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INSTALLATION, MAINTENANCE AND OPERATION MANUAL

Ovivo® Control Panels

Serial No.: RSW0001000-01 A thru B

For

PROJECT: Wichita STP #2

CUSTOMER: City of Wichita

Purchase Order No.: DP190029

Ovivo USA, LLC Order No.: RSW0001000 (RSW000933)

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General

To ensure complete warranty coverage of the equipment thoroughly read and familiarize yourself with the instructions in this manual.

It is the sincere desire of Ovivo USA, LLC that this equipment will give dependable, efficient and economical operation throughout the entire period of service. To achieve this kind of performance and ensure full warranty coverage, it is important to thoroughly read and understand the contents of this manual before the unit is installed, adjusted, or operated.

The equipment, including the accessory equipment furnished but not built by Ovivo, must be stored, installed, operated and maintained according to these instructions to ensure the warranty coverage.

The instructions in this manual are based on information available at the time of issue of this manual; the right is reserved to make subsequent changes to the instructions without obligation to replace existing copies.

Documents, drawings, technical manuals and all other information contained in this manual, provided in conjunction with the purchase of Ovivo products and services, are the property of Ovivo, are confidential, and may not be made public or copied.

Ovivo will not furnish editable electronic copies of any data and/or drawings at any time.

Ovivo accepts no liability whatsoever for unauthorized changes and/or alterations to the data provided.

English is the governing language. When manuals are provided in both English and any language other than English, **THE NON-ENGLISH TRANSLATION IS PROVIDED ONLY AS A CONVENIENCE**. **Ovivo shall not be liable for damages caused by errors in translation**. The English translation will govern in case of minor discrepancies. In the event of major discrepancies, notify your Ovivo representative immediately. Refer to the Offices page in this manual for applicable address and telephone number.

Before You Erect It Your Way

Let Us Show You Our Way-

Read the Instructions

These instructions are based on years of field experience. We selected the best procedures from that experience and put them together to give you our best-suggested method of erection. Consider them. They will save you time and money.

But -

- If you believe you have a better way, call us first anyway.
- If you want assistance or a pre-erection conference before you start, call us.
- If problems should occur, call us at once.

Contact your Ovivo representative, referring to the Offices page in this manual.

GENERAL — Special Instructions to Field Erectors

Ovivo does not anticipate problems with the erection of this equipment. However, due to the nature of fabricated steel equipment, the erector may require a certain amount of field fit-up and adapting work. This is considered to be a normal part of erection, as well as the use of such tools as come-alongs, welding and cutting torches, and drift pins. However, in case of problems, the following will apply:

1. The AISC "Code of Standard Practice", latest edition, specifically states under "Correction of Errors" that cutting, reaming and use of drift pins are a part of standard erection practice:

   "Normal erection operations include the correction of minor misfits by moderate amounts of reaming, chipping, welding or cutting, and the drawing of elements into line through the use of drift pins. Errors that cannot be corrected by the foregoing means or that require major changes in member configuration are reported immediately to the owner and fabricator by the erector. This is done in order to enable whoever is responsible either to correct the error or to approve the most efficient and economic method of correction to be used by others."

2. **Should a problem develop because of fabrication or engineering errors, Ovivo will not accept back charges unless they are authorized in advance and in writing by your Ovivo Project Manager. Before corrective work is started, the erector must obtain an Ovivo Field Work Order that must include a cost limitation. Payment may be refused for corrective work that is done without the above authorization.**

   Authorized charges will be paid only on the basis of standard direct field labor hours, material, and variable overhead. Other charges will not be allowed.

3. Drawings and erection or installation instructions must be followed. The drawings will govern in case of minor discrepancies. In the event of major discrepancies, notify your Ovivo representative immediately, referring to the table of contents for the location of the Offices page.

4. If a protective coating (paint, rubber, etc.) is to be applied to the mechanism, it may need to be applied to some parts before they are installed. Parts that must be coated before installation are those that would be inaccessible after installation. Hold back paint 3” from all field welds. Study Erection drawings carefully and determine field welded areas in question before painting.

WARNING: The fumes given off during welding and cutting can be injurious to the operator's health. Some fumes, such as those produced when working with Zinc, Cadmium and painted surfaces can be toxic

Although all possible precautions are taken to protect the equipment against damage or losses during shipment, before accepting the shipment check all items against the packing list for shortages and inspect for evidence of physical damage. In either case, immediately notify the carrier or note on the delivery ticket "Accepted subject to full inspection after unpacking". Notify Ovivo within 7 days (maximum) in case of shortages or discrepancies in the amounts received according to the packing list. If not notified, Ovivo will not be responsible for replacing those items.

Keep a record of all claims and correspondence. Photographs are recommended.

1. Packing Boxes and Covers

Do not remove protective covers unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, especially if they are to be discarded. Refer to the Storage Instructions.

2. Shipping Braces and Bars

All braces, bars, etc., that are required for shipment, but are not a part of the mechanism, should not be removed until necessary for installation or removal from the carrier. Shipping braces are marked "SHIPPING BRACE ONLY" with white painted letters or they are painted purple.

3. Storage

When the equipment is not to be installed immediately, refer to the storage instructions. These are important to ensure warranty protection.

4. Erection Bolts

Check these against the packing lists to avoid shortages later in assembly.

Equipment stored or out of use for more than 30 days must be protected against corrosion and damage.

1.5.1 Drive Equipment

1.5.1.1 Accessory Equipment

For storage and maintenance of equipment furnished by Ovivo, refer to the manufacturer's instructions at the back of this manual.

1.5.1.2 Drive Equipment

Failure to comply with these storage instructions will void the Ovivo warranty.

1.5.1.3 Drive Shipped from Factory

The drives provided by Ovivo received in shipment can be stored as long as 24 months, taking into account the in transit time. No special precautions are required other than those listed below.

Note: All drive unit machined surfaces are coated with LPS #3 (or an equivalent product), which is a rust inhibitive agent good for approximately 24 months storage. No storage oil is required and, in fact, must not be used since LPS #3 will dissolve in oil or most other petroleum based products. Therefore, do not add oil etc. to the drive unit until it will be operated. If storage time is to exceed 24 months, contact Ovivo for long-term storage information.

a. Store the drives in the normal operating position. If possible, store the drives indoors in a dry, well-ventilated place with a relatively constant temperature. Do not add oil. See note above.

b. When drive equipment is not installed, but must be stored outdoors:

   1) Use wooden blocks, arranged for even and firm support, to elevate it above the ground. Shipping crates or skids will suffice. Make certain the storage area is not where water can collect.

   2) If protective covers have been removed or damaged, cover the equipment with canvas or protective tarpaulin, but allow adequate ventilation. Do not use space heaters.

   3) Whenever possible, store the equipment in a shaded area protected against the sun and wind. This should also be an area away from moving equipment.

1.5.2 Long Term Storage

.1 Failure to comply with these storage instructions will void the Ovivo warranty.

.2 The following precautions cover non-operation or shutdown periods that exceed two months. They apply to the Ovivo or accessory mechanical drive equipment that has been installed and operated. Keep records and schedules to ensure compliance with instructions.

Note: As LPS #3 will dissolve in and is compatible with oil, it is not necessary to remove it using solvents before adding oil.

1.5.2.1 Plan #1 - Power Available

When power is available, lubricate and operate the equipment about five minutes, or run it through a complete cycle once each week. Remove accumulated water from drives each month at drain plugs. Refer to the accessory equipment manufacturer's instructions for additional information.

WARNING: In climates where snow and ice might accumulate in the tank, do not operate the drive. Follow Plan #2.

1.5.2.2 Plan #2 - No Power Available

a. Fill housing and gear cases with clean oil to maximum level. A rust inhibitive agent is recommended for adding to the oil. Check that all greased bearings are well lubricated. Cover seals, screws, chains and guides with heavy grease and cover breather caps with tape. Cover with tarpaulins, but allow ventilation. Space heaters or dehumidifiers must operate continuously.

b. Once each month open drain plugs to remove accumulated water and return oil to maximum level. Check all greased items monthly for adequate covering. On variable speed drives, make certain condensate plugs are removed from the speed housing.

c. When the storage period extends into seasonable warm or cold weather, drain all gear housings and flush them with oil to remove residual water after the storage period. Do not flush with solvents. Refill with oil up to normal operating level.

WARNING: Before the drive equipment is put into operation after storage, drain all oil and lubricate according to instructions. Re-lubricate all greased bearings and pump out old grease. Check motor windings. Refer to the accessory equipment manufacturer's instructions.

1.5.3 Motor Storage

.1 If a motor is not put into immediate service (one month or less), or if it is taken out of service for a prolonged period, special storage precautions should be taken to prevent damage. The following schedule is recommended as a guide to determine storage needs.

.2 When to Put a Motor in Storage:

a. Out of service or in storage for less than one month – No special precautions, unless there are space heaters. Space heaters, if supplied, must be energized at any time the motor is not running.

b. Out of service or in storage from one to six months –

1) Where possible, store indoors in a clean, dry area.

2) If indoor storage is not possible, cover the motors with a tarpaulin. The cover should extend to the ground. Do not tightly wrap the cover, as this will restrict airflow, resulting in condensation. Care must be taken to protect the motor(s) from flood damage or any harmful chemical vapors.

3) The storage area must be free from excessive vibration, which can cause bearing damage.

4) Precautions must be taken to prevent rodents, snakes, birds or other small animals from nesting inside the motors. Insects should be prevented from gaining access to the interior of the motor.

5) Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. If necessary, recoat the surfaces with a rust inhibitor, such as Rust Veto No. 342 or equivalent. The coating should be inspected periodically.

6) To prevent moisture accumulation, some form of heating must be used to prevent condensation. The heating should maintain the winding temperature at a minimum of 5°C above ambient. If space heaters are supplied, they should be energized.

7) All motors must have the shaft rotated a few turns once a month to maintain a lubricant film on the bearing races.

c. Out of service or in storage six months or more –

1) Where possible, store indoors in a clean, dry area.

2) If indoor storage is not possible, cover the motors with a tarpaulin. The cover should extend to the ground. Do not tightly wrap the cover, as this will restrict airflow, resulting in condensation. Care must be taken to protect the motor(s) from flood damage or any harmful chemical vapors.

3) The storage area must be free from excessive vibration, which can cause bearing damage.

4) Precautions must be taken to prevent rodents, snakes, birds or other small animals from nesting inside the motors. Insects should be prevented from gaining access to the interior of the motor.

5) Inspect the rust preventative coating on all external machined surfaces, including shaft extensions. If necessary, recoat the surfaces with a rust inhibitor, such as Rust Veto No. 342 or equivalent. The coating should be inspected periodically.

6) To prevent moisture accumulation, some form of heating must be used to prevent condensation. The heating should maintain the winding temperature at a minimum of 5°C above ambient. If space heaters are supplied, they should be energized.

7) All motors must have the shaft rotated a few turns once a month to maintain a lubricant film on the bearing races.

8) Bearing cavities must be completely filled with lubricant during long-term storage. Remove the drain plug and fill the cavity with grease at the grease inlet until it begins to purge from the drain hole, then replace the drain plug. Refer to the Lubrication section for a list of lubricants.

9) Every two months, a small quantity of grease should be injected into the grease fitting with the drain plug removed. Exiting grease should be inspected for moisture and contamination. If these are present, the motor bearings should be inspected and fresh grease installed.

1.5.4 Structural Storage Precautions

.1 Inspect painted surfaces for deterioration of paint. Apply finish coats as soon as possible. When this is not possible, remove rust or corrosion and paint, as necessary.

.2 For shop primed steel equipment, refer to the special "Paint Durability" precautions below.

Note: Shop primer paint durability

Shop primer paints are intended to serve only as a bonding coat between metal surfaces and protective finish or seal coats and act as a minimal protective finish. Ovivo will not be responsible for condition of primed or finish painted surfaces after equipment leaves its shops. Purchasers are invited to inspect painting in shops for proper preparation and application prior to shipment. Ovivo assumes no responsibility for field surface preparation or touch up of shipping damage to paint. Painting of fasteners and other touch up to painted surfaces will be by purchaser's painting contractor after mechanism erection.

.3 Identification tags that are removed for painting prior to assembly must be reattached to the original components for correct identification. Assistance from Ovivo will be charged at the normal service rate.

.4 Lubrication plates, **WARNING** and **CAUTION** signs, and the Ovivo nameplate must be masked off prior to field painting. Do not remove these signs/plates from the drive. After field painting is completed, make

sure that lubrication plates, **WARNING** and **CAUTION** signs, and the Ovivo nameplate are clearly visible and readable.

DRIVE UNIT VENT CAUTION:

Vent holes in vented pipe plugs and sight glass vent openings must be kept clear of dirt, paint or other foreign material.

Failure to heed these warnings will VOID the drive warranty.

1.6.1 Warning Signs

LUBRICATION WARNING:

The drive unit is shipped from the factory without operating lubricant.

SANDBLASTING WARNING:

The main drive unit and motor drive must be fully covered or sealed off to protect against sand and dust when sandblasting in their vicinity. All external openings, including vents and oil fill plugs and the space between the rotating main gear and stationary base on the main drive, should be taped closed, covered with polyethylene film, or stuffed with oakum or rag waste. After sandblasting and before start-up, drain a portion of oil from the drive through nylon stocking to be sure grit has not penetrated the drive. Remove all covers.

Sand, dust and other foreign material must not enter into the drive mechanism.

WELDING WARNING:

The fumes given off during welding and cutting can be injurious to the operator's health. Some fumes, such as those produced when working with Zinc, Cadmium and painted surfaces can be toxic.

Use the piece being welded as the ground to prevent drive unit damage due to electrical circuit contact.

DRIVE DIRECTION OF ROTATION:

The drive must rotate in the direction specified on the drawings, unless a reverse rotation is specifically allowed.

REMOVE GEARMOTOR BREATHER PLUG!

If the plug was not removed during assembly, remove this plug before operating the gearmotor.

DRIVE CONTROL WARNING:

The load cell drive control assembly must be properly installed and checked for operation, as specified in the General Drive Maintenance instructions, before the drive is operated. Electrical wiring (not by Ovivo) to the drive control and motor drive assembly must be installed, as specified. The drive motor must be wired so an automatic restarting of the motor cannot occur after a drive control shutdown, following a torque overload. All interconnecting wiring must meet local electrical codes.

1.6.2 Safety Signs

1.6.2.1 Area Safety Signs

Safety signs should be installed to alert anyone entering dangerous areas. Several safety signs may be required and located so they can be seen from any direction the equipment might be approached.

a. Suggested text for these signs in appropriate language would be:

WARNING:

EXPOSED MOVING PARTS -KEEP AWAY

b. If personnel working with this equipment cannot readily read or understand English, warning signs on the equipment and procedures set forth in this manual must be translated and provided for their benefit in a language they understand. Multilingual signs may be needed.

c. Location of signs will depend upon the specific design and placement of the equipment. They may be located above catwalks, for example, or affixed to walls adjacent to the equipment, or on the equipment itself. Make sure these signs are visible to the operator during operation and visible to persons approaching the area of the machine.

WARNING:

LOCK OUT POWER BEFORE
PERFORMING MAINTENANCE

1.6.2.2 Equipment Safety Signs (by Ovivo)

a. Safety and warning signs are shop mounted to the equipment.

b. These signs must be kept clean and must not be covered up. Also, if these signs are damaged or deteriorated, replace them.

WARNING: Do not pull, drag, push or dump the structural components off the carrier.

All structural components should be lifted and handled as covered below and/or in the installation instructions. Proper handling is necessary to protect special coatings or coverings and to ensure ease of assembly during equipment installation.

Ovivo will not accept charges for repair or replacement of equipment or materials damaged due to improper handling.

Lifting Recommendations and CAUTIONS

Observe these precautions when lifting or handling structural components furnished by Ovivo:

WARNING: Stand clear as the equipment is lifted.

1. Make sure the equipment being lifted and the lifting equipment cannot come into contact with overhead electrical cables, etc.

2. Make sure the rigging and hoist equipment is of adequate capacity.

3. Experienced personnel should do all rigging and lifting.

4. Before the equipment is removed from the carrier, check to be sure the blocking, bracing and banding securing it to the carrier have been removed and it is ready for moving.

5. Use multiple point lifting whenever possible.

6. When lifting structural members of this equipment, avoid twisting or bending the members. Use spreader beams, as necessary, to fully support the pieces as they are lifted.

7. Lift the equipment an inch or two off the carrier to be sure it is free to be moved and balanced correctly. Adjust as necessary.

8. Never move the equipment suddenly or in jerks and never allow it to strike the ground, tank or other equipment.

9. When lifting components that are special painted, use rubber belting, burlap or other padding between the lifting cables and the equipment to prevent damage to the protective covering.

Equipment or parts manufactured by **Ovivo USA, LLC,** ("SELLER"), is backed by the following warranty:

Solely for the benefit of the original user, SELLER warrants that new equipment and parts manufactured by it and provided to the original user (collectively, "Products") shall be free from defects in material and workmanship for the period of one (1) year from the date of Owner acceptance not to exceed eighteen (18) months from the date of shipment by Seller (the "Warranty Period").

If any of SELLER'S Products fail to comply with the foregoing warranty, SELLER shall do one of the following:

(a) repair or replace free of charge to original user, EX WORKS SELLER'S factories or other location that SELLER designates, any Product or parts thereof returned to SELLER, which examination shall show to have failed under normal use and service operation by the original user within the Warranty Period; provided, that if it would be impracticable for the Product or part thereof to be returned to SELLER, SELLER will send a representative to the original user's job site to inspect the Product. If it is determined after inspection that SELLER is liable under this warranty to repair or replace the Product or part thereof, SELLER shall bear the transportation cost of (i) returning the Product to SELLER for inspection or sending its representative to the job site, and (ii) returning the repaired or replaced Products to the original user; however, if it is determined after inspection that SELLER is not liable under this warranty, SELLER'S customer or the original user shall pay those costs; or

(b) at SELLER'S sole option, refund all or part of the purchase price allocable to the defective Product, or parts thereof.

For SELLER to be liable with respect to this warranty, the original user must make its claims to SELLER with respect to this warranty in writing no later than thirty (30) days after the original user discovers the basis for its warranty claim and in no event more than thirty (30) days after the expiration of the Warranty Period.

In addition to any other limitation or disclaimer with respect to this warranty, SELLER shall have no liability with respect to any of the following:

(i) failure of the Products, or damages to them, due to the negligence or willful misconduct of SELLER's customer or the original user, abuse or improper storage, installation, application or maintenance (as specified in any manuals or written instructions that SELLER provides to the original user);

(ii) any Products that have been altered or repaired in any way without SELLER'S prior written authorization;

(iii) the costs of dismantling and reinstallation of the Products;

(iv) any Products damaged while in transit or otherwise by accident;

(v) decomposition of Products by chemical action, erosion or corrosion or wear to Products caused by abrasive materials or due to conditions of temperature, moisture and dirt; or

(vi) claims with respect to parts that are consumable and normally replaced during maintenance such as filter media, filter drainage belts and the like, except where such parts are not performing to SELLER'S estimate of normal service life, in which case, SELLER shall only be liable for the pro rata cost of replacement of those parts based on SELLER'S estimate of what the remaining service life of those parts should have been; provided, that failure of those parts did not result from any of the matters listed in clauses (i) through (v) above.

