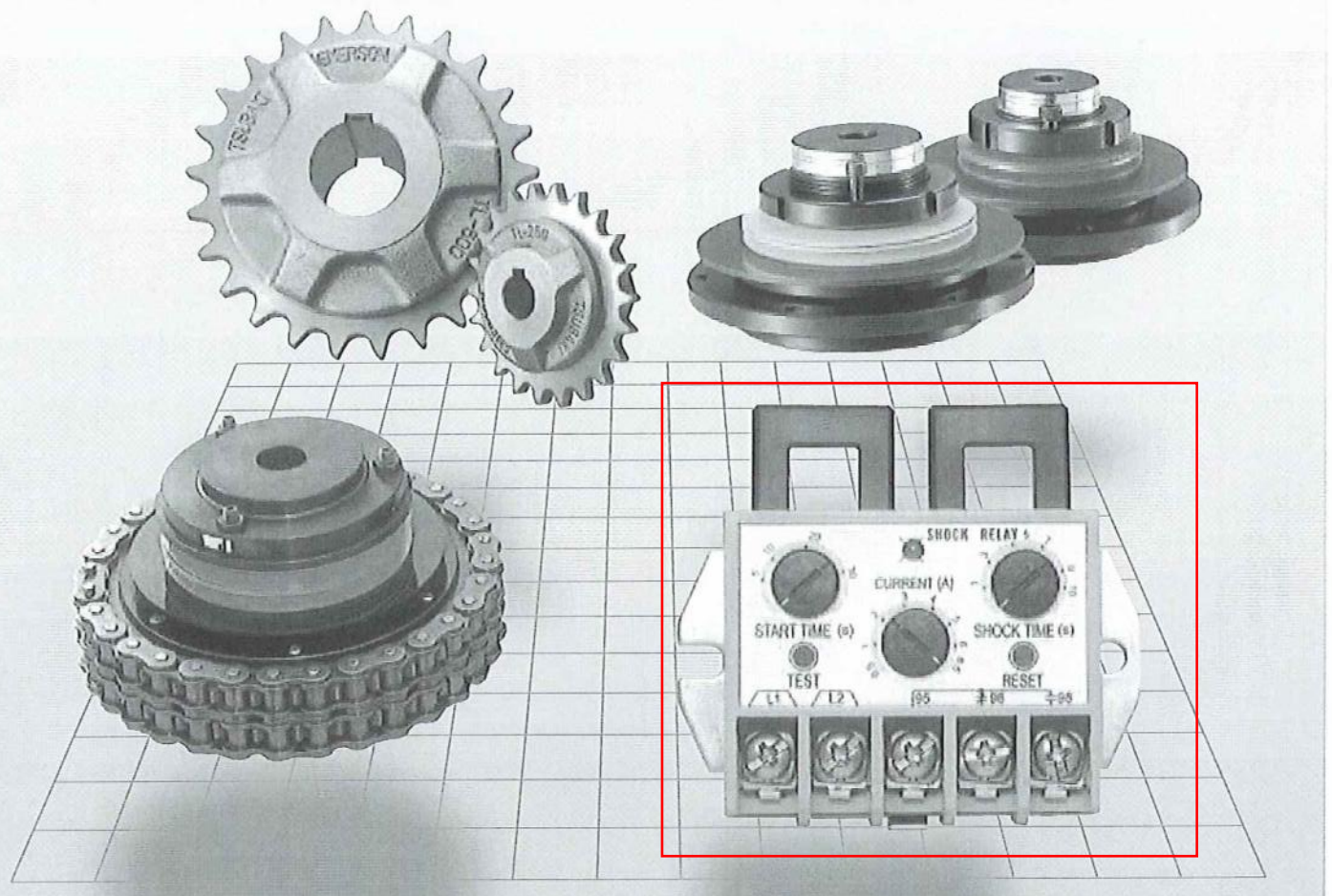
Production Protection

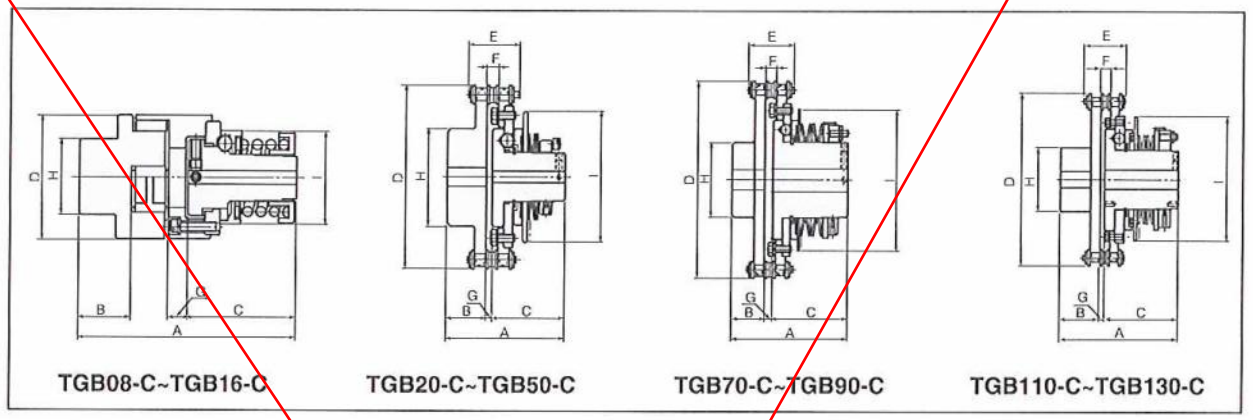


TSUBAKI EMERSON

OVERLOAD PROTECTION DEVICE

SHOCK RELAY™
TORQ GARD
TORQUE LIMITER

Tsubaki Emerson Torq Gard



Dimensions of Torq Gard Coupling

Dimensions in mm

Model	A	B	C	D	E	F	G	H	I	Coupling type and Sprocket size	Mass (kg)	Moment of Inertia ($\times10^{-2}$kg·m²)	GD² ($\times10^{-2}$kgf·m²)
TGB 08-C	80	20.6	39	44.5	—	—	7.2	24	13.2	L075A	0.235	0.005	0.02
TGB 12-C	88	19.9	47	53.6	—	—	7.9	32	13.2	L090A	0.380	0.0123	0.049
TGB 16-C	112	27	56	64.3	—	—	10.2	38	18.8	L100A	0.673	0.0324	0.129
TGB 20-C	76	25	47	117.4	32.6	7.4	4	63	—	RS 40-26	2.5	0.313	1.25
TGB 30-C	93	28	60	146.7	40.5	9.7	5	75	—	RS 50-26	4.8	0.948	3.79
TGB 50-C	126	40	81	200.3	51.0	11.6	5	83	—	RS 60-30	12.2	4.43	17.7
TGB 70-C	165	45	110	283.2	64.8	15.3	10	107	—	RS 80-32	32.0	22.43	89.7
TGB 90-C	242	80	157	394.4	78.5	18.2	5	147	—	RS100-36	71.1	117.32	469.29
TGB110-C	303	100	195	473.4	99.2	21.9	8	157	—	RS120-36	130.5	314.15	1255.61
TGB130-C	365	120	230	534.2	127.3	29.1	15	197	—	RS160-30	202.3	632.66	2530.63

Minimum number of teeth for the Center member of Torque Limiter and fixing to the Center flange of Torq Gard.

Minimum Number of Teeth of Sprocket and Bushing Length for Torque Limiter

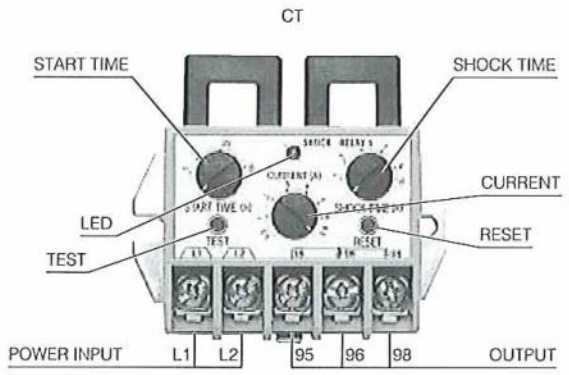
Model	Bore of Center Member (mm)	Sprocket Pitch and Number of Teeth																	