With regard to third-party parts, equipment, accessories or components not of SELLER's design, SELLER'S liability shall be limited solely to the assignment of available third-party warranties.

It is the responsibility of SELLER'S customer or the original user to hire or retain engineers and other experts to determine the suitability of the Product for the original user's use. SELLER shall not be liable for the design or suitability of any Products for any particular use (except to the extent that a warranty or guarantee with respect to such a matter is

expressly set forth in a written document executed by an authorized representative of SELLER). In making interpretations of data, SELLER'S employees will give its customer the benefit of their reasonable professional judgment as to the correct interpretation, but SELLER cannot and does not guarantee the accuracy or correctness of these interpretations (except to the extent that a warranty or guarantee with respect to such a matter is expressly set forth in a written document executed by an authorized representative of SELLER).

SELLER'S quoted price for the Products is based upon this warranty. Any increase in warranty obligation may be subject to an increase in price.

THE PARTIES AGREE THAT ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, WHETHER WRITTEN, ORAL OR STATUTORY, ARE EXCLUDED TO THE FULLEST EXTENT PERMISSIBLE BY LAW. ALL WARRANTIES AND OBLIGATIONS OF SELLER SHALL TERMINATE IF: (1) SELLER'S CUSTOMER OR ORIGINAL USER FAILS TO PERFORM ITS OBLIGATIONS UNDER THIS OR ANY OTHER AGREEMENT BETWEEN THE PARTIES; OR (2) SELLER'S CUSTOMER AND THE ORIGINAL USER FAIL TO PAY ANY CHARGES OTHERWISE DUE SELLER.

SELLER shall not be liable for any indirect, special, punitive, exemplary or consequential damages, including damages for lost production, plant shut-down, service interruptions, increased expense of operation, increased costs of power supply, loss of use of capital, lost revenue, lost product, lost profit or lost business opportunities, from any cause whatsoever, including the negligence of any person or entity.

To make sure the right replacement parts are received and to avoid undue delay, it is important to give the following information with each order:

1. Size and Type of Unit: These are found on the cover page of this manual and on the Parts List pages.

2. Serial Number: This is found on the unit nameplate and the Parts List. In case the S/N is omitted on the Parts List, use the Order number since it and the S/N are similar.

3. Part Number and Descriptions: Listed on Parts List.

4. Special Field Modifications: This is important if the original material or design has been changed. Include drawings and/or other descriptive information.

Please contact Ovivo for parts, repair orders, and/or equipment service. Specify order number **RSW0001000-01** when talking to a parts representative.

Ovivo USA, LLC
Attn: Aftermarket Representative
4246 Riverboat Road, Suite 300
Salt Lake City, Utah 84123
Telephone: 801-931-3000
Facsimile: 801-931-3090
Website: www.ovivowater.com

Local Service Representative
Haynes Equipment
Attn: Kevin Gabbert
15725 Pflumm Road
Olathe, KS 66062
Telephone: 913-782-4962
Email: kgabbert@hayneseqiup.com

Installation

WARNING: Disconnect all electrical power to the drive.

1. Block the rake arms in position, then disconnect them from the cage.

2. Remove the walkway and platform. Retain the slide plates, if used.

3. Disconnect the cage from the drive unit and lower the cage to the tank bottom. Remove the drive mounting bolts.

4. Disconnect the drive from the column and remove the drive from the tank.

5. For replacement of the C54 drive - remove the specified area on the existing cage, referring to Figure 2.1a and drawing RSW933-152.

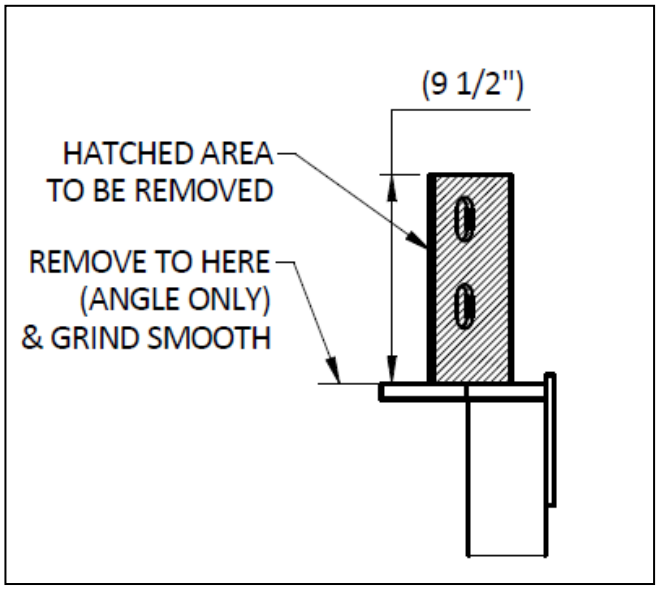


Figure 2.1a

6. After removal of the existing cage angles for the C54 drive cage, match drill six (6) 13/16" Ø holes and one (1) 1-1/8" Ø in the existing cage side and top plates using the cage adapter as a template. Use the supplied touch up paint on all cut, ground or drilled surfaces.

7. Clean the top surface of the column. Place the new column adapter on top of the specified column, making sure to align the v-notch in the adapter with the centerline of the walkway.

8. The cage adapter will be installed with installation of the cage. The walkway will be modified prior to re-installation of the walkway.

The drive unit is shipped fully assembled, including the drive control (overload cutout device). The main drive housing assembly to which the cage attaches is on the bottom, and the secondary drive and worm drive assemblies are on top.

2.2.1 Lift the Drive Unit

Lift and install the drive as a complete assembly, using the four lifting lugs located inside the main drive housing as shown in Figure 2.2a.

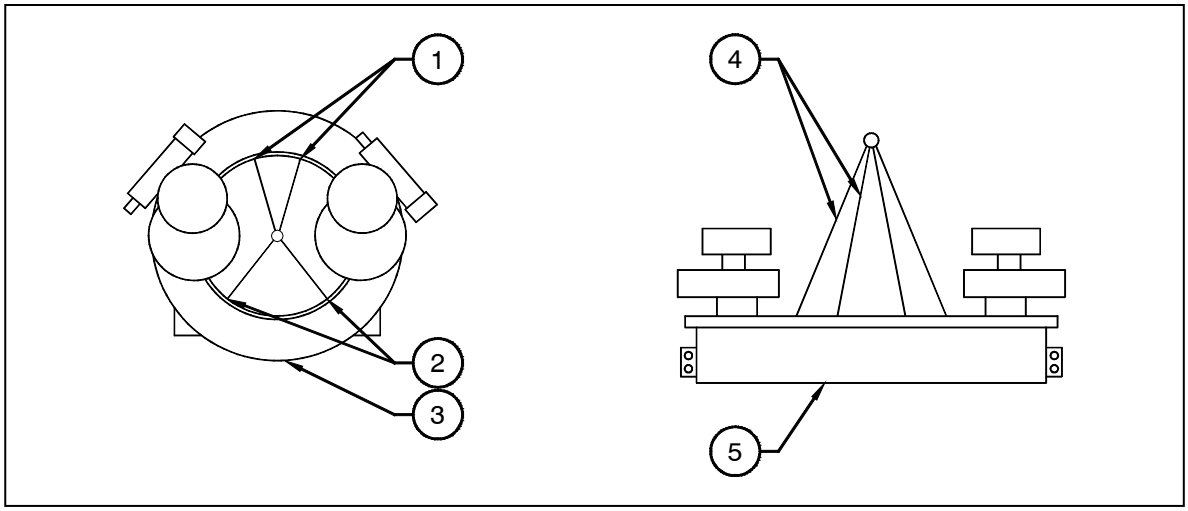


Figure 2.2a

1 - Lifting Lugs	3 - Rake Drive Assembly	5 - Drive
2 - Lifting lugs inside the main drive housing	4 - Lifting Cable to (4) Lifting Lugs	

2.2.2 Install the Drive

.1 Check the mounting surface of the drive housing for foreign matter and the column mounting flange for spatter or other foreign matter. Remove as necessary for a clean flat surface.

.2 Place the drive unit on the column, orienting as shown on the Motor Assembly and General Arrangement drawings. Insert but do not tighten the drive hold down bolts.

2.2.3 Level the Drive

.1 At this point in the erection the drive will be adjusted for near level, using a carpenter's level and the leveling jackscrews. After installation of the arms

and cage, the drive will be adjusted for final level by shimming.

.2 Check the drive for level, using a 4' carpenter's level placed on the leveling surface of the main drive cover. Check in two directions (90°).

.3 Remove, clean and lubricate the jackscrews in the drive base, then reinstall the jackscrews.

.4 Adjust for level using the jackscrews.

.5 After leveling, support the drive using shims at the jackscrews.

.6 Install the drive hold-down bolts and snug tighten only. Do not torque.

.7 Final leveling of the drive will follow installation of the rake arms.

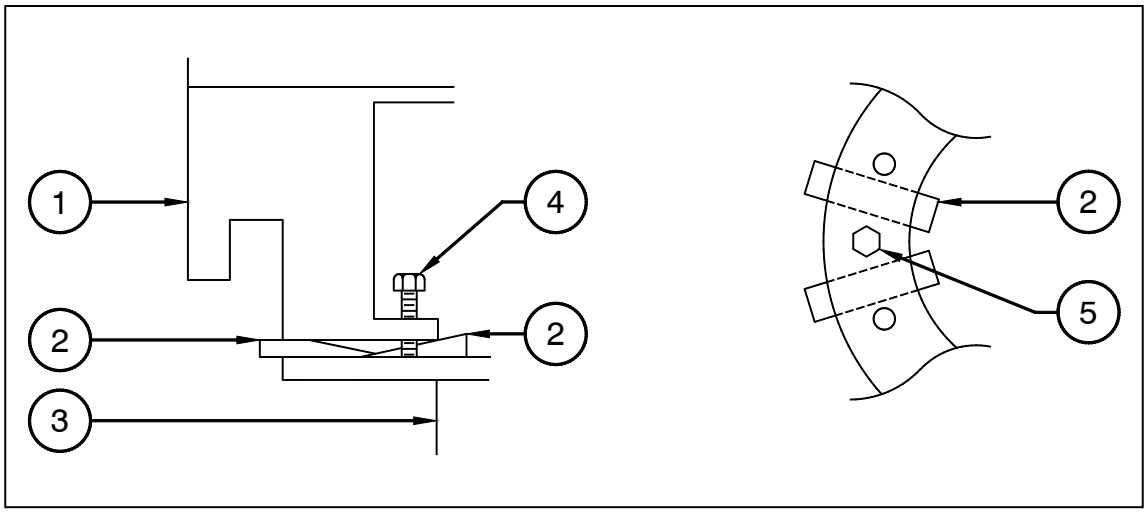


Figure 2.2b

1 - Drive	3 - Column	5 - Leveling Screw
2 - Shim	4 - Leveling Screw	

LUBRICATION WARNING: The drive is shipped from the factory without operating lubricant.

SANDBLASTING WARNING:

The main drive unit and motor drives must be fully covered or sealed off to protect against sand and dust when sandblasting in their vicinity. All external openings, including vents and oil fill plugs and the space between the rotating main gears and stationary bases on the main drive, should be taped closed, covered with polyethylene film, or stuffed with oakum or rag waste. After sandblasting and before start-up, drain a portion of oil from the drive through nylon stocking to be sure grit has not penetrated the drive. Remove all covers.

Failure to observe this **WARNING** will void the drive warranty.

2.2.5 Drive Lubrication and Rotation Warnings

.1 Refer to the "Lubrication" instructions in this manual. Refer to the Table of Contents for Lubrication Instructions page numbers.

.2 Incorrect rotation of the drive and in some cases, rotation of the drive without electrical power, will cause serious damage to the drive and possibly a dangerous buildup of torque.

Note: To rotate the arms without power, remove the gearmotor fan cover and turn the shaft with a drill.

.3 Refer to the "Lubrication, Electrical Wiring, Drive Rotation and Drive Controls" instructions on a following page.

.4 Do not attempt to operate or rotate the drive (rake arms) before you read those instructions.

1. Referring to Figure 2.3a, attach the cage adapter to the drive gear cage attachment, using the vertical adjusting studs (6) and hex nuts (4).

2. Loosely install the capscrews with lock washers (9).

3. Raise the cage to its highest position and secure the hex nuts (4).

4. Using a carpenter's level, check the cage for plumb.

5. Adjust the cage for plumb using the adjusting studs (6) and hex nuts (4).

   Note: A final check for plumb will follow drive leveling.

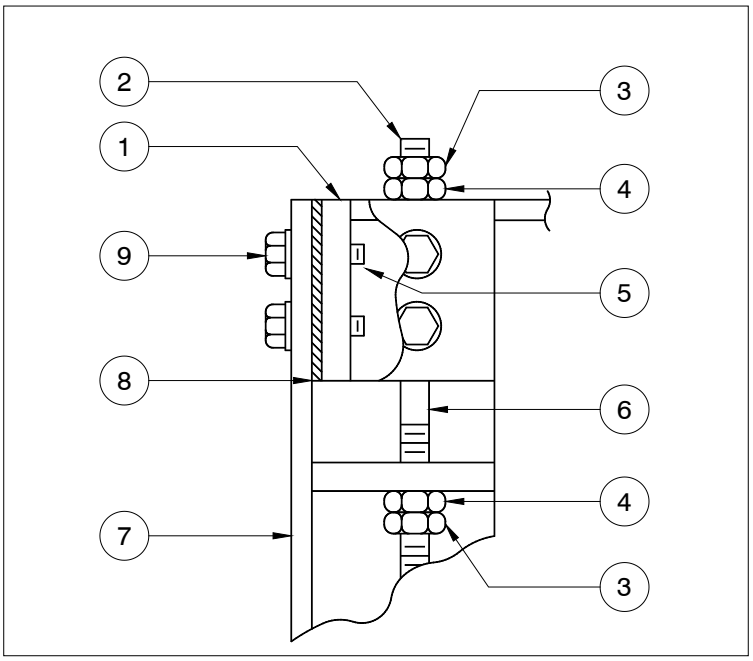


Figure 2.3a

1 - Drive gear cage attachment	6 - Adjusting stud
2 - Avoid unnecessary projection of stud	7 - Cage
3 - Jam nut	8 - Shim using the spacers provided for tight fit of cage
4 - Hex nut	9 - Capscrews with washer
5 - Tapped holes or welded nuts or loose nuts	

6. Check for any gaps between the cage and gear cage attachment at (1) and, if necessary, shim equally, using the spacers provided.

7. Secure the capscrews with lock washers (9). Do not torque.

8. Install and secure the jam nuts (3).

1. Drill two (2) 7/8”Ø in the existing walkway angles where shown on the General Erection drawing, to allow for clearance of the studs in the drive top cover.

2 CHECK alignment of the mounting surfaces on the tank and the drive with relation to the centerline of the tank. The mounting surfaces must be level within the same relative planes.

3. If sliding plates and/or floating plates are used, install them in their former positions.

4. Set the walkway back in place on the drive and tank. Do not force the installation. Elongate the mounting holes in the walkway, if necessary. Check for lateral level and adjust by shimming.

5. Secure all mounting bolts. When sliding plates and/or floating plates are used, tighten the bolts at the end, where the plates are located, then loosen the nuts one half turn and lock in place.

   Note: The 1/16" approximate clearance between the walkway and nuts, shown in Figure 2.5a, allows for contraction and expansion of the walkway during temperature changes.

6. Install the new drive cover handrail and the new handrail section to the existing walkway, using the supplied fasteners. Also, install the floor plates around the drive, if they were removed.

7. When dissimilar materials are used for the handrails, existing walkway and the floor plates, the surfaces must be separated by material that prevents galvanic reaction. Ovivo recommends a Bi-Metallic adhesive backed neoprene tape for all aluminum to steel connections.

LUBRICATION WARNING

The drive is shipped from the factory without lubricating oil.

Prior to being operated, the drive and all accessory equipment components must be lubricated, referring to both the "Drive Lubrication" instructions and the accessory equipment manufacturer's instructions included in this manual. Refer to the Table of Contents for page numbers of the Drive Lubrication instructions and the accessory equipment manufacturer's instructions.

GEARMOTOR CAUTION

The gearmotor has been selected for the specified torque and output speed required for this mechanism. Neither gearmotor power nor output speed should be changed without consulting Ovivo for engineering evaluation and comments.

2.5.1 Connect Electrical Wiring

Refer to the drawings for connection of the wiring to the drive gearmotor, drive control, etc. Ovivo does not furnish, locate or install the interconnecting wiring. All interconnecting wiring must meet local electrical codes.

Note: An appropriate fitting and drain (not by Ovivo) must be used at the wiring (conduit) connection to the drive control to eliminate water condensation. The fitting and drain must comply with National Electrical Codes (N.E.C). specifications.

Note: The drive gearmotor must be wired so an automatic restarting of the gearmotor cannot occur after a drive control shutdown, following a torque load.

2.5.2 CAUTION when no power is available:

.1 The drive can be rotated without power by removing the gearmotor fan cover and turning the shaft with a drill.

.2 To rotate the rake arms for final leveling when no electricity is available, observe the following **WARNINGS**:

a. Direction of rotation - The worm shaft (driven sprocket) must be turned the direction of the rotation "arrow" on the cover guard

and the rake arms must turn clockwise, when viewed from above. (It is necessary to ensure warranty coverage). An air ratchet or hand crank can be used to turn the shaft, but the worm shaft should be protected against damage.

b. Torque buildup - Watch the drive control arrow, during the rotation, to make sure it does not go above zero "0". If it does, immediately stop the rotation and refer to the "Drive Maintenance **WARNING**" in the Maintenance section.

2.5.3 Check Drive Rotation

.1 The gearmotor must be connected for the direction of rotation specified on the drawing and shown by the arrow on the chain guard. If not, the drive warranty will be void, and Ovivo will not pay for damage.

.2 Check the gearmotor for direction of rotation without the drive chain installed. Refer to the directional "arrow" on the chain guard or the Motor Drive Assembly drawing. Reinstall the chain.

2.5.4 Check Alignment of a Field Installed Gearmotor Drive

.1 If the gearmotor was shipped separately from the main drive, install and align the sprockets as follows:

.2 Set the driven sprocket on the worm shaft outward 1/8" from true alignment (with the drive sprocket). This is necessary since the worm shaft will move inward 1/8" under maximum running load. So this initial setting will be closer to true alignment with the displacement that occurs under normal load.

.3 Adjust the chain for tension, referring to the instructions under Drive Maintenance.

2.5.5 Check the Drive Control for Operation

Refer to the parts list for the switch settings in checking the drive control. (Electricity is required for this check).

a. Start the drive gearmotor. (Check the tank for obstructions or do this check while the chain is removed).

b. Remove the cylindrical switch housing, unscrewing it from the base. Then manually actuate the cam switches by turning the camshaft (and pointer) with the set collar (end of camshaft). Slowly turn the pointer

through a complete range to 100. This will simulate a mechanism full load condition. At the set points, the alarm should sound and the drive gearmotor should stop.

c. If the drive control does not react correctly, check each switch individually. If none of the cam switches actuate, recheck the wiring to the drive control. Refer to the Manufacturer's Wiring Diagrams. If the wiring is correct, check the cams for proper setting and the camshaft for alignment. Contact your Ovivo representative in case of a problem.

d. Replace the switch housing cover, being sure it goes on straight to avoid cross threading and to ensure a tight seal. Tighten the cover a minimum 1/2 turn after contacting the O-ring.