		3/8"- #35		1/2"- #40		5/8"- #50		3/4"- #60		1"- #80		1¼"- #100		1½"- #120		1¾"- #140		2"- #160	
		Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)	Minimum No. of Teeth	Bushing Length (mm)
TL200	30 $^{+0.03}_{0}$	20	3.8	16	6														
TL250	41 $^{+0.05}_{0}$			20	4.5	17	6.5												
TL350	49 $^{+0.05}_{0}$			26	4.5	21	6.5	18	9.5	15	9.5								
TL500	74 $^{+0.05}_{0}$					29	6.5	25	9.5	19	9.5								
TL700	105 $^{+0.05}_{0}$							33	9.5	26	9.5	21	12.5	18	12.5				
TL 10	135 $^{+0.07}_{0}$											29	12.5	24	15.5	22	19.5		
TL 14	183 $^{+0.07}_{0}$											39	15.5	33	15.5	29	19.5	26	23.5
TL 20	226 $^{+0.07}_{0}$											54	15.5	46	15.5	40	19.5	35	23.5

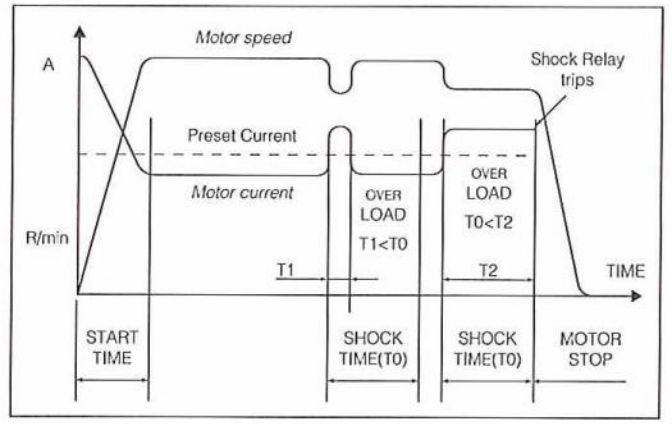
Minimum Number of Teeth of Sprocket for Torq Gard

Model	1/4"- #25	3/8"- #35	1/2"- #40	5/8"- #50	3/4"- #60	1"- #80	1¼"- #100	1½"- #120	1¾"- #140	2"- #160
TGB 08	24	17								
TGB 12	28	20								
TGB 16	32	23								
TGB 20	48	34	26	22						
TGB 30	60	41	32	26	22	18				
TGB 50		57	43	35	30	24	20	17		
TGB 70			58	47	40	31	26	22		
TGB 90				62	52	40	33	28	25	22
TGB110						48	39	33	29	26
TGB130						53	43	37	32	24

Tsubaki Emerson Shock Relay

Tsubaki Emerson Shock Relay is an extremely reliable electronic device for the protection of machinery from dangerous overloads. While conventional safety devices such as shear pins and thermal relays, the Tsubaki Emerson Shock Relay provides complete protection with accuracy and dependability.