DRIVE CONTROL CAUTION:

The drive control is an overload cut out device to protect the drive. Since it is installed and adjusted at the factory for proper operation, do not tamper with it. If the original cam settings are not satisfactory for the conditions, contact your Ovivo Representative before attempting any adjustments. The gearmotor must not be able to restart automatically after a torque overload; see Electrical Wiring, above.

WARNING: If the drive unit stops due to an overload, do not attempt to restart it until the cause of the overload has been located and corrected. Refer to the Drive Maintenance **WARNING** instructions in this manual.

The rake arms were blocked in position and disconnected from the cage prior to removal of the old drive.

To prevent misalignment or damage to the cage or cage connection, the arms must be reinstalled in pairs. The connections to the cage must not be forced.

1. Make sure the rake arms are in alignment with their matching fittings on the cage. Adjust, if necessary.

2. Connect the arms to the cage at the bottom connection first. Do not force the connection. Then connect the upper connection.

3. Remove the blocking equally from each arm, beginning at the cage and working outward.

4. CHECK the arm blades for clearance with the tank bottom to be sure they Do Not touch. Final arm level will be checked later.

5. If it is necessary to adjust the arms, adjust them as a pair, or adjust one arm while supporting the opposite arm with blocking. This is to maintain equal weight on the cage.

2.7.1 Check for Level

.1 The main bearing of the rake drive must be level for proper operation of the mechanism and maximum bearing life.

.2 The drive will be checked for level by measuring the level of the drive at the end of a rake arm, at various points around the tank. It will then be shimmed for level.

Note: Checking and leveling must be done when the center column is a uniform temperature, such as the early morning or an overcast day.

.3 The drive must be leveled within a maximum out-of-level tolerance of .005 inch per every 12 inches of arm distance. This tolerance will be measured on a large scale using one of the rake arms, rather than using the relatively small area of the drive cover.

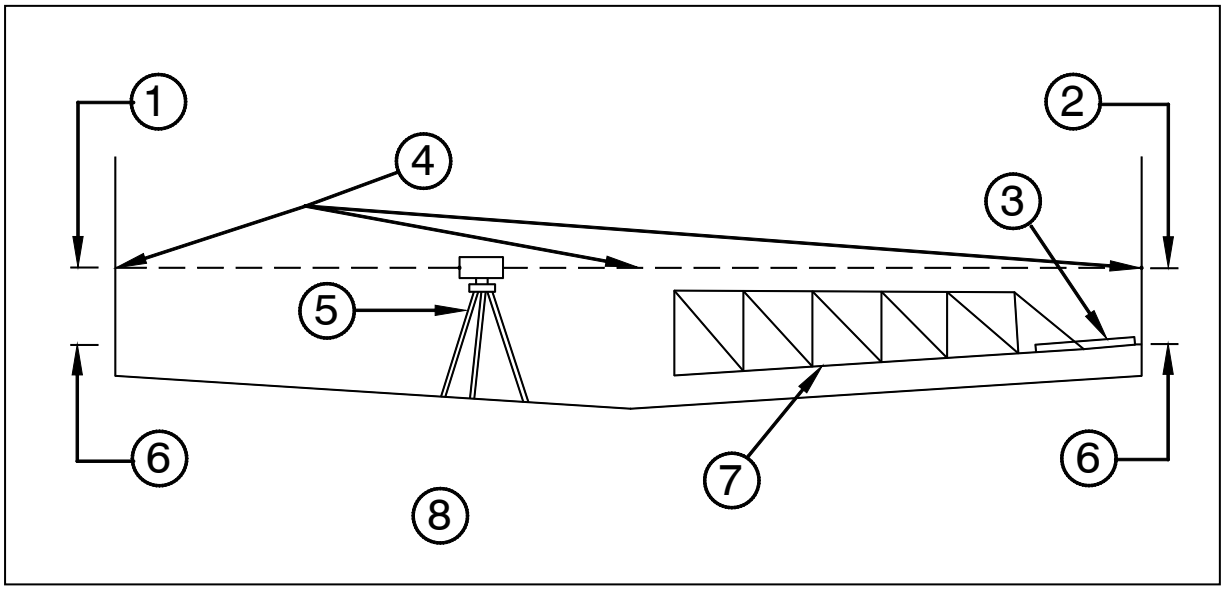


Figure 2.7a

1 - "d_1"	5 - Surveyor's level
2 - "d_2"	6 - Reference mark from rake arm
3 - Use carpenter level to reach from arm to tank wall	7 - Rake arm
4 - Level bench marks (4 places around the tank)	8 - Note: d_1 and d_2 are 180^o opposite

a. Set up a surveyor's level near the center of the tank. Using the level, mark four, level benchmarks on the tank wall at the same

height and spaced approximately 90° apart. See Figures 2.7a and 2.7b. Benchmarks should be in alignment with the jackscrews (drive leveling screws), as shown in Figure 2.7b.

b. Rotate the drive and stop one (and the same) rake arm at each of the four level points marked around the tank, and using a carpenter's level as an extension from that arm to the tank wall, make the second marks. These are shown as the "Reference Marks" in Figure 2.7a.

WARNING: Refer to the "Warnings" on drive rotation and lubrication on a previous page under "Lubrication, Electrical Wiring, Drive Rotation and Drive Controls."

c. Referring to Figures 2.7a and 2.7b, compare the difference in dimensions between the level marks and the rake arm reference marks at diametrically opposite sides of the tank (two directions, 90° apart).

d. The difference between the two observed dimensions (d1 minus d2) must not exceed the maximum out-of-level dimension below:

Mechanism Diameter	Maximum Out-Of-Level Tolerance (d1 minus d2)
50' [15,240 mm] or less	1/4" [6.35 mm]
100' [30,480 mm] or less	1/2" [12.70 mm]
150' [45,720 mm] or less	3/4" [19.05 mm]
200' [60,960 mm] or less	1" [25.70 mm]
250' [76,200 mm] or less	1-1/4" [32.05 mm]

2.7.2 Shim for Level

.1 Shimming may be necessary to level the drive. Maximum bearing life of the drive unit main bearing is dependent on proper leveling and shimming. Perfect final leveling is not practical; however, it should be as accurate as possible.

.2 In making a final shimming adjustment, care should be taken to tighten the drive mounting capscrews equally and to support each drive mounting capscrew, as necessary, with the proper thickness of shim material.

Uneven tightening and shimming may cause deformation of the bearing race, causing shortened bearing life.

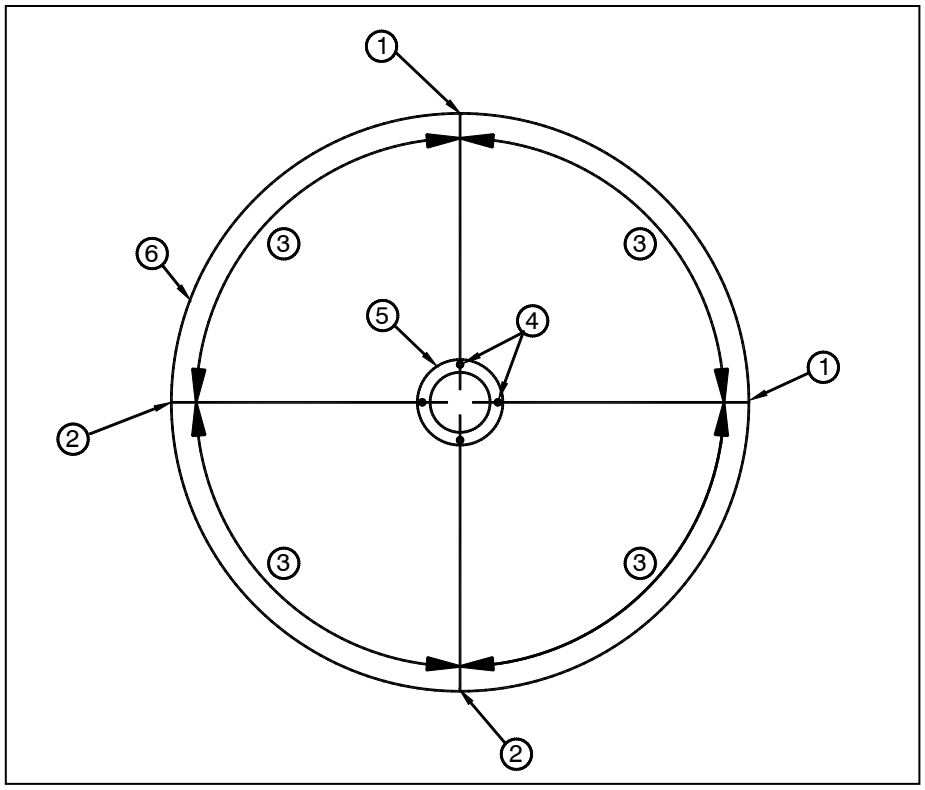


Figure 2.7b

1 – "d_1"	3 – 90°	5 – Column mounted drive unit
2 – "d_2"	4 – Jackscrews (drive leveling screws)	6 – Tank

2.7.2.1 Shims

Use only the stainless steel shims furnished by Ovivo and attached to the drive unit. They are provided in sizes and quantities to satisfy most requirements. If more shims are needed, contact the Ovivo Aftermarket Dept., referring to the telephone number on the Offices page in this manual and referring to the parts list for the shim package part number.

2.7.2.2 Shimming

a. Use the jackscrews provided in the drive base to level the drive. Be sure to release the drive mounting capscrews (4).

b. CHECK clearances between the drive base and column with a feeler gauge at each of the drive mounting capscrews. Mark

clearances on the drive base for ready reference.

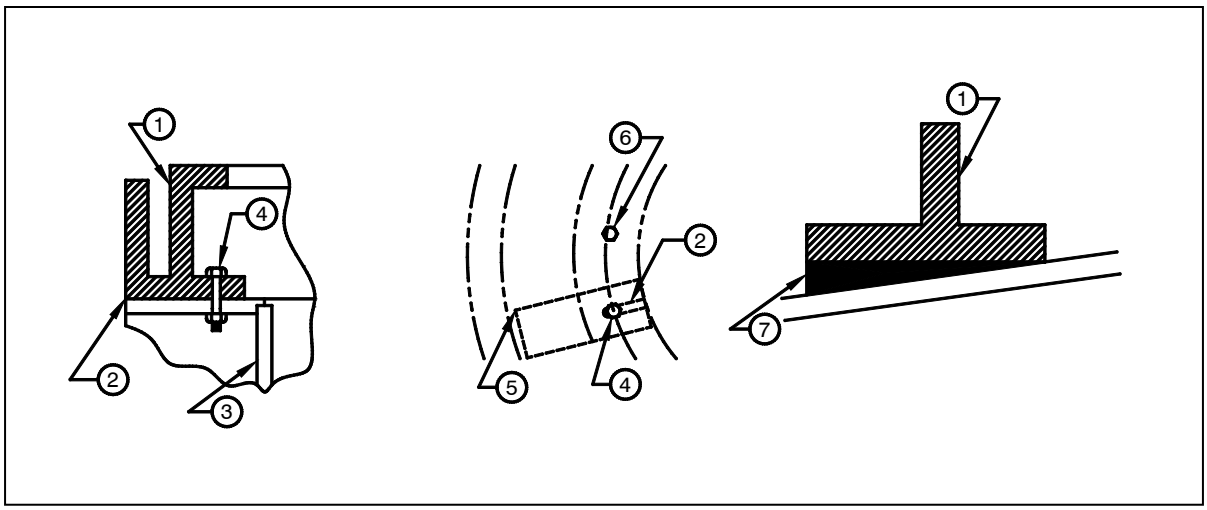


Figure 2.7c

1 - Drive base	5 - Shim completely in area of shim to within .005
2 - Shims	6 - Jackscrew
3 - Column	7 - Example of trimming shims for uneven column flange
4 - Drive mounting capscrew	

c. Shim at the mounting capscrews, using the Ovivo furnished shims and referring to Figure 2.7c. Insert shims from the outside of the drive to the inside. Since the shims ensure the level of the drive for optimum service life of the main bearing, use only these stainless steel shims provided by Ovivo. Do not use any other type of shims or shim material.

d. Back off the jackscrews so the drive is supported only by the shims. Recheck the level of the drive by rotating the arm to the level marks. Adjust as necessary until the drive is within specified level tolerance.

e. Tighten the drive mounting capscrews. Make sure that no jackscrews are supporting the drive.

INSTALLATION — Check the Cage for Final Plumb

1. Check the cage for plumb with a surveyor's instrument.

   Note: Checking and adjustment must be done when the steel is a uniform temperature, such as the early morning or an overcast day.

2. If it is necessary to adjust for plumb, loosen all capscrews (5) and jam nuts (8). Then adjust the cage for plumb using the adjusting nuts (7).

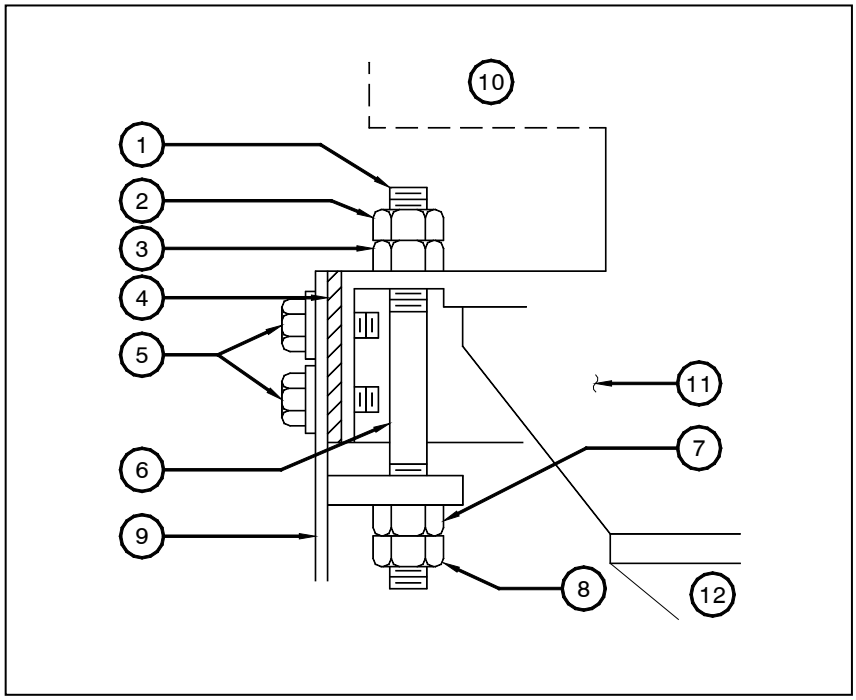


Figure 2.8a

1 - Avoid unnecessary projection of stud	7 - Adjusting Nut
2 - Jam Nut	8 - Jam Nut
3 - Adjusting Nut	9 - Cage (Ref)
4 - Shim as required for a tight fit	10 - Drive Platform or Upper Drive
5 - Capscrews and washers	11 - Drive
6 - Adjusting Stud	12 - Top of Column

3. Shim between the drive and cage at (4) for a tight fit, if necessary, and centering the cage around the drive.

4. Check the cage for centering around the drive.

5. Secure the stud jam nuts (8) when the cage is plumb. Tighten the capscrews at (5), but do not torque.

6. Check the arm blades for proper clearance with the tank bottom at the center of the mechanism, referring to the General Arrangement drawing. Raising or lowering the cage by means of the take-up studs and slotted connections between the drive and cage makes vertical adjustments. Use of jacks under the cage and arms for this adjustment is required. In this case, recheck the cage for plumb.

The purpose of this check is to ensure that all arms have proper and equal clearance with the tank bottom so that each arm is loaded equally, thus preventing unbalanced loading on the mechanism.

This adjustment must follow final leveling of the drive unit.

CAUTION: Checking and leveling must be done when the steel is at a uniform temperature such as the early morning or an overcast day.

1. Check that the arms and blades sweep at the clearance specified with the tank bottom and in the same plane. Checking is done by means of reference devices on the tank bottom such as a pile(s) of sand. Adjust or mark the device for the specified clearance of the spiral blades from the tank floor.

2. Rotate each arm to the place of the checking device. Minor clearance adjustments can be made using the slotted holes at the blade-to-arm connections. If additional adjustment is needed, adjust the arm for the required clearance by adding or removing shims equally at either the upper or lower connections, as necessary to achieve equal arm level. Use a jack to lift the arms to assist in this adjustment. Block under the opposite arm before the arm being adjusted is raised or lowered.

3. Weld arm-to-cage connections, if required.

WELDING WARNING: Use the piece being welded as the ground to prevent damage to the drive unit bearings due to electrical circuit contact.

4. If shims are used at the arm-to-cage connection, weld must be enlarged so that the load will be transferred from the rake arms to the cage, not from arms to shims.

1. Final Mechanical Checklist

a. At the completion of erection or installation of the equipment, an Ovivo Service Representative must complete a final field mechanical check of the equipment. Unless accepted and signed-off by the Service Representative at the completion, the warranty will not be in effect.

b. Previous inspections will not count towards final acceptance unless a sign-off is obtained, in writing, from the Service Representative. Also, depending on any previous inspections, this final check may be an additional paid service call.

2. Arrangements for Service

a. The "Final Mechanical Check List", included at the back of this manual, must be completed for each mechanism furnished before contacting your Ovivo representative to arrange for the final field mechanical check.

b. Arrangements for field mechanical check should be made at least two weeks in advance with your Ovivo representative. Refer to the Offices page to contact him.

3. Do Not Fill the Tank with Water

The mechanical check cannot be done if the tank is filled with water. If the check cannot be performed, an additional paid service day will be charged.

Lubrication

The drive is a combination of drive components manufactured by Ovivo, and accessory equipment (gearmotors) purchased from others. These instructions apply only to the components manufactured by Ovivo. Refer to the Accessories section of this manual for equipment provided by others.

CAUTION: Accessory equipment must be properly lubricated, as specified in the manufacturer's instructions, to maintain the equipment warranty. If you have any questions regarding proper lubrication of accessory equipment provided by Ovivo, contact your Ovivo representative referring to the Offices page.

Note: The drives are shipped without oil. **Fill each drive housing, initially, to the level indicated on the sight glass**, referring to "Oil Fill Procedure" below. Approximate oil quantities are listed below.

3.1.1 Drive Oil Quantities In Approximate U.S. Gallons

MODEL	MAIN GEAR	WORM GEAR
C60P-S1	46 gals	6 gals

CAUTION: Oil quantities are approximate only. Fill the main drive housing and the upper bearing housing assembly to the level indicated on the housing sight glass

Using the "Lubricant Number" specified (1, 2, or 3) determine the type of oil to be used in each drive housing. This will vary based on the "Ambient Temperature Range" to be expected at the equipment installation site. For temperatures outside of those ranges shown on the Lubrication Plate, contact the Ovivo Engineering Department. Refer to the Offices page.

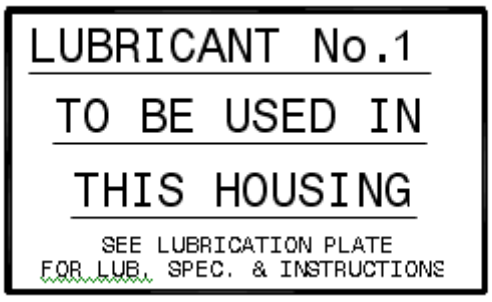
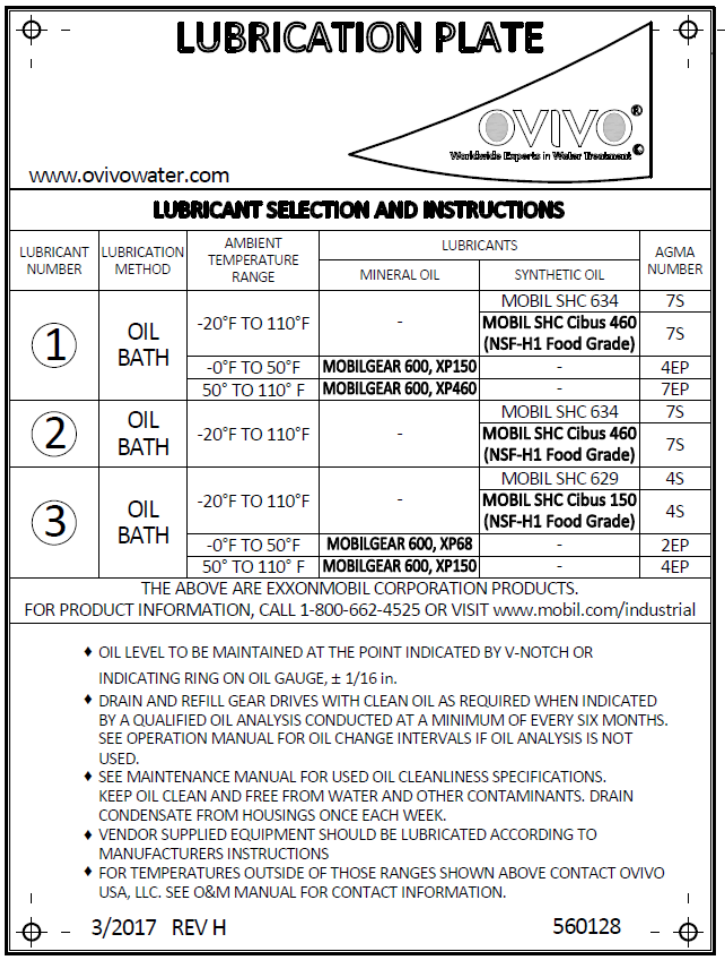


Figure 3.1a



LUBRICATION PLATE

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LUBRICANT SELECTION AND INSTRUCTIONS

LUBRICANT NUMBER	LUBRICATION METHOD	AMBIENT TEMPERATURE RANGE	LUBRICANTS		AGMA NUMBER
			MINERAL OIL	SYNTHETIC OIL	
1	OIL BATH	-20°F TO 110°F	-	MOBIL SHC 634	7S
				MOBIL SHC Cibus 460 (NSF-H1 Food Grade)	7S
		-0°F TO 50°F	**MOBILGEAR 600, XP150**	-	4EP
		50° TO 110° F	**MOBILGEAR 600, XP460**	-	7EP
2	OIL BATH	-20°F TO 110°F	-	MOBIL SHC 634	7S
				MOBIL SHC Cibus 460 (NSF-H1 Food Grade)	7S
3	OIL BATH	-20°F TO 110°F	-	MOBIL SHC 629	4S
				MOBIL SHC Cibus 150 (NSF-H1 Food Grade)	4S
		-0°F TO 50°F	**MOBILGEAR 600, XP68**	-	2EP
		50° TO 110° F	**MOBILGEAR 600, XP150**	-	4EP

THE ABOVE ARE EXXONMOBIL CORPORATION PRODUCTS.
FOR PRODUCT INFORMATION, CALL 1-800-662-4525 OR VISIT www.mobil.com/industrial

- OIL LEVEL TO BE MAINTAINED AT THE POINT INDICATED BY V-NOTCH OR INDICATING RING ON OIL GAUGE, ± 1/16 in.
- DRAIN AND REFILL GEAR DRIVES WITH CLEAN OIL AS REQUIRED WHEN INDICATED BY A QUALIFIED OIL ANALYSIS CONDUCTED AT A MINIMUM OF EVERY SIX MONTHS. SEE OPERATION MANUAL FOR OIL CHANGE INTERVALS IF OIL ANALYSIS IS NOT USED.
- SEE MAINTENANCE MANUAL FOR USED OIL CLEANLINESS SPECIFICATIONS. KEEP OIL CLEAN AND FREE FROM WATER AND OTHER CONTAMINANTS. DRAIN CONDENSATE FROM HOUSINGS ONCE EACH WEEK.
- VENDOR SUPPLIED EQUIPMENT SHOULD BE LUBRICATED ACCORDING TO MANUFACTURERS INSTRUCTIONS
- FOR TEMPERATURES OUTSIDE OF THOSE RANGES SHOWN ABOVE CONTACT OVIVO USA, LLC. SEE O&M MANUAL FOR CONTACT INFORMATION.

3/2017 REV H 560128

Figure 3.1b

3.1.2 Check oil levels weekly.

.1 A general oil level check can be made while the drive is operating, but to be more accurate, stop the drive a few minutes to allow the oil to settle. Adding oil in excess of the amount required could cause oil to over flow.

.2 Drain condensate once a week. This will keep the oil free of water and other contaminants. Refill to operating level.

3.1.3 Clean the sight glass vent opening.

If the vent opening in the top screw plug is clogged or dirty, a sight glass will not show the correct oil level and it may not show an oil level at all. Check monthly.

DRIVE UNIT VENT CAUTION: Vent holes in vented pipe plugs must be kept clear of dirt, paint or other foreign material.

3.1.4 Replace the oil

If the oil is **not** tested by qualified oil analysis, then oil change intervals are as follows:

Initial Replacement: All gear housings should be drained and refilled with fresh oil, referring to "Oil Fill Procedure" below, after the first 500 operating hours.

Regular Oil Replacement: Mineral oil should be replaced each year, unless ambient temperatures dictate otherwise. Refer to the Lubrication Plate. Synthetic oil should be replaced every two years or as required by oil analysis.

Oil Fill Procedure: Stop the drive, then drain the housing and refill with fresh oil. At first, until the oil settles, a sight glass will not show an accurate oil level, due to settling time, trapped air and other factors. Allow the drive to sit at least 10-15 minutes after filling to check the oil level. Adding oil in excess of the amount required could cause oil to over flow.

3.1.5 Check the oil condition

.1 Ovivo recommends that oil samples are sent to a commercial laboratory for analysis. This is not required.

.2 Every six months, take an oil sample (100 ml, or 4 oz.) from the drain piping of each housing (worm gear and main gear), using a clean receptacle to collect each sample (allow the oil to flow from the drain until water and other settled contaminants are no longer present and the oil consistency is uniform). Refill the drive housings to operating level.

3.1.6 Drive chain - Lubricate monthly with spray-on chain lube (not by Ovivo), while the drive is running, using the access hole in the side of the chain guard.

3.1.7 **Sight Glass Replacement** - If the oil level sight glass is replaced, it must be notched to show the oil level. Do likewise for drives shipped without the oil level notched.

Contact your Ovivo representative before using a synthetic bearing and gear oil that is not listed as an equivalent. Physical characteristics of Mobil SHC® 600 series synthetic oils are listed below:

Physical Characteristics of Mobil SHC series oil	Mobil SHC 629	Mobil SHC 634
Product Number	60294-6	60291-2
ISO Viscosity Grade	150	460
Specific Gravity	0.866	0.867
Gravity, API	32.4	31.4
Pour Point, °C (°F) max, ASTM D 97	-45 (-49)	-42 (-44)
Flash Point, °C (°F) min, ASTM D 92	245 (473)	250 (482)
Viscosity, ASTM D445 cSt at 40° C cSt at 100° C	 142.8 18.3	 436.4 44.9
Viscosity Index, ASTM D 2270	144	159
Copper Corrosion 24 Hrs at 121° C, ASTM D130	1B	1B
Rust Protection ASTM D665A and 665B, Distilled and Synthetic sea water	Pass	Pass
FZG Scuffing, Fail stage, DIN 51534	13	13+
Color, ASTM D1500, Max	3.5	3.5
TOST Life, Hrs., ASTM D943-2	10,000+	10,000+

3.2.1 Recommended and Synthetic Oils

MANUFACTURER	**SYNTHETIC OILS** **AGMA EQUIVALENT NUMBER**/VISCOSITY cSt AT 40°C	
	4 SYN/ ISO150	**7 SYN/** ISO460
MOBIL	*SHC 629	*SHC 634
TRIBOL	800/150	800/460

* Synthesized Hydro Carbon

3.2.2 Petroleum Based and Food Grade Oils

MANUFACTURER	**PETROLEUM BASED OILS** **AGMA EQUIVALENT NUMBER**/VISCOSITY cSt AT 40°C		
	2EP/ISO 68	**4EP**/ISO 150	**7EP**/ISO 460
MOBIL	Mobilgear 600, XP 68	Mobilgear 600, XP 150	Mobilgear 600, XP 460
AMOCO	Permagear EP #68	Permagear EP #150	Permagear EP #460
EXXON	Spartan EP-68	Spartan EP 150	Spartan EP 460
GULF OIL	EP Lubricant H.D. 68	EP Lubricant H.D. 150	EP Lubricant H.D. 460
TEXACO	Meropa 68	Meropa 150	Meropa 460
PHILLIPS	All Purpose Philgear (ISO Grade 68)	All Purpose Philgear (ISO Grade 150)	All Purpose Philgear (ISO Grade 460)

MANUFACTURER	**PETROLEUM BASED OILS** **AGMA EQUIVALENT NUMBER**/VISCOSITY cSt AT 40°C		
	2EP/ISO 68	**4EP**/ISO 150	**7EP**/ISO 460
SHELL	Omala 68	Omala 150	Omala 460
STANDARD OF CALIFORNIA CHEVRON USA	Chevron Gear Compound NL68	Chevron Gear Compound NL150	Chevron Gear Compound NL460
SUN OIL	Sunep 68	Sunep 150	Sunep 460
KEYSTONE	Zeniplex - 2	Keygear 90	Keygear 140
LUBRICATION ENGINEERS	Monolec 300	Almasol 604	Almasol 608

MANUFACTURER	**FOOD GRADE OILS** **AGMA EQUIVALENT NUMBER**/VISCOSITY cSt AT 40°C		
	2EP/ISO 68	**4EP**/ISO 150	**7EP**/ISO 460
MOBIL	CIBUS 68	CIBUS 150	CIBUS 460
ROYAL PURPLE	POLYGUARD FDA 68	POLYGUARD FDA 150	POLYGUARD FDA 460
SUMMIT	N/A	SYNGEAR 150	SYNGEAR 460

3.2.3 Grease Equivalents

CAUTION: Do not mix lubricant types without first verifying product compatibility. Contact your Ovivo representative. When changing to a product that is not compatible with existing lubricant, the existing lubricant (oil or grease) must be completely removed before the new lubricant type is installed.

MANUFACTURER	**GREASE**	MANUFACTURER	**GREASE**
	NLGI No. 2 EQUIVALENT**		**NLGI No. 2** EQUIVALENT**
MOBIL	Mobilgrease XHP222 (mineral) Mobilgrease SHC200 (synthetic)		
AMOCO	Rykon #2	STANDARD OF CALIFORNIA CHEVRON USA	RPM Multimotive #2

** NLGI #2 antiwear (EP) lithium complex (high temperature) grease.

MANUFACTURER	**GREASE**	MANUFACTURER	**GREASE**
	NLGI No. 2 ** **EQUIVALENT**		**NLGI No. 2** ** **EQUIVALENT**
EXXON	Ronnex MP		
GULF OIL	High Temperature Grease	SUN OIL	Sunaplex 992 EP
TEXACO	Multipak EP2	KEYSTONE	81 EP-2
PHILLIPS PET	Philube 2 EP	LUBRICATION ENGINEERS	Alma-Gard 3752

** NLGI #2 antiwear (EP) lithium complex (high temperature) grease.

Maintenance

4.1.1 Safety Statement

No personnel, authorized or unauthorized, should depend wholly on safety devices to prevent accidents. Safety features and devices are meant only to supplement proper, careful, and safe practices on the part of the individual.

WARNING: If the safety procedures given in this manual are compromised or ignored, severe personal injury or death may occur. Safety practices accepted by the industry, as well as those dictated by the responsible regulatory agencies must be followed.

PERSONNEL SAFETY WARNINGS

WARNING: Use extreme care when working around rotating or other moving parts, to prevent injuries to yourself or others. Also, anyone entering the area of this equipment must be wearing adequate safety equipment such as safety glasses, safety shoes, hard hat, etc. Loose fitting clothing, uncovered long hair, or jewelry must not be worn when working around rotating or moving equipment.

WARNING: Keep foreign objects, hands, etc. away from moving parts. Do not operate this equipment if guards have been removed, or are damaged. All guards and safety devices must be properly installed and functional before operating this equipment.

WARNING: Lock-out power from electrical equipment using a manual breaker or disconnects switch before starting any work or maintenance on the equipment. Lock and tag disconnect switch so it cannot be closed.

WARNING: Before attempting any maintenance or adjustments on the drive, refer to the "Drive Maintenance Warning".

WARNING: Experience with and understanding of this equipment is essential for the safe disassembly and repair of the equipment. Therefore, in case of a question on how to safely proceed, contact Ovivo immediately.

WARNING: The fumes given off during welding and cutting can be injurious to the operator's health. Some fumes, such as those produced when working with Zinc, Cadmium and painted surfaces can be toxic.

4.1.2 Before Operation, Maintenance or Repair of this Equipment:

Read and understand the instructions in this manual.

.1 As with any other mechanical equipment, there are safety concerns associated with the operation and maintenance of Ovivo supplied equipment. It is absolutely essential, therefore, that operators, maintenance personnel, and supervisors be instructed in safe working practices

.2 Only personnel who have been trained in safety procedures for this equipment should be allowed around or in the area of the Ovivo equipment or its auxiliaries. Training can be done by your own safety personnel or it can be conducted by an Ovivo representative at your request. Contact Ovivo Engineering, Salt Lake City, Utah. Refer to the Offices page listed on the Table of Contents.

4.1.3 Check Points Before Start-Up

Note: The drive and mechanism must be level and checked by an authorized Ovivo representative before start-up.

.1 Remove any foreign matter from inside the tank. Remove any blocking or shoring used in the erection of the equipment.

.2 Check the oil levels in the main drive and upper bearing housing assembly. Refer to Drive Lubrication Instructions. Check the motor drive, referring to the Manufacturer's Instructions.

.3 Make sure the load cell drive control was checked for proper operation, referring to the General Drive Maintenance Instructions in this manual.

.4 Make sure the drive platform and walkway are clean and free of oil, debris and tools. Make sure all drive cover guards are in place and secure.

WARNING: Do not operate this equipment if guards have been removed, or are damaged. All guards and safety devices must be properly installed and functional before operating this equipment.

.5 Rotate the arms for at least 4 or 5 revolutions. Make all observations from outside the tank.

This procedure should be conducted when distortion from sunlight would be at a minimum, such as, early morning or an overcast day.

.6 Watch for clearance of the rake arm blades and/or squeegees with the tank bottom. Check for loose parts, bolts and nuts.

4.2.1 Motor Maintenance Record

Refer to manual for instructions. Maintenance records must be logged and available for review to maintain warranty

DATE	ITEM - BASIN #, UNIT #	VOLUME/TYPE GREASE/RESISTANCE	REMARKS	INITIALS

4.2.2 Gear Reducer Maintenance Record

Refer to manual for instructions. Maintenance records must be logged and available for review to maintain warranty

DATE	ITEM - BASIN #, UNIT #	VOLUME-TYPE OIL/GREASE-% WATER	REMARKS	INITIALS

MAINTENANCE

Maintenance Summary

MAINTENANCE PROCEDURE	FREQUENCY	LUBRICANT (IF APPLICABLE)	COMMENTS/ REFERENCES
Drive:			
Check oil level in both the upper bearing housing and main gear housing	Weekly	Refer to the lubrication plate mounted on the drive unit	Replace oil as necessary. Oil must be kept clean
Drain condensate from the main gear, and upper bearing housings	Weekly	Refer to the lubrication plates on the drive unit	Refill with oil as necessary
Make sure vent holes in vented pipe plugs and sight glass vent openings are clear	Monthly		Vent holes in vented pipe plugs (if used) and sight glass vent openings must be kept clear of dirt, paint or other foreign material.
Have samples of drive oil (all housings) checked for condition	After first 500 operating hours, then every 6 months thereafter		Refer to the Lubrication Instructions for “Used Oil Cleanliness Specifications”
Change oil – main gear and upper bearing housing	When indicated by a qualified oil analysis, or annually/bi-annually if oil analysis is not used	Refer to the lubrication plates on the drive unit	Replace oil as necessary; it must be kept clean. Refer to the lubrication Instructions
Check connections between the cage (not by Ovivo) and main gear	Monthly		Refer to the Cage Installation Instructions
Inspect gears & bearings for wear. Replace internal oil seals, if necessary (main gear and upper bearing housing assembly)	Yearly		Refer to the Manufacturer's Instructions

4.4.1 Check Drive Rotation

.1 Check the new motor for direction of rotation before the drive chain is installed, referring to the directional "arrow" on the drive cover, chain guard, and/or Motor Drive Assembly drawing.

.2 If the drive unit is not turning in the proper direction of rotation, the drive unit warranty will be void and Ovivo will not accept costs for drive damage.

4.4.2 Check Drive Sprocket Alignment

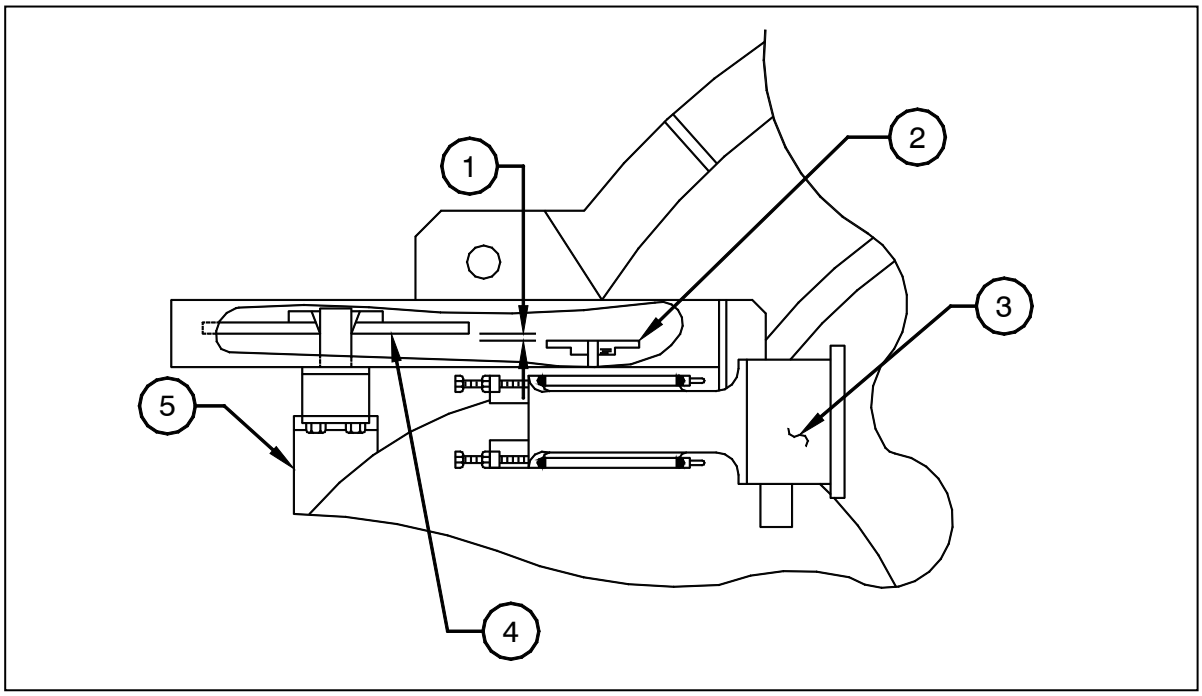


Figure 4.4a

1 - 1/8" offset at zero load	4 - Driven Sprocket
2 - Drive Sprocket	5 - Worm Drive
3 - Gearmotor	

Because the worm shaft and its driven sprocket (4) will be displaced inward under load, check that the driven sprocket (4) is offset 1/8" inward from true alignment with the motor's drive sprocket, as shown in Figure 4.4a. Adjust driven sprocket if out of alignment, referring to the Motor Drive Assembly drawing. This initial setting, then, will allow for near true alignment under normal load.