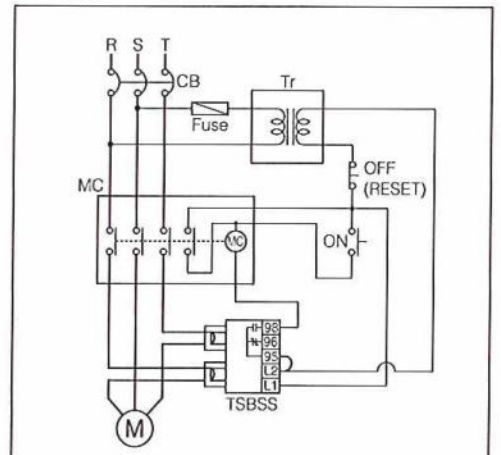


Specifications of Shock Relay

Function \ Model		TSBSS05	TSBSS30	TSBSS60
Motor kW	At 200VAC	0.1~0.75 *1	1.5~5.5	7.5~11
	At 400VAC	0.2~2.2 *1	3.7~11	15~22
Start time		0.2~30s		
Shock time		0.2~10s		
Load current		0.5~5A	3~30A	5~60A
Output relay	Contact rating	A transfer contact 250VAC 3A, Resistive load		
	Minimum allowable load	DC10V, 10mA		
	Status	Normally Energized (self-holding)		
CT Built-in		Yes		
UL Approved		Yes		
cUL		Yes		
CE Conformity		Yes *2		
For DIN rail 35mm		Yes		
Indicator for operation		Yes		
Test function		Yes		
Control voltage		90 to 250VAC 50/60Hz		
Temperature range		–20~+60°C (At Operating)		

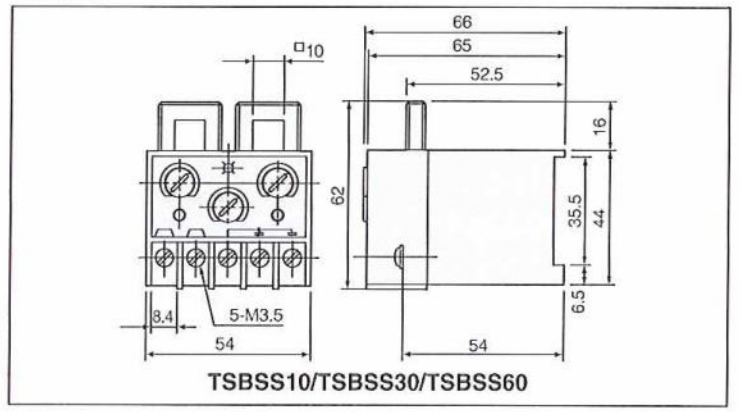
*1 Make sure normal operating current is over 0.5A.
*2 This apparatus shall not be used in the residential, commercial and light-industrial environment.

Wiring



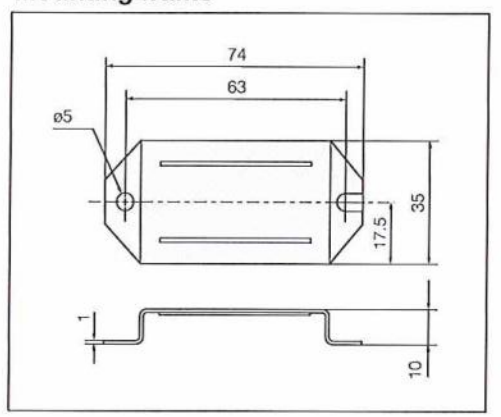
MC : Magnetic contactor ON : Start switch
OFF : Stop switch Fuse : Fuse Tr : Transformer
*1. A transformer may be required, depending on the voltage of motor (ie. over 250VAC).
*2. Output relay is normally energized. When Shock Relay works, it is OFF.
*3. Two of three phase of the motor are passed through the Shock Relay's CT in the same direction.

Outline



TSBSS10/TSBSS30/TSBSS60

Mounting frame

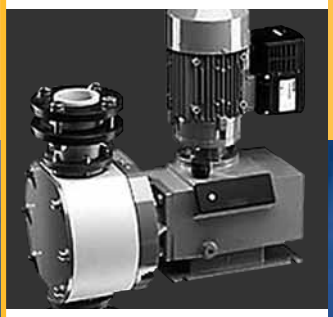


Shock Relays

one more way Tsubaki saves you money

TSUBAKI

Driving your business.



Shock Relays

one more way Tsubaki saves you money

TSUBAKI
Driving your business.

At Tsubaki, our commitment is to bring you the highest value in the industry today. Period. And as a full line supplier of power transmission products this commitment extends to our complete line of Shock Relay products as well.

Protect your equipment and investment with Tsubaki shock relays and external current transformers. Unexpected shock loads can damage chains, drives, gears, turbines – the entire mechanical assembly. That means high maintenance, costly repairs, and expensive downtime.

Simply put, when the shock relay detects a problem, it shuts down the line – quickly, safely and securely. That means big savings in both time and money.

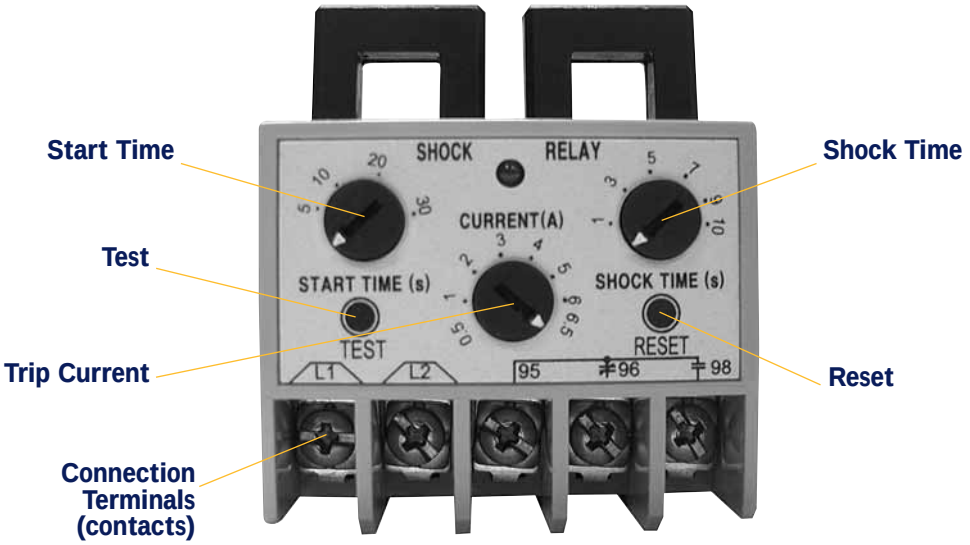
After the problem is corrected, the shock relay is reset at the touch of a button. No tear down is required. That means improved efficiency and reduced downtime.

And it's all part of the Tsubaki Advantage: reliable premium products that don't just perform, they outperform the competition. All the while saving you money.

For more information call us at 800-263-7088.

TSBSS05
TSBSS30
TSBSS60

ULC Listed



Explanation of Terms

Start Time
During startup, the current draw of a motor is greater than the running current. In order to prevent the shock relay from engaging during startup, the start time of the shock relay is adjustable from 0.2 seconds to 30 seconds. The shock relay will only trip when the current draw of the motor exceeds the trip current and when the start time is reached.

Test
The test button simulates a current overload.

Trip Current
The trip current level is user adjustable and varies according to the shock relay model selected - see specification chart on the following page for complete details. When the actual current level exceeds the preset current (outside of the shock time range), the shock relay will trip.

Shock Time
The shock time feature allows the current overload time to be set. The shock time is adjustable from 0.2 seconds to 10 seconds. The shock relay will only trip when the current draw of the motor exceeds the trip current and when the shock time is exceeded.

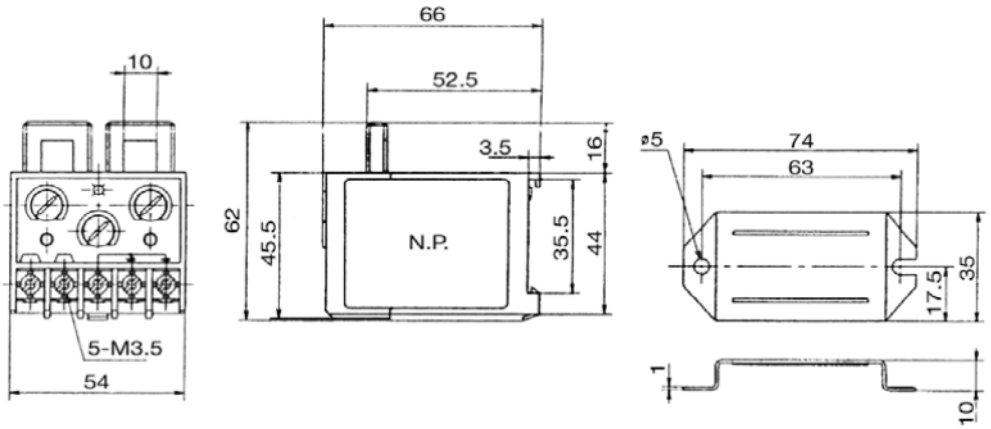
Reset
The reset button will reset the shock relay after a current overload.

Connection Terminals (contacts)
There are 5 connection terminals:
L1 & L2: These terminals are used to provide power (from 90VAC to 240VAC) to the shock relay.
95, 96 & 98: These terminals provide output from the shock relay.
The application - such as a motor - can be wired into these terminals.
When the shock relay trips, the circuit opens and the application stops.

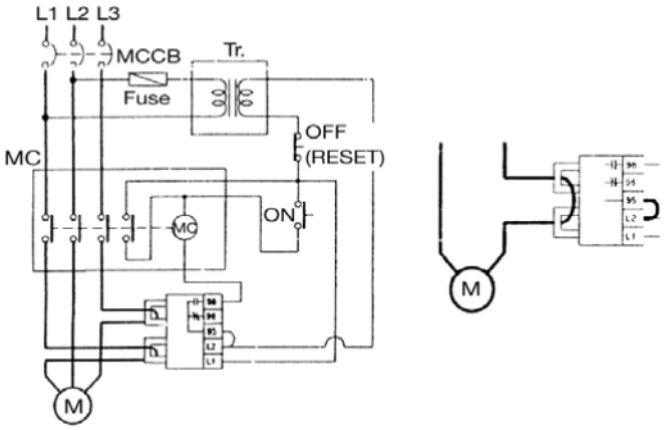
"SS" Series Shock Relays Specifications

SPECIFICATIONS / MODEL	TSBSS05	TSBSS30	TSBSS60
Built-in or External Current Transformer	Built-in	Built-in	Built-in
Motor Horsepower at 200 VAC	0.08hp ~ 1.5hp	2hp ~ 7.5hp	10hp ~15hp
Motor Horsepower at 400 VAC	0.27hp ~ 3hp	5hp ~ 15hp	20hp ~ 30hp
Load Current Setting Range	0.5A ~ 5A	3A ~ 30A	5A ~ 60A
Trip Output Relay - contact rating	3A load	3A load	3A load
Trip Output Relay - status	Normally Loaded	Normally Loaded	Normally Loaded
Start Time Setting Range	0.2 ~ 30 sec.	0.2 ~ 30 sec.	0.2 ~ 30 sec.
Shock Time Setting Range	0.2 ~ 10 sec.	0.2 ~ 10 sec.	0.2 ~ 10 sec.
Input Voltage	90VAC to 240VAC 60HZ	90VAC to 240VAC 60HZ	90VAC to 240VAC 60HZ
Test Function Built-in	Yes	Yes	Yes
Mounting available for 35mm DIN rail or panel	Yes	Yes	Yes
Operating Temperature Range	-4°F ~ 158°F	-4°F ~ 158°F	-4°F ~ 158°F
CUL Approval	Yes	Yes	Yes

"SS" Series Shock Relays Dimensions (mm)



"SS" Series Shock Relays Typical Wiring Diagram



CB:	Circuit Breaker	**Off:**	Stop Switch
MC:	Magnetic Contactor	**M:**	Motor
On:	Start Switch	**Tr:**	Transformer

TSBSS100
TSBSS200
TSBSS300

The external current transformer is wired together with the "SS" series shock relay to provide overload protection for applications using larger motors – typically over 100A. See specification chart below for more details.