4.4.3 Check Chain Tension

Proper chain tension is essential for maximum drive and chain life, as well as for smooth and quiet operation of the drive. Chains that are too tight can damage drive motor/reducer bearings, or cause broken chains. Loose chains will clatter and can come off the sprockets.

.1 Chains should be installed with only a small amount of slack. New chains will loosen up slightly as the joints seat themselves, causing initial elongation of the chain.

.2 After several weeks of operation, chain tension should be rechecked, and adjusted as necessary.

.3 Refer to the Lubrication instructions for proper lubrication.

4.4.4 Drive Unit General Maintenance

.1 These drive units consist of a main gear on the bottom, which is the main driving unit for the rake arms, and a worm gear assembly on top which drives the main gear with a pinion.

.2 The worm gear drive is designed with a worm shaft that moves axially under loaded conditions of the drive unit. This movement is made possible by a thrust bearing with a sliding bearing seat arrangement on the loaded side of the worm.

.3 The sliding bearing seat is held in place by a spring, and the compression of that spring, when the drive is under load, indicates the torque on the drive unit. When the spring compresses, its movement is transmitted by the movement of the bearing seat against an actuating pin screwed into the drive control actuator pointer. The spring is calibrated for load at the factory.

4.4.5 Drive Control General Maintenance

.1 The drive control, which mounts to the worm housing, protects the drive unit and mechanism in case of overload, such as an excessive solids load on the rake arms.

.2 Basically the drive control consists of the actuating pin in the actuator pointer, the scale, a camshaft and cams and switches. The actuating pin, which connects to the sliding bearing seat in the worm drive assembly, rotates the actuator pointer, which rotates the cam shaft, as the sliding seat moves when load is applied to the mechanism.

.3 The cams rotate with the camshaft and they actuate the switches at various load settings as they rotate. At the same time, the pointer shows the amount of torque on the drive on the scale, which is graduated, into percents from 0 to 100.

.4 CHECK the drive control once a year for condition and operation, as follows below:

Note: In areas with wide variations in temperature, at first check the drive control once a month for condensation and for operation until a reasonable inspection frequency can be determined.

.5 Start the motor drive.

.6 Remove the cylindrical switch housing, unscrewing it from the base. Then manually actuate the cam switches by turning the camshaft (and pointer) with the set collar (end of camshaft). Slowly turn the pointer through a complete range to 100. This will simulate a mechanism full load condition. At the set points the alarm should sound and the drive motor should stop.

.7 If the drive control does not react correctly, check each switch individually.

.8 If none of the cam switches actuate, as stated above, recheck the wiring (not by Ovivo) to the drive control. Refer to the Manufacturer's Wiring Diagrams.

.9 If the wiring is correct, check the cams for proper setting and check the actuation pin to be sure it is in position and not bent. Contact your Ovivo Representative if the problem cannot be determined.

.10 Replace the switch housing cover, being sure it goes on straight to ensure a tight seal. Tighten the switch housing cover a minimum of ½ turn after contacting the O-ring.

4.4.6 Electrical Equipment and Enclosures

.1 Electrical enclosures for the motor, drive control panels, etc. are listed on the drawings and Ovivo parts list.

.2 If any electrical equipment, including motors, is to be replaced, it must be of equal or better rating. Refer to the latest edition of the NEMA ICS (National Electrical Manufacturer's Association Industrial Control Standards) and NEMA MG 1 (N.E.M.A. Motors and Generators) for a description of those enclosure designations.

DRIVE CONTROL CAUTION:

The drive control is the overload cutout device for the drive. Since it is installed and adjusted at the factory for proper operation, do not tamper with it. If the original cam settings are not considered satisfactory for the operating conditions, contact your Ovivo Representative before attempting any adjustment.

WARNING: If the drive unit stops due to an overload do not attempt to restart the unit until the cause of the overload has been located and corrected. Refer to the Drive Maintenance **WARNING** instruction in this manual.

4.5.1 The Shear Pin Sprocket

The shear pin sprocket is furnished as a backup overload device to the drive control. For example, if the drive is not stopped by the drive control, during a high torque overload, the shear pin will fail and disconnect the motor drive from the drive unit.

4.5.2 Shear Pin Selection

.1 The shear pin furnished with this drive has been selected for the torque required for this drive and mechanism. The torque limit of the shear pin sprocket depends on the size of shear pin. See Figure 4.5a. Do not replace the shear pin with any other material or other size pin.

.2 In case of shear pin failure, first determine the cause of the failure and then replace the shear pin. The replacement pin must be identical to the pin that was furnished with the drive. Refer to the shear pin assembly number and shear pin neck size listed below.

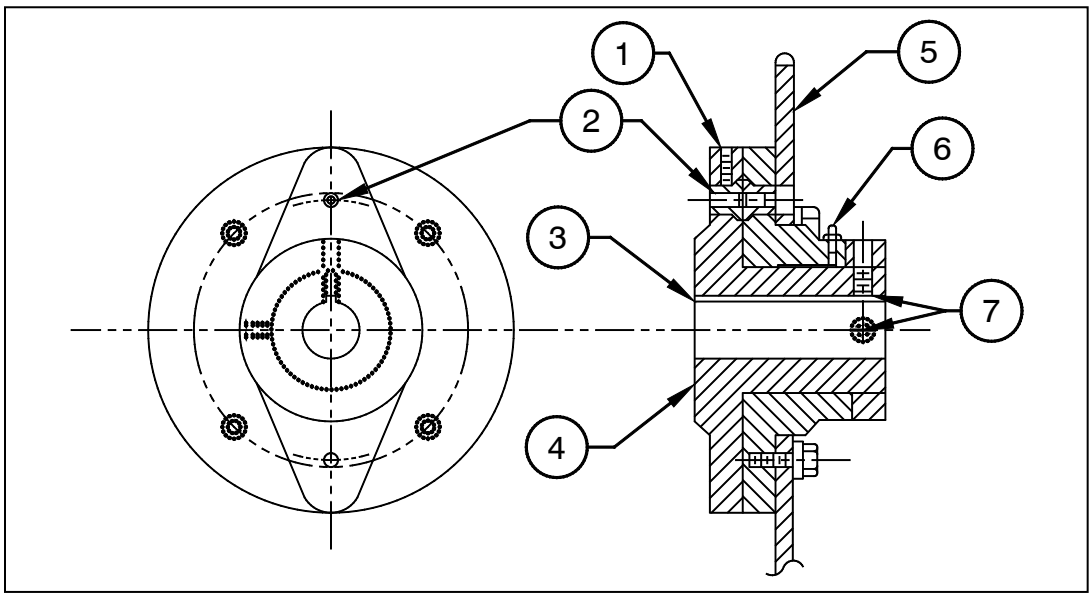


Figure 4.5a

1- Set Screw	4- Hub	7- Set Screw
2- Shear Pin	5- Sprocket	
3- Key	6- Grease Fitting	

SHEAR PIN ASSEMBLY – No. SP-22
SHEAR PIN NECK DIA. – 9/64”

4.5.3 Maintenance

The shear pin assembly requires lubrication. Lubricate with Mobilgrease 1S XHP 222 (or equal) every 6 months.

Inject grease via the grease fitting using a grease gun (not by Ovivo).

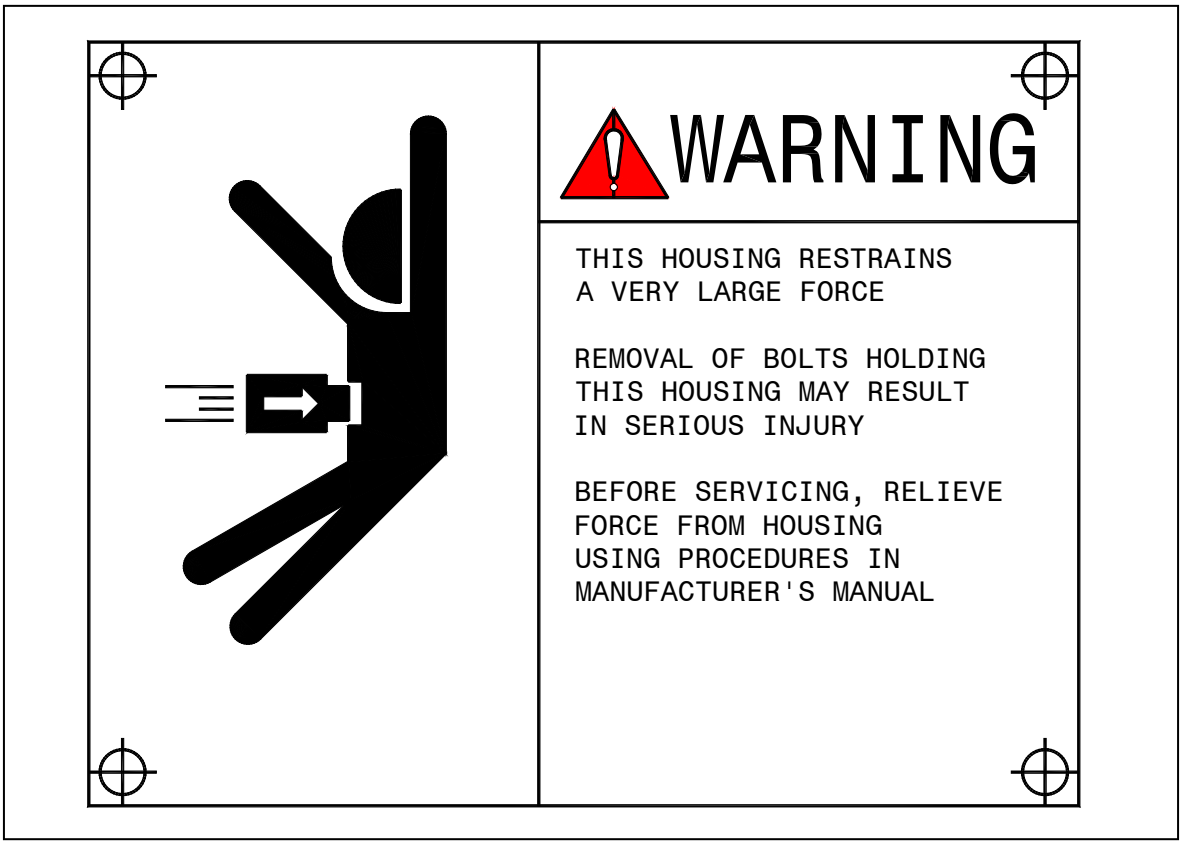


Figure 4.6a

This Drive High Torque Shutdown **WARNING** plate on the drive unit is there to warn you of possible danger before you service the drive.

When a raking mechanism drive shuts down due to high torque load, it might have stored spring force energy. This energy can be dangerous to those who service the drive unit in returning it to operation, if the energy is not relieved in a safe way.

The stored energy is most likely in two areas: (1) the torque control spring which is located in the worm drive housing and (2) the elastic deformation of the rake arms and rake cage, which is caused by the torsional load.

4.6.1 How to Check for Stored Energy:

Check the drive control. If the arrow indicates any torque above zero "0" as in Figure 4.6b, the drive assembly has stored energy. That is dangerous and must be relieved as covered below.

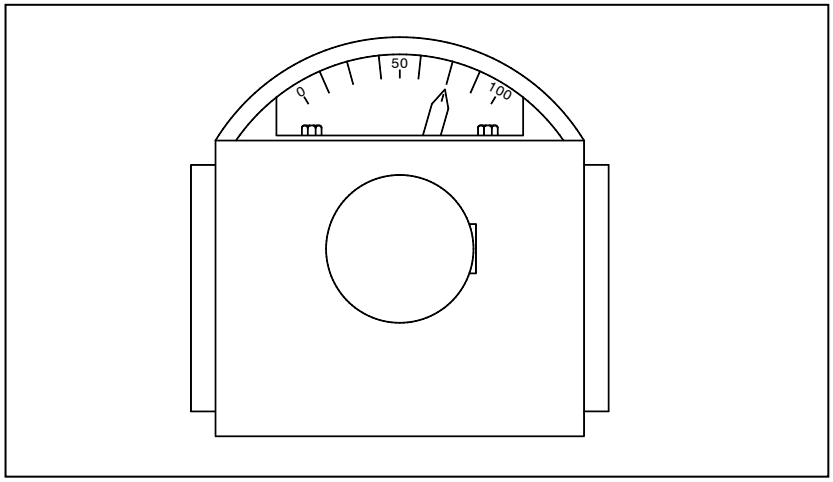


Figure 4.6b

The right-hand drive control is shown in Figure 4.6b. It shows dangerous stored energy in the amount of 70%.

4.6.2 How to Relieve Stored Energy:

The **only** safe way to relieve stored energy is to use the motor to reverse the drive unit. All other methods are hazardous.

Reversing the motor will require temporary alteration of the wiring so the motor can be jogged in reverse:

.1 Exchange the motor leads as required for reversing motor direction of rotation per the motor manufacturer's instructions.

Note: The customer is responsible for altering his own plant wiring.

.2 Close the torque control circuit.

.3 Disconnect the "hold-in" circuit in the motor starter circuit so that only jogging can be done.

.4 The pushbutton used for jogging must be located where the operator can watch the drive control arrow.

.5 Reverse the motor in jogs of **only** 1-second duration to avoid drive damage. Watch the drive control indicator movement and progress towards relaxing the stored energy. Discontinue reverse jogging immediately when the drive control indicates zero torque, since a drive

can damage itself and other components when running in reverse without torque control protection.

.6 Now correct the cause of the shutdown/overload as required before proceeding.

.7 Restore all wiring to its normal operating condition.

4.6.3 Dangerous Methods to Relieve Stored Energy

Do not attempt to reverse the drive unit to relieve stored energy by pulling the chain backwards, or, disconnecting the chain, as shown in Figure 4.6c. The worm shaft may spin suddenly, pulling in fingers and hands, or if a wrench or pry bar is used, it may be ejected violently.

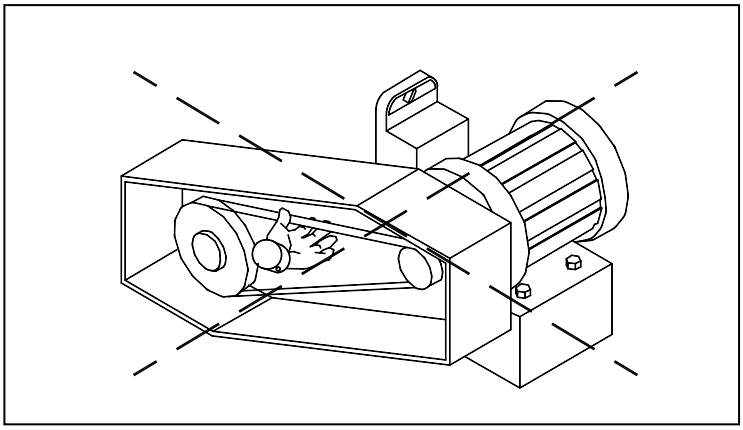


Figure 4.6c

DO NOT ATTEMPT

Do not disassemble a drive unit while there is stored energy, as shown in Figure 4.6d. Parts of it may release suddenly, when some of the fasteners are loosened, causing serious injuries and machine damage. This danger is greatest at the worm drive end cap where the spring is housed, which can burst away from the worm housing if the fasteners are unscrewed.

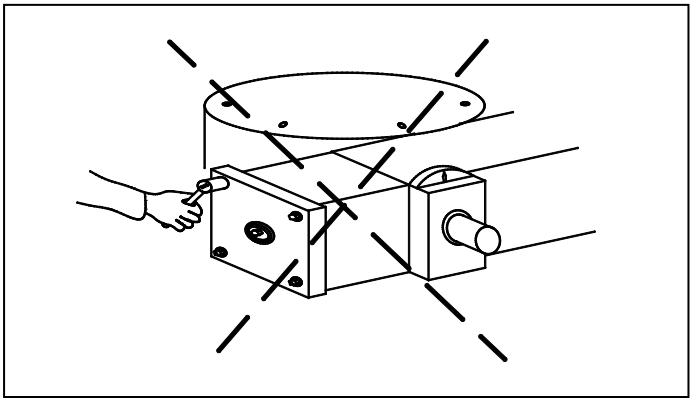


Figure 4.6d

DO NOT ATTEMPT

4.6.4 Safety Signs

Two signs are installed on the drive unit to warn personnel of unsafe practices: (1) "**CAUTION**" sign 204181A on chain guards cautions personnel to follow the manufacturer's instructions.

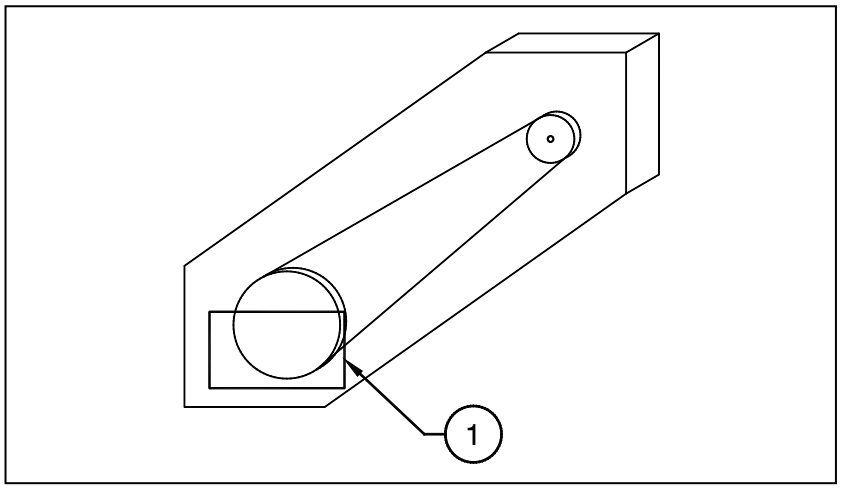


Figure 4.6e

1 - **CAUTION** Sign Installation- Typical for chain guard. Sign 204181A

"**WARNING**" sign 49045A on the torque control spring end cap (shown previously) warns about relieving the spring energy before attempting to remove the end cap.