"SS" Series Shock Relays & Included External Current Transformer Specifications

SPECIFICATIONS / MODEL	TSBSS100	TSBSS200	TSBSS300
Shock Relay Model	TSBSS05	TSBSS05	TSBSS05
External Current Transformer Model	TSB2CT100	TSB2CT200	TSB2CT300
Motor Horsepower at 230 VAC	20hp ~ 25hp	30hp ~ 50hp	60hp ~100hp
Motor Horsepower at 460 VAC	40hp ~ 60hp	75hp ~120hp	150hp ~175hp
Load Current Setting Range	10A ~ 100A	20A ~ 200A	30A ~ 300A
Trip Output Relay - contact rating	3A load	3A load	3A load
Trip Output Relay - status	Normally Loaded	Normally Loaded	Normally Loaded
Start Time Setting Range	0.2 ~ 30 sec.	0.2 ~ 30 sec.	0.2 ~ 30 sec.
Shock Time Setting Range	0.2 ~ 10 sec.	0.2 ~ 10 sec.	0.2 ~ 10 sec.
Input Voltage	90VAC to 240VAC 60HZ	90VAC to 240VAC 60HZ	90VAC to 240VAC 60HZ
Test Function Built-in	Yes	Yes	Yes
Mounting available for 35mm DIN rail or panel	No	No	No
Operating Temperature Range	-4°F ~ 158°F	-4°F ~ 158°F	-4°F ~ 158°F

TSUBAKI

TSBSD10
TSBSD60

Test

Digital Display

Trip Current

Start Time

Reset

Alarm Current

Shock Time

Connection Terminals (contacts)

DIP Switches (top to bottom):

1. **No Voltage Release**
2. **Phase Loss Protection**
3. **Reset**
4. **Alarm Relay's Movement**

Explanation of Terms

Digital Display
The digital display indicates the actual current, trip level, time and the trip code.

Test
The test button simulates a current overload.

Reset
The reset button will be used to reset the shock relay after a current overload.

Trip Current
The trip current level can be set by the operator. When the actual current level exceeds the preset current (outside of the shock time range), the shock relay will trip.

Start Time
During startup, the current draw of a motor is greater than the running current. In order to prevent the shock relay from engaging during startup, the start time of the shock relay is adjustable from 0.3 seconds to 12 seconds. The shock relay will only trip when the current draw of the motor exceeds the preset current and when the start time is met.

Shock Time
This feature allows the shock relay to ignore normal machine fluctuations, yet react when a true problem develops. The shock time is adjustable from 0.3 seconds to 3 seconds. The shock relay will only trip when the current draw of the motor exceeds the trip current and when the shock time is met.

Alarm Current
An alarm can be connected to the terminals on the front panel of the shock relay. The alarm current can be set to between 50% and 100% of the trip current level. This allows for a pre-alarm warning when the current draw is approaching the preset current level.
If an alarm is not being used, the alarm current setting can be set to the "off" position.

DIP Switches
The shock relay has 4 DIP Switches that toggle between two settings and that allow the shock relay to be configured for a particular application.

The DIP switches are:

1: "No Voltage Release" (on/off) This switch changes the status of contacts 95-96 and 97-98. For example, in left-hand position contacts 95-96 are normally closed; and in the right-hand position, contacts 95-96 are normally open. This adds flexibility to aid installation.

2: "Phase Loss Protection" (on/off) When set to the "on" mode (right hand position), the connected motor will shut down if one of the three phases of the motor drops out. The motor will also shut down if there is a phase imbalance. The "off" mode (left hand position) disables this feature.

3: "Reset" (manual/automatic) When set to the "manual" mode, if the shock relay trips due to current overload or phase failure, the shock relay must be reset manually by pushing the "reset" button. In the "automatic" mode, the shock relay automatically resets one second after the current overload causes it to trip. Also in the "automatic" mode, the shock relay must be manually reset after phase failure causes it to trip.

4: "Alarm Relay's Movement" (flicker/continuous) This feature works with the alarm current setting. In the left-hand position, "flicker" mode, when the alarm current setting is met, the alarm will activate by blinking/flickering one time per second. Essentially this is a "pre-alarm" to indicate the potential for a problem. In this mode, the motor will continue to operate. When the problem is corrected and when the current drops to normal, the alarm will stop. If the situation is not corrected and the shock relay trips, (shutting down the application) the alarm will stay on, but now blinks/flickers at a rate of two-times per second. In the right-hand position, "continuous" mode, the alarm will be activated when the motor current is between the pre-alarm set point and the overload trip point. If the current drops below the setting or if the shock relay trips, the alarm will turn off.

Explanation of Terms (Continued)

Connection Terminals (contacts)
There are 4 sets (pairs) of connection terminals.

A1 & A2
These terminals are used to provide power to the unit.

95 & 96
These terminals are for the trip output relay and are “normally closed”. The application - such as a motor - could be wired into these terminals. When the shock relay trips, the circuit opens and the application stops.

97 & 98
The circuit connected to these terminals is “normally open”. A warning device such as an alarm or light could be wired into these terminals. When the shock relay trips, the circuit closes and then the alarm is activated.

07 & 08
These terminals are used to connect an alarm. This circuit is “normally open”. When the alarm set point is reached, the circuit closes and then the alarm is activated. This could be considered a pre-alarm to indicate the potential for a problem should the current increase further.

“SD” Series Digital Display Shock Relays Specifications

SPECIFICATIONS / MODEL	TSBSD10	TSBSD60
Built-in or External Current Transformer	Built-in	Built-in
Motor Horsepower at 230 VAC	0.1hp ~ 3hp	5hp ~15hp
Motor Horsepower at 460 VAC	0.2hp ~ 5hp	7hp ~ 30hp
Load Current Setting Range	0.5A ~ 10A	5A ~ 60A
Trip Output Relay - contact rating	3A load	3A load
Trip Output Relay - status	DIP switch #1 can be set to "normally closed" or "normally open"	
Alarm Output Relay - setting level	50% - 100% of load current setting	50% - 100% of load current setting
Alarm Output Relay - contact rating	3A load	3A load
Alarm Output Relay - status	Loaded 3 seconds after exceeding preset alarm current level	
Open phase, reverse phase, phase unbalance	DIP switch #2 can be set to enable or disable phase failure protection.	
Start Time Setting Range	0.2 sec. ~ 12 sec.	0.2 sec. ~ 12 sec.
Shock Time Setting Range	0.3 sec ~ 3 sec.	0.3 sec ~ 3 sec.
Input Voltage	85VAC ~ 250VAC, 50/60Hz, 85V DC ~ 250V DC	
Test Function Built-in	Yes	Yes
Mounting available for 35mm DIN rail or panel	Yes	Yes
Operating Temperature Range	14°F ~ 122°F	14°F ~ 122°F

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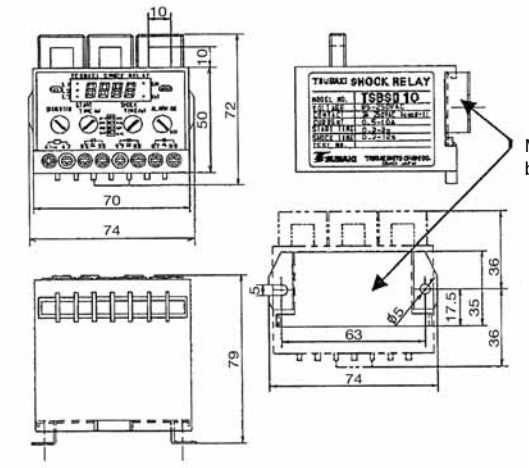
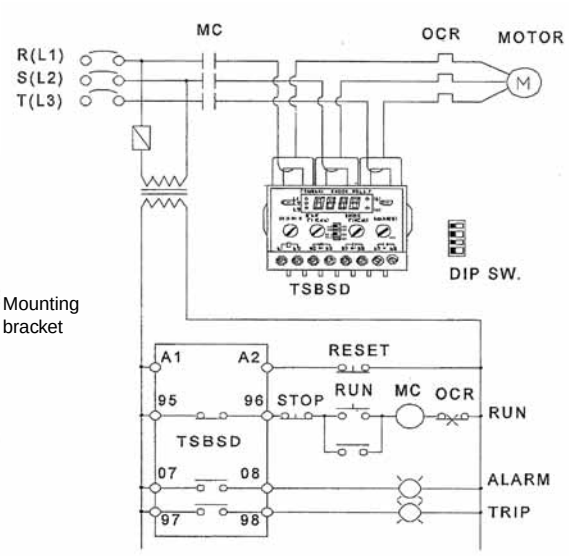
“SD” Digital Shock Relay Dimensions (mm) & Typical Wiring Diagram