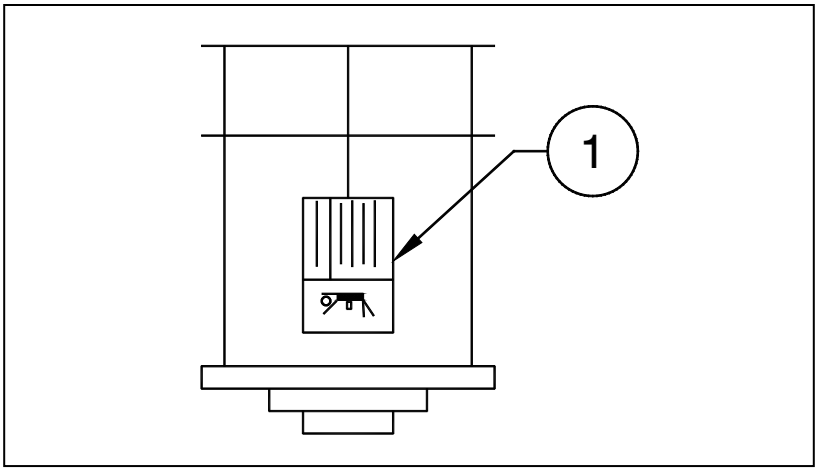


Figure 4.6f

2 - **WARNING** Sign Installation- Most common end cap shown. Sign 49045A

WARNING: Check the drive for torque, referring to the preceding "Drive Maintenance **WARNING**" before starting disassembly. Make sure the power to the drive has been disconnected to prevent it being accidentally started.

4.7.1 Removal of the Worm Drive

.1 Remove the guards and then disconnect all gearmotors

CAUTION: Refer to the Caution in the "Drive Maintenance" instructions

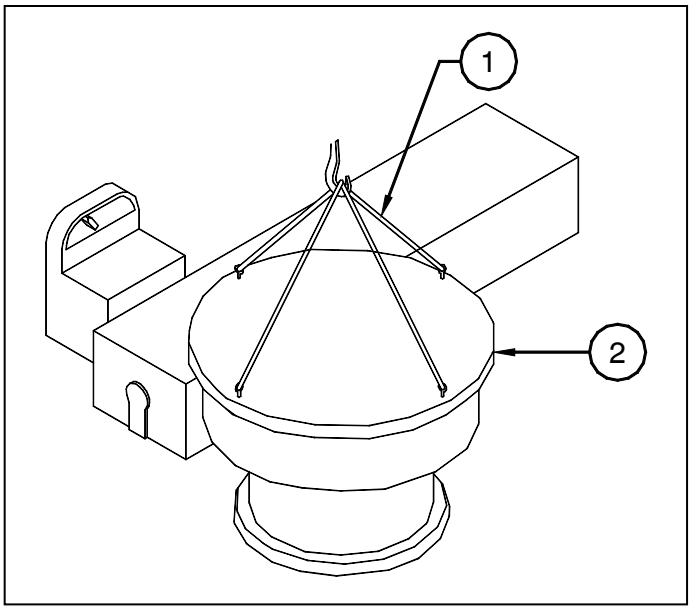


Figure 4.7a

1 - Lifting cables	2 - Worm gear drive assembly

.2 Drain the oil from the worm housing.

.3 Remove the capscrews (28), connecting the worm housing (21) to the secondary drive (refer to Figure 4.7c).

.4 Lift the worm gear drive assembly from the lower drive, referring to the

lifting illustration. See Figure 4.7a. Place four (4) eye bolts symmetrically through the upper cover screw holes into the housing and lift with cables. If shims are in place between the worm housing and lower drive, match mark them so they can be returned to their original positions.

CAUTION: Use care when removing the unit from the secondary gear to prevent damage to the drive control, pinion, secondary main gear and bearings.

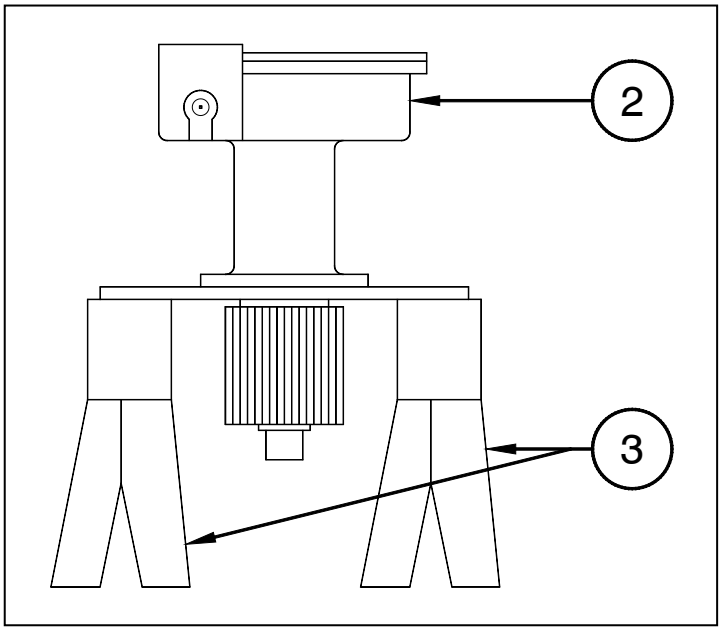


Figure 4.7b

2 - Worm gear assembly	3 - Support

.5 Place the worm gear unit on saw-horse type supports as shown in Figure 4.7b. Make sure this device will support the weight of the worm gear unit.

4.7.2 Disassembly of the Worm Drive

.1. Remove the switch cover and switch bracket with limit switch from the end cap. Remove the boot and hose clamps, if used. Remove the cam and jam nut from the end of the actuator rod.

.2 Remove the capscrews and end cap (6). Remove the spring seat (7) and the spring (8). Remove the "Centering Device", as used, from the stop rod (Refer to the Worm Gear Assembly drawing).

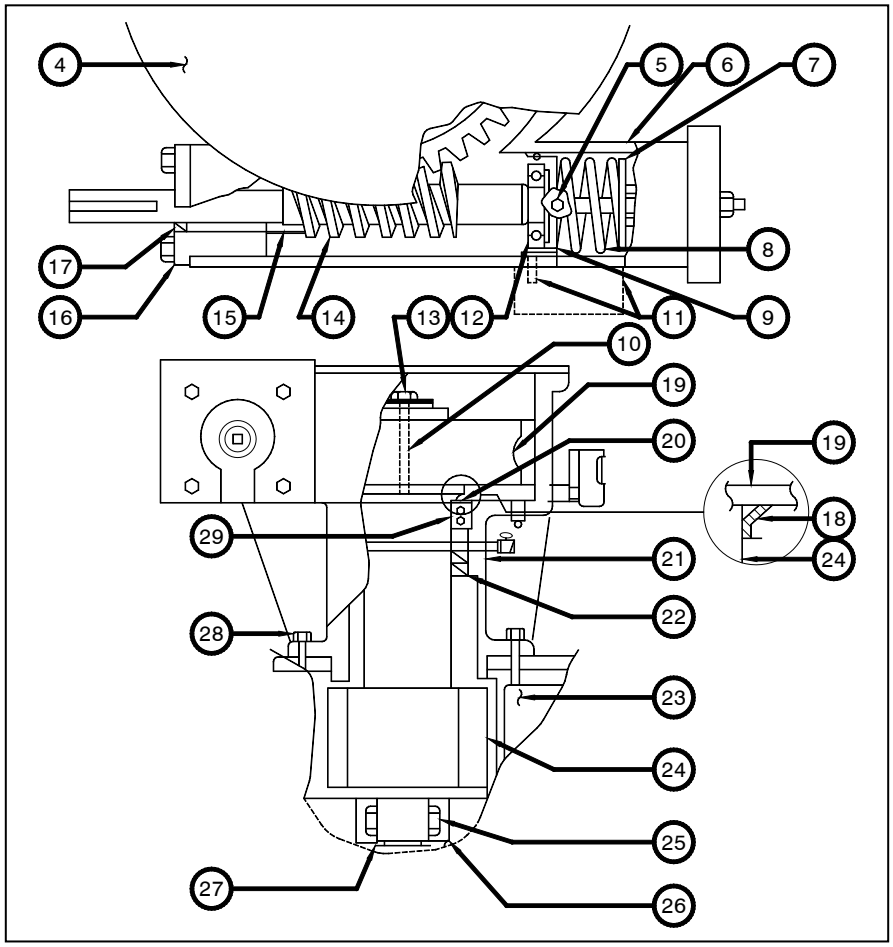


Figure 4.7c

4 - Housing cover	13 - Lock nut and lock washer	22 - Oil seals
5 - Pipe Plug, if furnished	14 - Worm shaft	23 - Secondary drive (Reference)
6 - End cap	15 - Reverse thrust sleeve (or bearing)	24 - Pinion
7 - Spring seat	16 - Bushing housing	25 - Bearing race
8 - Spring (with centering device, if used)	17 - Oil seals	26 - Outer race
9 - Sliding bearing seat	18 - Disc spring & spacer	27 - Retaining ring
10 - Key	19 - Worm gear	28 - Capscrew
11 - Drive control pin	20 - Retaining ring	29 - Pinion bearing
12 - Bearings	21 - Worm housing	

.3 Remove oil seals (17), capscrews and bushing housing (16).

.4 Remove the drive control and drive control pin (11).

.5 Remove the worm shaft (14) reverse thrust sleeve (or bearing) (15) and bearings (12) with sliding bearing seat and stop rod (9) by turning the worm shaft so that the worm moves to the non-drive end. Do not remove the actuator rod from the end of the stop rod, if used.

.6 Remove the housing capscrews and cover (4).

.7 Place blocking under the pinion (24) to prevent it from falling out of the drive when the lock nut (13) and washer (13) are removed. Remove the gear lock nut (13), lock washer (13) and the key (10) (the 3/8 UNC tapped hole on the top of the key is to help in removing the key). Remove the worm gear (19) and the spring disc and spacer (18).

.8 Support the pinion (24) (using an eyebolt in the top of the pinion) and lower it down through the housing as the blocking is removed.

.9 Remove the bearing retaining ring (20). Remove the pinion bearing (29) using a puller. Remove the oil seals (22).

.10 Remove the retaining ring (27) and the bearing race (25) from the end of the pinion. Remove the outer race (26) from the bottom of the main gear housing.

.11 Remove the reverse thrust sleeve (15) sliding bearing seat (9), and bearing (12) from the worm shaft (14). Use a bearing puller if necessary.

Note: Some drive units have a thrust bearing in place of the thrust sleeve (15).

4.7.3 Inspection

.1 Inspect the teeth of the worm gear and pinion and the worm for the following:

a. ABRASIVE WEAR: Wear will show at random spacing across the gear teeth and worm. This is normally caused by dirt or other foreign material in the lube oil.

b. SCORING: This is shown by vertical scratches and/or grooves running from the pitch line (approx. center of tooth) to the top of

the tool or worm. It can result from improper lubrication or abrasive materials in the lubricant.

c. PITTING: It is evident in large or numerous pits in the gear teeth and worm. Note that small pits may occur during run-in of a new gear, but these will smooth out as the gear wears in. It is caused by overload, poor lubrication or improper lubricant.

d. GALLING: This condition appears as numerous deep grooves or gouges and it is caused by overload of gearing for the lubricant used.

e. NORMAL WEAR: Eventually all gears and worms wear out due to long use and/or prolonged overload. Replacement should be considered based on the condition of the gearing and extent of the wear.

.2 Depending on the condition of the worm gear, replacement may be required depending on the severity of the condition and the affect that a breakdown would have on the operation. Small scratches can be removed by repolishing the surface but if the scratches are large or deep, such as galling, replacement of the worm may be necessary, since the operating life would be limited. Would failure cause damage to the components? Cause production stoppage?

.3 Inspect the bearing balls for pitting or scoring. If there is any question about the condition of a bearing, it should be replaced.

.4 All parts should be cleaned with a solvent, and then coated with a light oil for inspection. Never rotate a dry bearing.

4.7.4 Reassembly of the Worm Drive

CAUTION: Gaskets in the drive unit are not to be used, except where specified on the assembly drawings and parts list.

Notes:

(a) Take care to prevent dirt or foreign matter from getting into the worm assembly. All parts must be cleaned with a solvent before assembly and then blown dry. Coat the bearings and seals with a film of oil.

(b) Inspect all parts for damage or wear and replace as necessary.

(c) Check all bearings for pitting, roughness of rotation or scoring. Replace all bearings on a shaft if one is defective.

(d) Coat all bearings and bushings liberally with grease or oil before they are installed.

(e) Oil seals are subject to deterioration and should be replaced with new seals when the unit is reassembled, even though the deterioration may not show.

.1 Mount the inner pinion bearing race (25) on the pinion shaft (24) and install the retaining ring (27). Install the outer race (26) into the main drive housing.

.2 Install the oil seals (22) inside the worm housing (21), referring to Figure 4.7d. The oil seals must be installed as shown with the lips facing upwards.

.3 Pull the pinion (24) up through the worm housing (21) with an eye bolt and cable and support the pinion from below with blocking. First cover the keyway with tape to prevent it from cutting the seals.

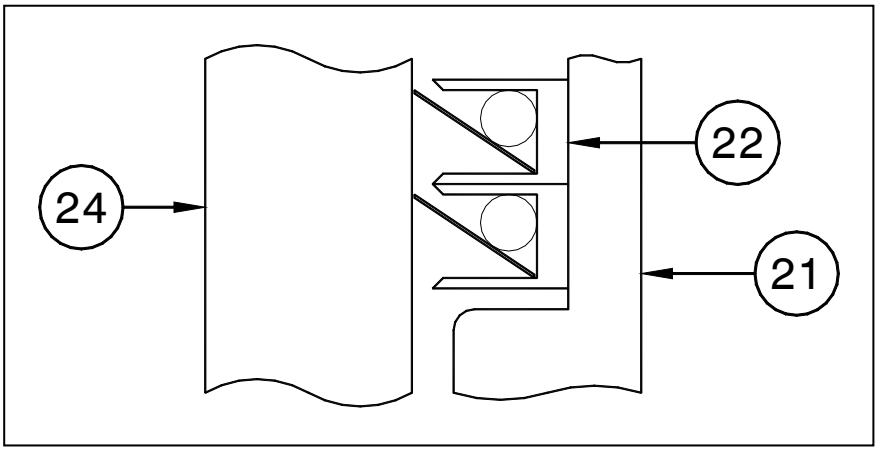


Figure 4.7d

21 - Worm housing	22 - Oil seal	24 - Pinion

.4 Install the bearing (29) over the shaft. Tap the bearing (29) in as necessary to seat, using a tubular driver. Install the retaining ring (20).

.5 Set the spacer and disc spring (18) in place in that order. Mount the worm (19) on the pinion shaft and install the keys (10) with the tapped hole located on top. Set the lock washer (13) on the worm gear, and then start the lock nut (13) onto the pinion (24).

Using a nut spanner (spanner wrench), tighten the nut one complete revolution. Do not bend the locking tabs on the lock washer at this time.

Note: A special nut spanner can be purchased from Ovivo. Refer to parts and repair orders.

.6 Place the bearings (12) in the sliding bearing seat (9), as shown in Figure 4.7e

CAUTION: The bearings must be installed as shown to take the thrust towards the spring. Improper assembly will cause bearing failure

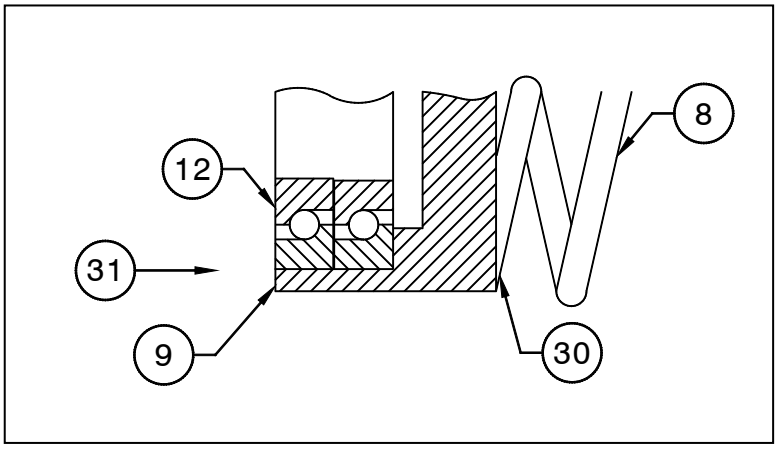


Figure 4.7e

8 - Spring	12 - Bearings	30 - Spring side of sliding bearing seat
9 - Slide bearing seat	31 - Thrust	

.7 Mount the sliding bearing seat (9) and bearings (12) on the worm shaft (14). The bearing must seat against the worm shoulder. Use a tubular drive or place the end of the worm on a block of wood and drive on the bearing housing, using a block of wood and hammer.

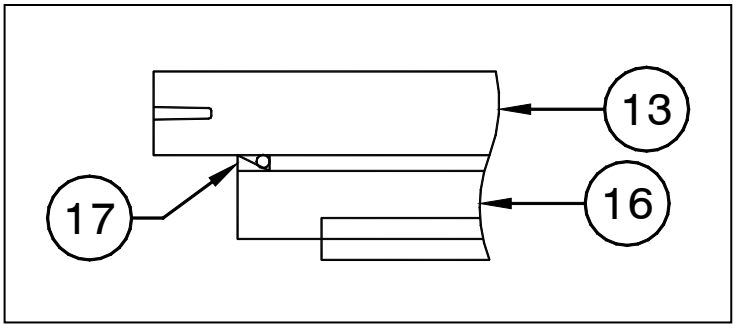


Figure 4.7f

13 - Worm shaft	16 - Bushing housing	17 - Oil seal

.8 Using a tubular driver, install the reverse thrust sleeve (15) or bearing as used. Seat it against the worm.

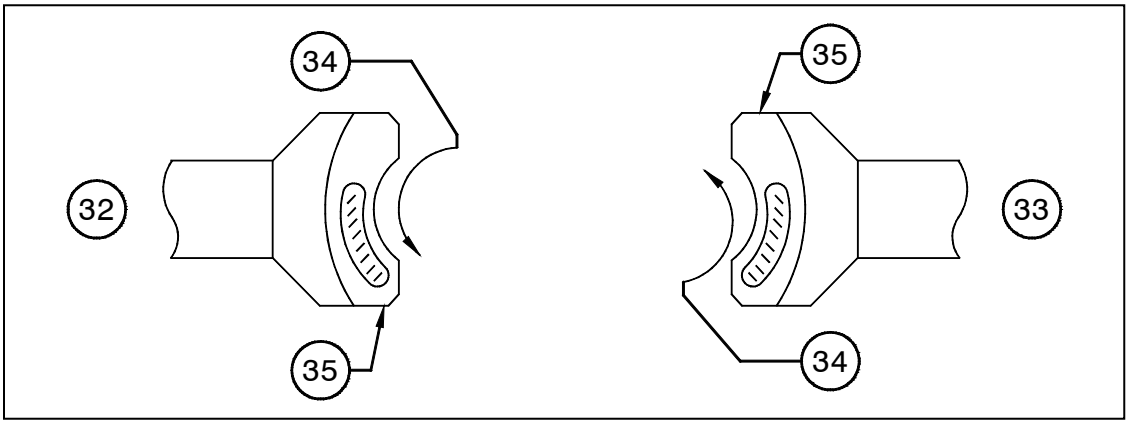


Figure 4.7g

32 - Right hand assembly	34 - Direction of worm rotation
33 - Left hand assembly	35 - Contact pattern

.9 Insert the worm into the gear housing (from the non-drive end), turning it as necessary to mesh with the worm gear threads. (Coat the worm with oil.)

.10 Coat both ends of the housing with Ultra Blue RTV-Silicone. Place the "Centering Device", if used, and the spring (8) over the shaft and install the spring seat (7) and end cap (6). Make sure the end cap is installed with the warning sign visible. Secure the bolts.

.11 Place the bushing housing (16) over the shaft and install the capscrews. Turn the bolts equally when tightening.

Note: If the bushing was replaced, make sure it is flush with the inside face of the housing.

.12 First, cover the keyway with tape to prevent the seal being cut, then install the oil seal (17) with the lip facing out, as shown in Figure 4.7f.

.13 If removed, screw the actuating pin into the drive control assembly, referring to Figure 4.7c. Torque the pin to 20-25 ft. lbs.

Note: On older drives, the drive control pin fits in the slot of the sliding bearing seat.

.14 Install the drive control, referring to "Drive Control Installation" on a following page.

.15 Turn the worm by hand to be sure all parts are properly installed.

.16 Check for proper pattern between the worm shaft (14) and gear teeth (19) as follows:

a. Coat the gear teeth (19) with Prussian blue.

b. Rotate the worm in the proper operating direction and observe the tooth contact pattern on the gear through the 1 3/4" pipe plug hole in the housing, using a flashlight.

c. Compare the actual tooth contact pattern with the correct contact pattern shown in Figure 4.7g.

Note: The contact pattern must be as shown with the contact on the side of the teeth where the worm leaves the gear.

.17 If the actual pattern on the gear teeth is not as shown in Figure 4.7g, adjust for correct pattern by tightening or loosening the lock nut (13) to raise or lower the worm gear.

.18 After any adjustment to the nut (13) coat the gear teeth with Prussian blue and recheck tooth contact pattern.

.19 After the adjustments for tooth contact are complete, bend the locking tabs of the lock washer (13) to secure the nut (13).

.20 Apply Ultra Blue RTV-Silicone to the worm gear housing lower mounting face. Lift the worm gear assembly, referring to the lifting instructions, and set it in position on the lower drive. Align the gear housing with the lower drive referring to the Drive Assembly drawing for orientation.

Note: If shims were used between the worm housing and the lower drive, return them to their original positions.

.21 Install the cover (4), using Ultra Blue RTV-Silicone to provide a liquid tight seal between the cover and housing, and secure the capscrews.

.22 Lubricate the drive referring to the Lubrication Instructions.

.23 Install motors, reducers, belts, torque arms, sheaves and guards.

CAUTION: The motor/reducer assembly must be blocked in position until the torque arm is installed.

WARNING: Do not operate this equipment if guards have been removed, or are damaged. All guards and safety devices must be properly installed and functional before operating this equipment.

.24 Mount the jam nut and cam on the actuator rod. Install the limit switch and switch bracket. Adjust the secondary control device setting, referring to the instructions on the Secondary Control Assembly drawing. Install the boot and hose clamps, if used. Install the switch cover.

.25 Reconnect the electrical wiring and check for proper drive rotation.

4.7.5 Drive Control Installation

.1 Referring to Figure 4.7h, run a bead of Ultra Blue RTV-silicone around pin slot in the worm housing. Install the mounting plate (37), using the capscrews provided, centering the slot in the mounting plate (37) over the slot in the worm housing. Torque the capscrews to 50-60 ft-lbs.

.2 Set the drive control in place on the mounting plate (37), and then install (but do not secure) the drive control mounting capscrews (39) with washer plates (40).

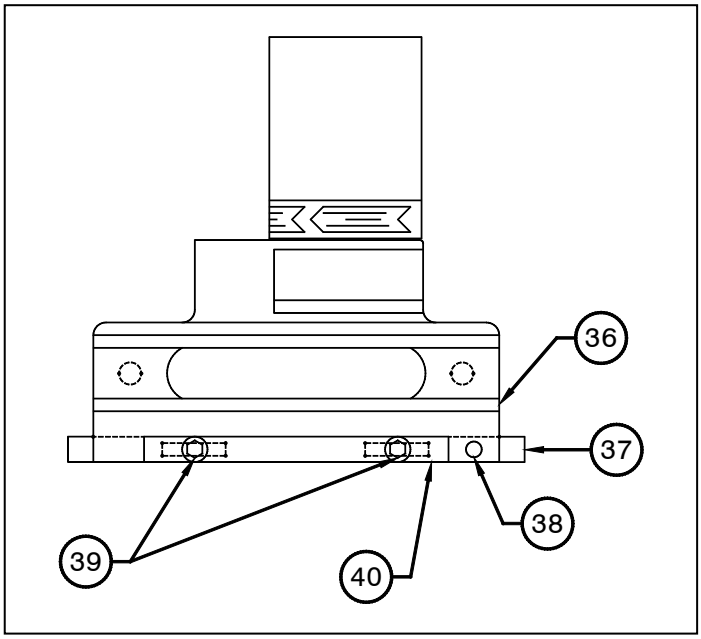


Figure 4.7h

36 - Drive control housing	39 - Mounting capscrews
37 - Mounting plate	40 - Washer Plates
38 - Alignment hole in housing must line up with matching hole in mounting plate, and then install capscrew.	

.3 Adjust the drive control by sliding it until the alignment hole in the drive control housing lines up with the matching hole in the mounting plate. Refer to Figure 4.7h. The drive control pointer should indicate "zero". Install the alignment capscrew (38) in the alignment hole(s). Secure the drive control mounting capscrews (39).

.4 Check the drive control for activation, referring to the Drive Maintenance Instructions.

WARNING: Check the drive for torque, referring to the preceding "Drive Maintenance WARNING" before starting disassembly. Make sure the power to the drive has been disconnected to prevent it being accidentally started.

4.8.1 Preparation for Drive Removal

.1 Disconnect all electrical power at its source. Flag or tag all breakers as a precaution.

.2 Drain all oil from the drive unit assembly.

.3 Block the rake arms in position. If the unit has a scum skimmer, shoring should be used to keep it upright. Disconnect the arms from the cage.

.4 Disconnect the cage from the drive unit and lower the cage free of the drive.

.5 Remove the walkway. Retain the slide plates and mounting plates, and match mark for return to original positions.

4.8.2 Main Gear Removal and Bearing Replacement

If possible, the drive base should **not** be removed from the column during the disassembly of the drive. If the drive is removed from the column, it will have to be checked and adjusted for final level, referring to the Installation instructions, following reinstallation.

.1 Remove the worm gear assembly, referring to the Worm Gear Disassembly and Reassembly Instructions.

.2 Remove the main gear cover plate.

.3 Remove the socket head capscrews (3), and remove the gear cage attachment (4) from the main gear. Refer to Figure 4.8a.

.4 Remove the lip seals and band clamps (5), if worn, cut or deteriorated.

.5 Using a socket head wrench, remove the capscrews (1).

.6 Remove the main gear (6). Set it upside down on a clean, level working area.

.7 Remove the socket head capscrews (2) to remove the bearing (7) from the gear (6), if the bearing or gear will be replaced.

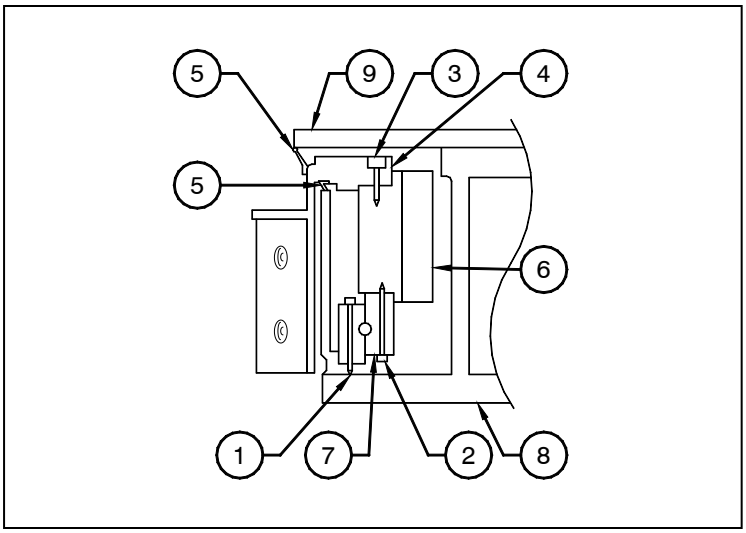


Figure 4.8a

1 - Socket Head Capscrew	4 - Gear Cage Attachment	7 - Bearing
2 - Socket Head Capscrew	5 - Lip Seal and Band Clamp	8 - Drive Base
3 - Socket Head Capscrew	6 - Main Gear	9 - Cover Plate

4.8.3 Inspection

1. Clean the gear, bearing and housing with solvent or kerosene and blow dry. Coat the bearing with light oil if it may be reused.

2. Inspect the teeth of the main gear for the following:

   a. ABRASIVE WEAR: The wear on the teeth will show at random spacing across the teeth. This is normally caused by dirt or other foreign material in the lube oil.

   b. SCORING: This is shown by vertical scratches and/or grooves running from the pitch line (approx. center of tooth) to the top of the tooth. It can result from improper lubrication.

   c. PITTING: It is evident in large or numerous pits in the gear teeth. Note that small pits may occur during run-in of a new gear, but these will smooth out as the gear wears in. It is caused by overload on the gear or poor lubrication.

d. GALLING: This condition appears on the gear teeth as numerous deep grooves and it is caused by overload of the gear for the lubricant used.

e. NORMAL WEAR: Eventually all gears wear out due to long use and/or prolonged overload. Replacement should be considered based on the condition of the gearing and extent of the wear.

.3 Replace the gear, as necessary, depending on the severity and extent of these conditions and, in some cases, the period of time to the next complete maintenance.

.4 Inspect the bearing by rotating the top bearing race by hand (bearing must be lubricated with light oil). Check for smooth, noiseless operation. Depending on the smoothness, the bearing may or may not need to be replaced. If the bearing will not rotate freely, or is rough in rotation, it must be replaced.

4.8.4 Installation of the Main Bearing and Gear:

.1 Make sure all parts are clean, including the housing, before installing the bearing. Remove any gasket material.

a. Prevent dirt or foreign matter from getting into the drive assembly.

b. Gears and housing must be cleaned with a solvent and blown dry or wiped clean.

c. The bearing must be cleaned in light oil and covered with light oil.

d. Seals and gaskets should be replaced, if they appear worn, damaged or deteriorated, whenever the unit is disassembled.

.2 Set the bearing (7) in place on the main gear (6), while the gear is upside down.

.3 Install the capscrews (2) hand tight.

.4 Secure the capscrews (2) in two stages and in a cross-diameter sequence to avoid bearing warpage. The final torque on all capscrews (2) must be 200 ft. lbs. lubricated (plus or minus 10 ft. lbs.). Rotate the bearing and check for smooth, noiseless operation.

.5 Cover the loading plug bore I.D. groove with Ultra Blue RTV-Silicone to provide an oil tight seal.

.6 Set the main gear (6) with bearing (7) in place in the base housing, lining up the bolt holes in the bearing with those in the main gear base, and orienting the loading plug as specified on the Drive Assembly drawing. Take care to prevent damage to the bearing.

.7 Install and secure the capscrews (1) following the instruction above under items #3 and #4. Same capscrews as (2).

.8 Install the drive housing to gear cage attachment lip seal if removed, as follows:

a. Thoroughly clean the seal mounting surfaces. These surfaces must be free of dirt, grease, or any foreign matter.

b. Measure a seal for cutting by laying it in position on the housing or gear mounting surface, where it will be located. The sealing surface must be oriented as shown on the Drive Assembly drawing. Make a square cut on the end of the seal, leaving a slight overlap. Refer to the Assembly drawing and Figure 4.8b.

c. Apply sealant (bonding agent) (Part No. 88899A) over the mounting surfaces where the seals will be installed.

d. Referring to Figure 4.8b, set the lip seal in place, except the last 12 inches of one end of the seal, making sure the seal lip is facing in the direction shown on the Drive Assembly drawing. Since bonding will take place within 45 seconds of contact, take care in setting the seal in place.

e. Bring the uncemented end together with the opposite end. Mark and cut the end of the seal for a square, butt fit against the opposite end.

f. Apply the sealant (bonding agent) to both square ends and set the seal in place. Press the ends together until a firm bond is made.

g. Apply sealant (bonding agent) to the inside angle of the seal at the splice, for about 3" on both sides of the splice. Glue a 4" long piece of wire rope (part no. 88951C) in place, as shown in Figure 4.8b, centered on the splice.

h. Allow the bonding agent to harden, and then use additional bonding agent to seal (encapsulate) the piece of wire rope in position.

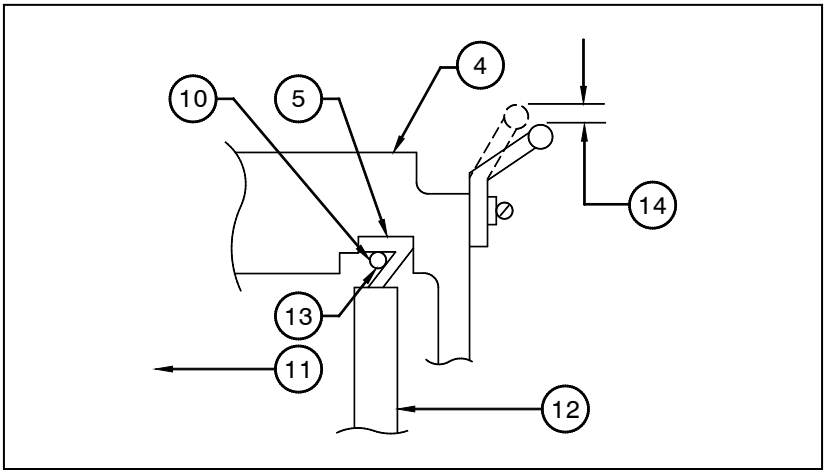


Figure 4.8b

4 - Gear cage attachment	11 - Main bearing and oil side	14 - 1/8" prior to installation of main gear cover
5 - Oil seal	12 - Drive housing	
10 - 4" piece of wire (part no. 88951C)	13 - Sealant (part no. 88899A)	

.9 Install the gear cage attachment (4) on the main gear. Secure the capscrews (3) in two stages and in a cross-diameter sequence. The final torque on all capscrews (3) must be 200 ft. lbs. lubricated (plus or minus 10 ft. lbs.).

.10 Install the gear cage attachment to main gear cover plate lip seal with the band clamp, locating it on the gear cage attachment as shown in Figure 4.8b and the Drive Assembly drawing.

.11 Install the main gear cover plates, using Ultra Blue RTV-Silicone at the joints and between the cover plates and base for a liquid tight seal.

.12 Install the worm gear assembly following the respective instruction.

.13 Lubricate the drive assembly referring to the lubrication instructions.

.14 Reinstall the cage, rake arms and walkway referring to the respective installation instructions in this manual.

.15 Reinstall the motor drive assembly, but leave the chain off.

.16 Connect the electrical wiring and check for proper drive rotation.

.17 Reinstall the drive chain referring to the instructions in this manual.

Careless installation is one of the most common reasons for seal problems. The installation mechanic can prevent these problems by reviewing and following these instructions.

4.9.1 Seal Components

Seals are made up of the following basic components, each performing a particular function, such as:

.1 Outer Shell (Case). The outer, cup-shaped, rigid structure of the lip seal assembly. Acts as a protective cover for the head of the sealing element.

.2 Inner Shell (Case). A rigid cup-shaped component of a seal assembly, which is placed inside the outer seal case. It can function as a reinforcing member, shield, and spring retainer or lip clamping device.

.3 Sealing Element. The normally flexible elastomeric component of a lip seal assembly, which rides against the shaft

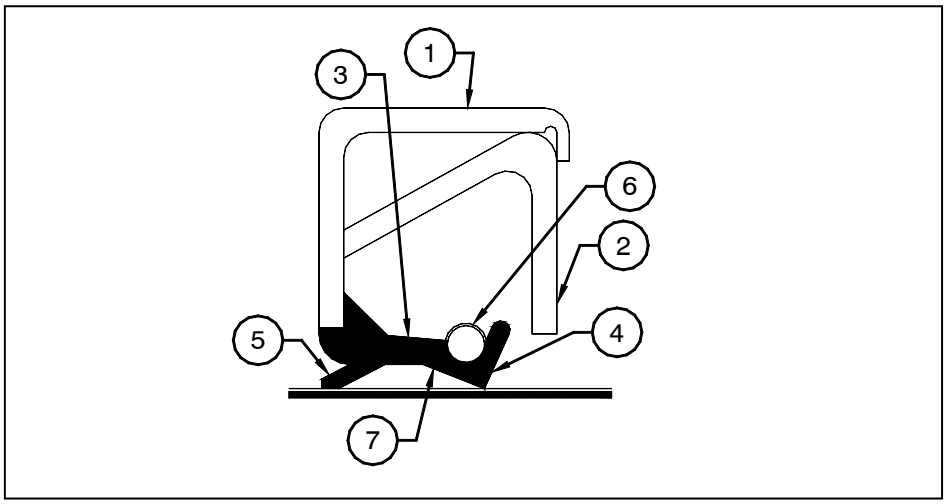


Figure 4.9a

1 - Outer Shell (Case)	5 - Secondary Lip (Auxiliary Lip
2 - Inner Shell (Case)	6 - Garter Spring
3 - Sealing Element	7 - Head Section
4 - Primary Lip	

.4 Primary Lip. The flexible elastomeric component of a lip seal which contacts the rotating surface.

.5 Secondary Lip (Auxiliary Lip). A short, non-spring loaded lip, which is located at the outside, seal face of a radial lip seal. Used to exclude contaminants.

.6 Garter Spring. A coiled wire spring with its ends connected. It is used for maintaining a sealing force between the sealing element and sealing surface.

4.9.2 Proper Installation Procedures

The seal is ready to be installed in the bore once the old seal has been removed, and the shaft and bore have been checked and cleaned. The seal should be pre-lubricated before installation.

4.9.3 Pre-Lubrication

Pre-lube the lip of the seal now before the seal is installed. This step is important because pre-lubrication provides a film on which the seal rides until there is ample lubricant in the seal cavity.

The best pre-lube to use is the lubricant being used in the drive unit. Refer to the Lubrication Instructions.

4.9.4 Tools

A hydraulic press that applies uniform pressure against the seal is recommended. However, if a press is not available or not practical, a round tool, such as a bearing cup, is excellent. The installation tool must follow the seal into the bore, and it should be slightly smaller that the outside diameter of the seal. An O.D. ten thousandths of an inch smaller than the bore is ideal. For best results, the center of the tool should be open so pressure is applied only at the outer edge of the seal case.

The tools used to install seals can often affect seal performance. For instance, a screwdriver may easily cut the seal lip or bend the case and cause the seal to leak. Even blunt-end drifts can damage the seal case or distort the seal from its proper working position.