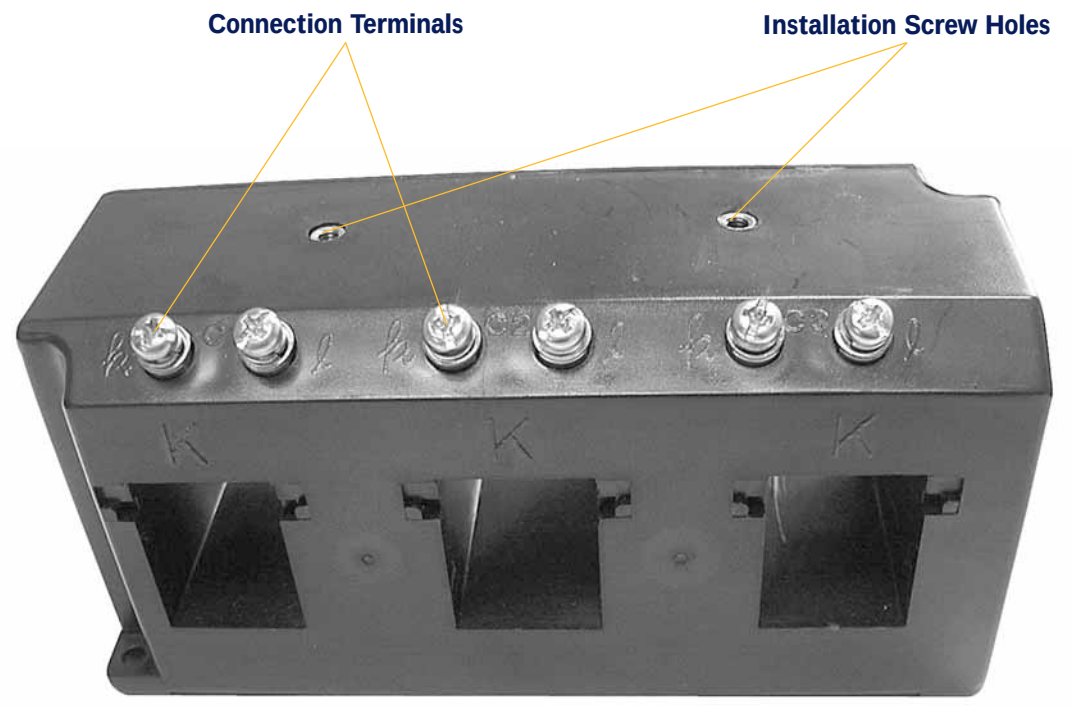




OCR: Open Circuit Reset
MC: Magnetic Contactor

“SD” Series External Current Transformer

TSB3CT100
TSB3CT200
TSB3CT300



Explanation of Terms

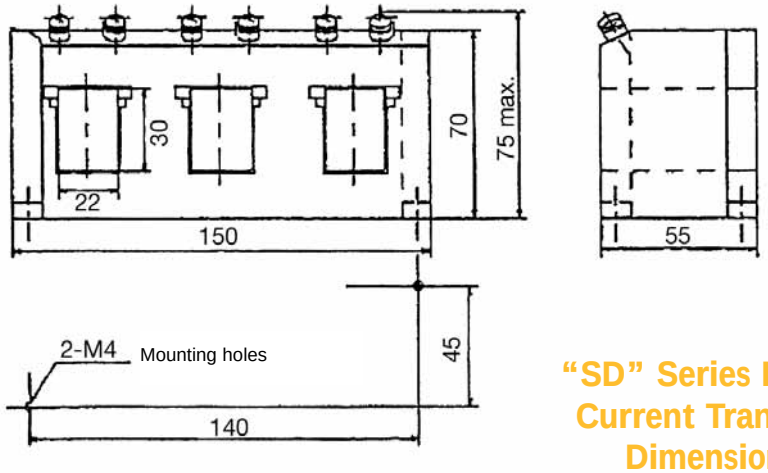
Installation Screw Holes
The digital shock relay is installed by threading the screws into the screw holes on the external current transformer.

Connection Terminals
Using the wires included with the external current transformer, loop the wires through the holes on the top of the digital shock relay and attach to the corresponding connection terminals.

“SD” Series External Current Transformer Specifications

Specifications for the External Current Transformer only

SPECIFICATIONS / MODEL	TSB3CT100	TSB3CT200	TSB3CT300
Built-in or External Current Transformer	External	External	External
Motor Horsepower at 230 VAC	20hp ~ 25hp	30hp ~ 50hp	60hp ~ 100hp
Motor Horsepower at 460 VAC	40hp ~ 60hp	70hp ~ 120hp	150hp ~ 175hp
Load Current Setting Range	5A ~ 100A	10A ~ 200A	15A ~ 300A
Mounting available for 35mm DIN rail or panel	No	No	No
Operating Temperature Range	14°F ~ 122°F	14°F ~ 122°F	14°F ~ 122°F



“SD” Series External Current Transformer Dimensions (mm)

Digital Display Shock Relay & External Current Transformer

Installation Example

TSBSD10 Digital Shock Relay & TSB3CT100 External Current Transformer

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SPIRAC ENGINEERING PTY LTD ACN 009 415 169 P.O. Box 1216, BIBRA LAKE, 6163 AUSTRALIA Ph (08) 9434 2127 Fax (08) 9434 2128	**FACTORY TEST REPORT** **CONVEYOR**	PROJECT Number:		CONVEYOR Number:	
		PROJECT Name:			
SPIRAC (USA) INC 75 Jackson Street, Suite 300 Newnan, Georgia 30263 USA Ph (770) 632-9833 Fax (770) 632-9838		FACTORY Name:			
		ISSUED BY (SPIRAC Proj Mgr):			

ITEM	OPERATION	ACCEPTANCE CRITERIA	ACTIVITY TYPE				REMARKS
			DATE	SHOP	DATE	CLIENT	
1	**MATERIAL TYPES** ARE CORRECT, IN GOOD CONDITION AND IN ACCORDANCE WITH DRAWING(S) AND WORK INSTRUCTIONS.	APPROVED DRAWING					
2	**WELD AND SURFACE QUALITY**, FINISH AND UNIFORMITY.	UCONWELD.dwg REV C					
3	**CRITICAL DIMENSIONS** HAVE BEEN CHECKED - OVERALL CONVEYOR LENGTHS, LOCATIONS OF INLET(S)/OUTLET(S), SUPPORT SET LENGTH(S), BRACKET LOCATIONS.	APPROVED DRAWING					
4	**LINERS** IN PLACE AND JOINTS FLUSH	SPIRAC STD					
5	**LIDS** OPEN PROPERLY AND CATCHES WORK (IF FITTED). LID GASKETS ARE IN PLACE OR PACKAGED SEPARATELY	SPIRAC STD					
6	**BELLHOUSING** IS COMPLETE, PACKING BOX HAS BEEN INSPECTED, LUBRICATED, AND ADJUSTED, AND UNIT IS FIT WITH A FINGER-PROTECTOR.	SPIRAC O&M					
7	**MOTOR AND GEARBOX** ARE CORRECT, SECURELY MOUNTED, AND ORIENTED PER DRAWING	APPROVED DRAWINGS					
8	**SPIRAL** – FACTORY TEST REPORT FOR THIS SPIRAL IS COMPLETE AND ATTACHED	FTR SPIRAL					
9	**FASTENERS FOR FIELD ASSEMBLED COMPONENTS** OR SECTIONS ARE PACKAGED AND CLEARLY LABELLED.	APPROVED DRAWINGS					
10	**NAME PLATE AND WARNING STICKERS** ARE CORRECT AND IN PLACE	APPROVED DRAWINGS					
11	**MATCH MARKS** ARE IN PLACE AND RECORDED WHEN DISMANTLING FOR PACKING.	APPROVED DRAWINGS					
12	**DRY RUN**–NO CONTACT WITH LINER WITHIN 300mm OF CD, WHILE TURNING.	NO CONTACT IN 300mm					
13	**DRY RUN**–GEARBOX MOVEMENT, MEASURED AT MOTOR FAN COVER. RECORD MAX IN "REMARKS"	LESS THAN 1/32" (1MM) IN ANY AXIS					

NOTES: **1. "ACTIVITY TYPE" COLUMNS TO BE DATED AND INITIALLED BY AUTHORIZED SIGNATORY, FOLLOWING COMPLETION OF EACH LINE ITEM. CLIENT COLUMNS PROVIDED FOR CUSTOMER USE.** **2. RETURN COMPLETED DOCUMENT TO SPIRAC PROJECT MANAGER PRIOR TO SHIPMENT.**	DRAWINGS/DOCUMENTS:

SPIRAC USA Inc.
75 Jackson Street, Suite 300
Newnan, GA 30263
770.632.9833

SPIRAC START-UP CHECKLIST

Project Name_____ SPIRAC #_____
Startup Date_____
Delivery Date_____

Follow lockout / tagout procedures

1.0 POINT OF CONTACT

____ 1.1-Fill out the point of contact information that is attached to this checklist

2.0 DRIVE UNITS

____ 2.1 - Check that the correct **gear drive, motor and spiral** is installed on each unit and verify the RPM on each.

____ 2.2 - Check that the position of the breather plug, drain plug and oil level plug is correct.

____ 2.3 – Remove the protective cap on the end of the hollow-shaft, and visually inspect that the fastening bolt, washer, and snap-ring are correctly installed.

____ 2.4 - Check that the reducer has a breather plug on the top side. Remove transit cover from the breather plug if needed.

____ 2.5 - Remove the proper fill level plug and check that the oil is on level with the plug hole. If oil level is low record amount of oil added, if any. Replace gear oil level plug.

____ 2.6 – Check that the lantern ring is snuggly installed and make sure that the lantern ring has been greased.

3.0 CONVEYOR INSTALLATION CHECK (Alignment & Anchorage)

Refer to the approved General Arrangement Drawing Set

____ 3.1 - Inlet(s) correctly connected to feeding equipment or elevation correct as shown on the GA set to +/- 1”.

____ 3.2 – Discharge(s) correctly connected to following equipment or elevation correct as shown on the GA set to +/- 1”.

NOTES:

____ Inlet(s), Elevation Dimension (IED). The distance from the top of Inlet(s) flange to the finished floor elevation shall be as shown on the general arrangement (GA) drawings. Check the IED.

____ Discharge point(s), Elevation Dimension (DED). - The distance from the bottom of each discharge(s) point to the finished floor elevation shall be as shown on the GA drawings. Check DED.

____ Inlet(s) Plan (view) Location Dimension (IPLD) & Discharge point(s) Plan (view) Location Dimension (DPLD), - The conveyor inlet(s) and discharge(s) are located from known points as shown on the GA drawings. These are typically: building columns or centerlines; connecting equipment centerlines; drain lines; storage bins; or other references as supplied to SPIRAC. Check the IPLD & DPLD and if needed for verification, support locations.

1. IF the conveyor inlet(s) and/or discharge(s) appear to be at the GA drawing correct elevation and plan orientation, but do not appear to align correctly with another object, consider the *variables*.
   - Finished floor or ceiling elevation may be incorrect or sloped.
   - The other object is incorrectly placed or the wrong object.
   - Changes have been made to plans without proper coordination.
2. For supports to a finished floor, 1" of grout is allowed (but not required), meaning the actual IED or DED can vary by this amount from that shown on the GA drawing. IED or DED can be made longer than the GA drawing, by adding more grout or a pedestal.
3. Ceiling supports are typically field welded, and usually given more than 1" allowance (typical 6 – 12", check GA drawings).

____ 3.3 – All sections of the conveyor/press are correctly aligned and firmly bolted together. Checks must be made both longitudinally and laterally (along the top/bottom and along a side). A long conveyor may require a string (laser or wire) be pulled full length to check total variation. Correction must be made to any results beyond the following:

Misalignment of conveyor trough sections is not to exceed 1/16" per 10' or ¼" over the full combined length of any two (2) connected flanged/bolted trough sections (typical 20' each) maximum ¼" per 40'.

____ 3.4 - Check the alignment of support steel work and any hoppers, making sure they are fixed to "U" trough firmly.

____ 3.5 - Check that all bolts are tight on the lids, spiral drive coupling and drive quadrant, gear motor drive and drive adaptor and all supports.

____ 3.6 - Check that all welds are clean. Check all painted and galvanized surfaces for chips or scratches.

____ 3.7 - Check all anchorage of the conveyor(s).

4.0 SLIDE GATES - If Provided

_____ 4.1 - Check that the correct gear drive/pneumatic/hydraulic drive is fitted.
_____ 4.2 - Check that the appropriate micro switches/reed switches/travel limits are fitted.
_____ 4.3 - Check the gate alignment and the connection of the actuator to the gate.
_____ 4.4 - Switch on the actuator and test open and close.
_____ 4.5 - Set limits on switches.

5.0 STARTING/Test run

NOTES:

- Ensure equipment feeding conveyors has been fully checked according to manufacturer's recommendations prior to producing product into SPIRAC Conveyors.
- Any machine following (downstream of) the conveyor/compactor has to be started before feeding the conveyor.

_____ 5.1 - Safely power up the equipment and insure proper operation.
_____ 5.2 - Check for correct spiral rotation.
_____ 5.3 – Check that the emergency stops operate properly in hand and in auto.
_____ 5.4 – Verify the set points and the operation of the Loss of Rotation Sensors.
_____ 5.5 - Make sure safety signs are installed on conveyors in a highly visible area.

6.0 FOR MAINTENANCE AND REPAIRS

_____ 6.1-Verify that the O&M Manual is available for the operators.

7.0 SPARE PARTS

_____ 7.1-Spare parts on site and accounted for
Comments on spare parts_____
_____

Comments on Start Up (use other sheet if necessary)

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

SPIRAC (or SPIRAC approved & contracted) **Service Technician:**

Company Name_____

Printed Name _____

Signature _____

Telephone # _____ Extension: _____

Email_____

Contractor

Name of Company _____

Name of Contact _____

Position_____

Telephone # _____ Extension: _____

Email_____

Plant Operations

Company Name_____

Name of Plant Operator_____

Telephone # _____ Extension: _____

Email_____

Name of Plant Maintenance Supervisor_____

Telephone # _____ Extension: _____

Email_____

Name of Other Plant Contact_____

Position_____

Telephone#_____ Extension: _____

Email_____