CAUTION: Sealing damage may result when:

.1 Using a steel hammer,
.2 Using a drift or punch,
.3 Using a chisel or screwdriver,
.4 Using direct hammer blows on the face of the seal, or
.5 Starting seal into bore at an angle (cocked)

4.9.5 Hammering

.1 Use a soft-faced or dead-blow hammer or mallet against an installation tool when installing seals (see Figure 4.9b). This type of tool, like a block of wood, absorbs the shock wave created by the tool's impact. A hammer blow without any material to absorb the shock wave can dislodge the garter spring from its proper operating position. Once the spring is out of position, the seal will fail. The spring can even interfere with the action of the seal lip, or find its way into the bearing.

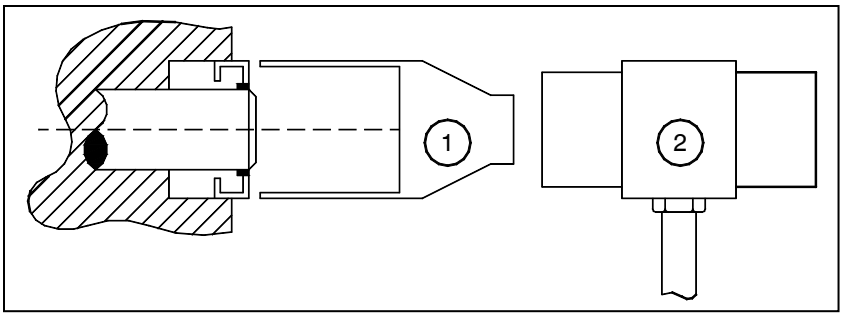


Figure 4.9b

1 - Tool	2 - Soft Faced Mallet

.2 Whatever tool is used, remember that seating force must be applied and spread out around the entire circumference of the seal. A direct blow on one side of the seal distorts the case and can cause the lip to be pressed against the shaft. This action produces increased friction between the lip and the shaft surface.

.3 If installation pressure is applied to the seal's inside diameter, the case is forced upward, lifting the lip from the shaft surface. If the seal is cocked -- not perpendicular to the shaft and bore -- the result will be too much contact on one side, and not enough on the other. The seal will leak as the shaft is deflected by shaft-to-bore misalignment or run-out. Seals must be seated up against the bore shoulder to achieve perpendicularity of sealing lip to shaft.

.4 Sealing lips must not be painted. Coating the seal case is acceptable after installation. Shaft seal surfaces including those seal surfaces that move axially must be free from paint, nicks, scratches, etc. in the area where the seals are to function.

1. The process performance of the equipment referred to in these instructions is dependent upon many factors, including influent or feed quality and quantity, additives required, time, temperature, rates of change, sizing criteria used, operating conditions, etc. Therefore, unless a written Process Performance Warranty has been included, Ovivo cannot assume any liability or responsibility for performance results that the user of the equipment is expecting or has predicted.

2. Should assistance be required in the operation of the equipment, due to unexpected conditions, or should accessory or add on components or changes be required to meet your performance needs, Ovivo can, at additional cost, provide the service of experts to assist you in determining what actions must be taken.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Overload alarm sound-or, drive operates at high torque for several days	a. Torque build up on drive and mechanism	(1) Reduce solids feed to clarifier and check for operating problem. Refer to Operating Instructions
2. Drive stops	a. Loss of electrical power	(1) Check power source (2) Check control fuse
	b. Drive control cutout	(1) If pointer on control is at maximum cutout, drain tank to locate problem Do not by pass control (2) If pointer is not at maximum torque, check control. See Maintenance Instructions
	c. Motor drives cutout	(1) Check for overheating refer to manufacturer's instructions (2) Check for broken chain or shear pin

Parts List

GLV Indented Current BOM Report

Table of Contents

GLV Indented Current BOM Report

BOM NUMBER: RSW0001000-01 **DESCRIPTION: Clarifier Control Panels (2)** **DRAWING NUM: RSW0001000-01**
TOP PARENT: RSW0001000-01
REQ QTY - 1

Lvl	Item	Description	Base QTY	Total Qty	U/M	Weight	Bub.	Drawing	Rev	Seq
0	RSW0001000-01	Clarifier Control Panels (2)	1.0	1.00	LOT	0.00		RSW0001000-01	A	1
1	RSW1000-01M2	ELECTRICAL CONTROLS (MASTER)	1.0	1.00	EA	0.00	2	RSW1000-01M2	A	2
1	ECO	ENGINEERING CHANGE ORDER	1.0	1.00	EA	0.00	999	N/A	A	6

Jobmatl Notes
ECO-S-013453 (REV A) - INITIAL RELEASE

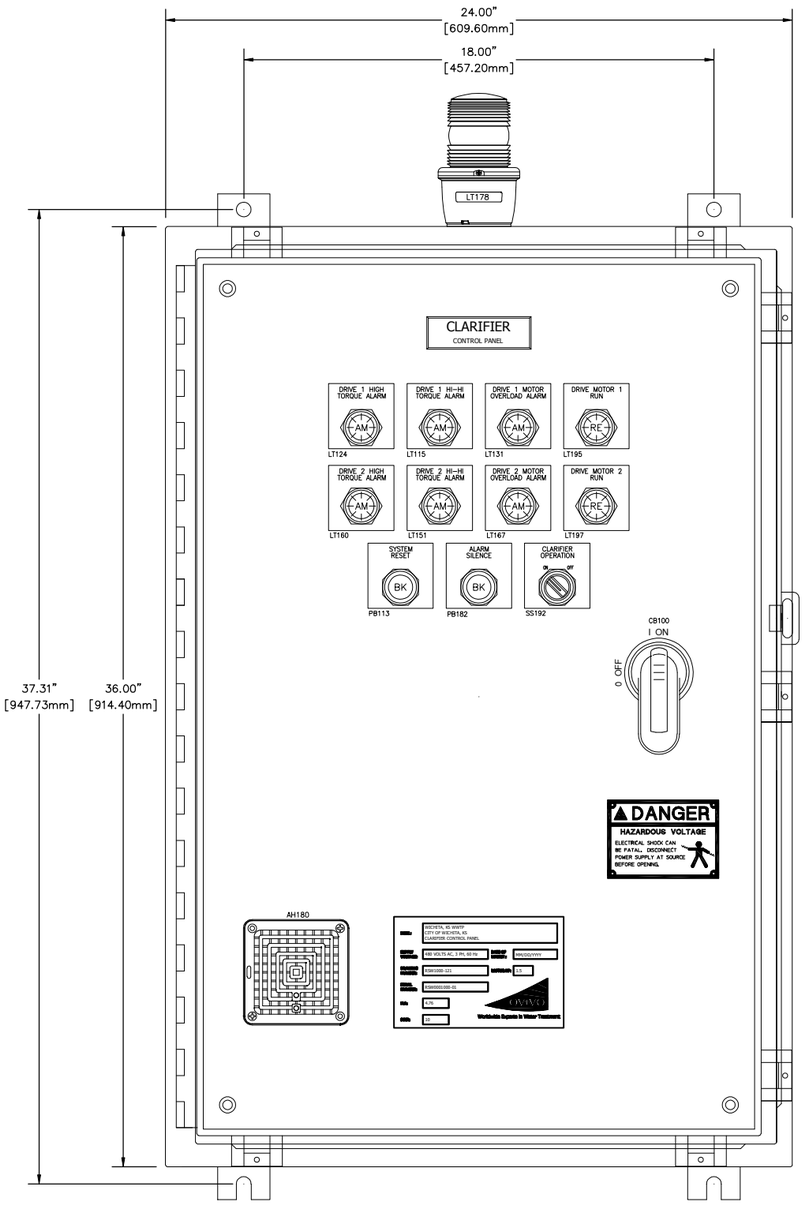
GLV Indented Current BOM Report

BOM NUMBER: RSW1000-01M2 **DESCRIPTION: ELECTRICAL CONTROLS (MASTER)** **DRAWING NUM: RSW1000-01M2**
TOP PARENT: RSW0001000-01
REQ QTY - 1

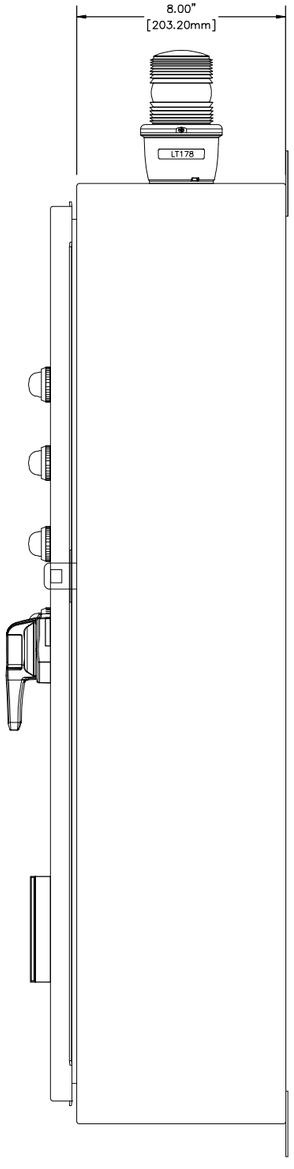
Lvl	Item	Description	Base QTY	Total Qty	U/M	Weight	Bub.	Drawing	Rev	Seq
2	DRAWINGS	ASSEMBLY & REFERENCE	1.0	1.00	EA	0.00 LB	0	N/A		3
	Jobmatl Notes									
	RSW1000-01M2 - ELECTRICAL CONTROLS (MASTER)									
	RSW1000-121 - CLARIFIER CONTROL PANEL									
	49046 - NAMEPLATE - DANGER									
	679001 - NAMEPLATE - OVIVO									
2	RSW1000-121	PANEL,CLARIFIER CONTROL	2.0	2.00	EA	0.00	1	RSW1000-121	A	4
2	ECO	ENGINEERING CHANGE ORDER	1.0	1.00	EA	0.00	999	N/A	A	5

Drawings

ELECTRICAL DRAWING INDEX	
DWG #	SHEET DESRIPTION
RSW1000-121 SHT1	TITLE SHEET AND CONSTRUCTION NOTES
RSW1000-121 SHT2	DOOR OPERATOR LAYOUT AND BILL OF MATERIALS
RSW1000-121 SHT3	SUB-PANEL LAYOUT AND EXPANDED VIEWS
RSW1000-121 SHT4	POWER AND CONTROL SCHEMATICS
RSW1000-121 SHT5	CONTROL SCHEMATICS AND REMOTE SIGNALS



FRONT VIEW



SIDE VIEW

PANEL ENCLOSURE LAYOUT

NEMA 4X ENCLOSURE

CONTROL PANEL SPECIFICATIONS

1. **COMPONENTS SPECIFIC**

1.1 ENCLOSURE TO BE NEMA 4X CONSTRUCTION.

1.2 ATTACH NAMEPLATES WITH MANUFACTURER'S RECOMMENDED ADHESIVE TO MAINTAIN NEMA STANDARD OF ENCLOSURE

1.3 CONTROL PANEL SHALL BE LABELED WITH SERIALIZED UL LABEL

1.4 PANEL WILL BE LABELED WITH IDENTIFICATION PLATE AS NOTED ON ENCLOSURE DRAWING.

1.5 ALL RELAY CONTACTS ARE RATED AT 10 AMPS UNLESS OTHERWISE NOTED.

1.6 COMPONENT IMAGES MAY NOT ACCURATELY REPRESENT THE ACTUAL DEVICE IN SOME INSTANCES. DIMENSIONS OF DEVICES, HOWEVER, WILL BE ACCURATE FOR PURPOSES OF LAYOUT AND SPACING.

1.7 SUBSTITUTIONS FOR COMPONENTS MAY BE PERMITTED UPON APPROVAL BY OVIVO ENGINEERS.

2. **WIRE SIZING & TYPE**

WIRE SIZING SHALL BE NO LESS THAN AS FOLLOWS (UNLESS OTHERWISE NOTED):
480 3 PHASE - 14 AWG TYPE: MTW
120 1 PHASE - 16 AWG TYPE: MTW

3. **WIRE COLOR**

WIRE COLOR SHALL BE AS FOLLOWS:
POWER (600 VOLTS)
GREEN - GROUND
BLACK - ALL PHASES

CONTROL (120 VAC)
RED - LOAD WIRES FOR ALL LOCAL CONTROL CIRCUITS
WHITE - NEUTRAL FOR ALL LOCAL CONTROL CIRCUITS
YELLOW - FOREIGN POWER IN PANEL

4. **CONNECTIONS**

4.1 ALL CONNECTIONS SHALL BE POINT TO POINT WITHOUT SPLICES. EXCEPTIONS APPLY TO SOLENOIDS AND MOTORS AND FACTORY WIRED COMPONENTS.

4.2 ALL CONDUCTORS MUST BE MARKED WITH MACHINE PRINTED TAGS AT EACH TERMINATION. MARKERS SHALL BE OF HEAT SHRINK TYPE.

5. **DOCUMENTATION**

5.1 FABRICATOR SHALL PROVIDE ONE COPY OF ALL DOCUMENTS SUPPLIED WITH THE COMPONENTS SUPPLIED BY THE FABRICATOR. THIS INFORMATION INCLUDES BUT IS NOT LIMITED TO MANUFACTURERS SPECIFICATIONS, INSTALLATION MANUALS AND OPERATION MANUALS.

5.2 ANY OVIVO APPROVED CHANGES OR MARK-UPS TO THE SCHEMATICS, PANEL LAYOUTS AND ANY OTHER PERTAINING DOCUMENTS SHALL BE MAINTAINED AND DELIVERED TO OVIVO AT ACCEPTANCE OF THE PANEL.

6. **TESTING**

6.1 OVIVO ENGINEERS OR OVIVO APPROVED FABRICATOR, WILL PERFORM A POINT TO POINT CONTINUITY TEST ON THE PANEL.

6.2 WHEN APPLICABLE, THE FABRICATOR WILL ALSO PROVIDE POWER TO THE 120VAC CIRCUITS FOR VERIFICATION AND TESTING. FABRICATOR SHALL ALLOW A MINIMUM OF 2 HOUR OF ACCESS TO THE CONTROL PANEL BY AN OVIVO ENGINEER FOR THIS AND PREVIOUSLY STATED TEST. 3 PHASE POWER CIRCUITS WILL NOT BE POWERED ON FOR TESTING.

REVISION	EN/ECO	BY	CHECK'D	DATE
INITIAL RELEASE	013415	DK	DR	12/05/18

D

THIRD ANGLE PROJECTION

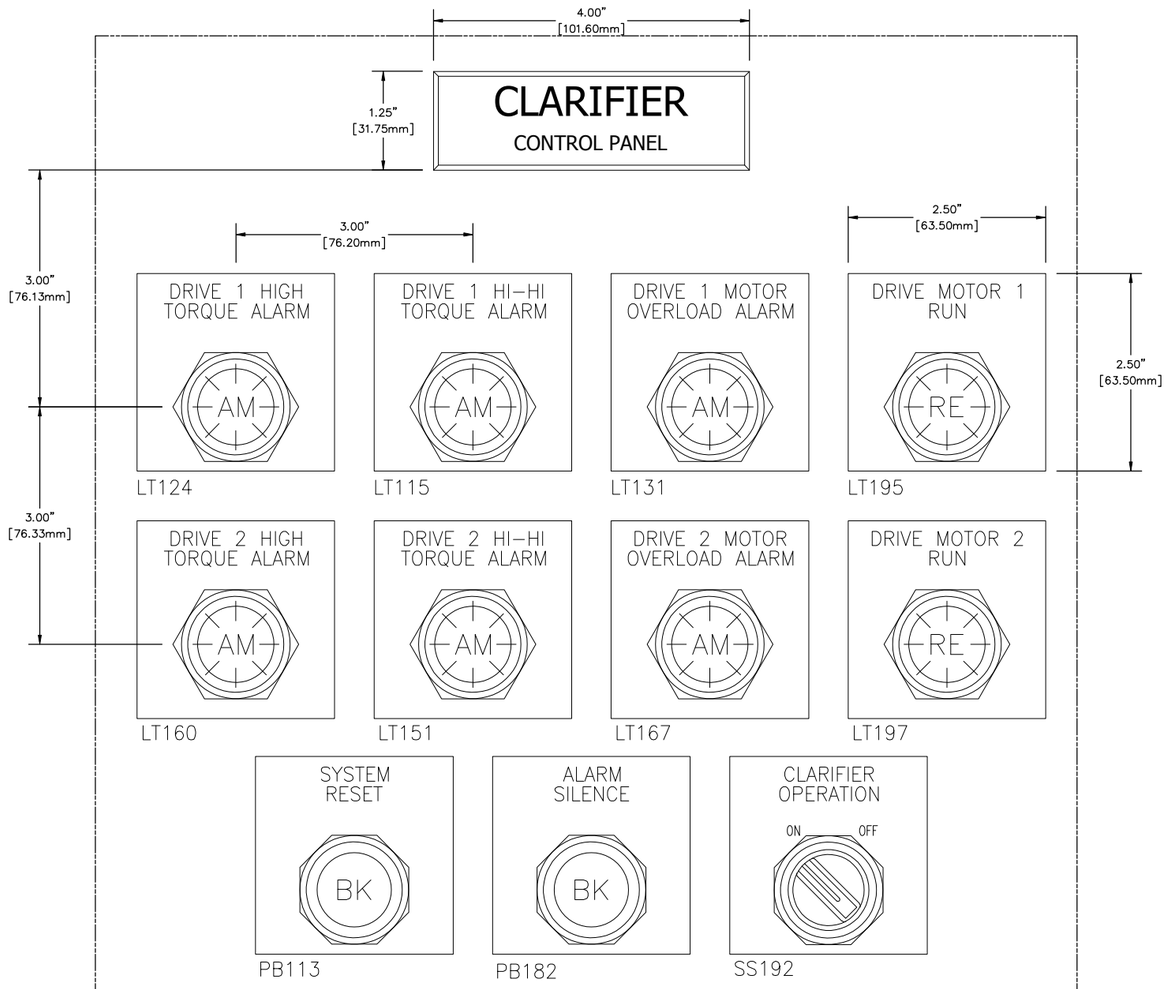
REF. FROM:	CSW1294-121	DO NOT SCALE PRINTS
DATE (mm/dd/yyyy)	12/04/18	WORKMANSHIP STANDARD ESD001 APPLIES
DRAWN	KD	ORIGINAL S.O.
CHECK'D	DR	RSW0001000-01

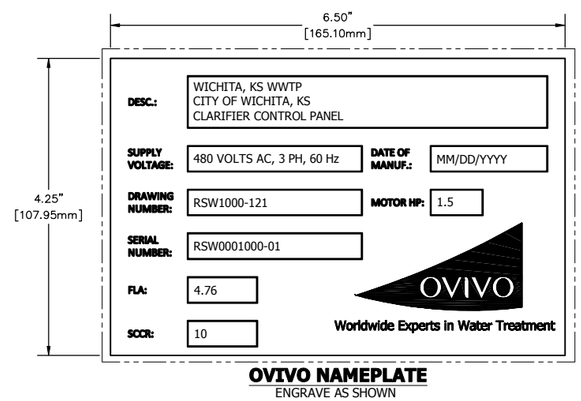
OVIVO
Worldwide Experts in Water Treatment

WICHITA, KS WWTP
CITY OF WICHITA, KS
CLARIFIER CONTROL PANEL

DWG. NO.	SHEET	REV
RSW1000-121	1 OF 5	A

DOOR OPERATOR LAYOUT





OVIVO NAMEPLATE
ENGRAVE AS SHOWN

BILL OF MATERIALS

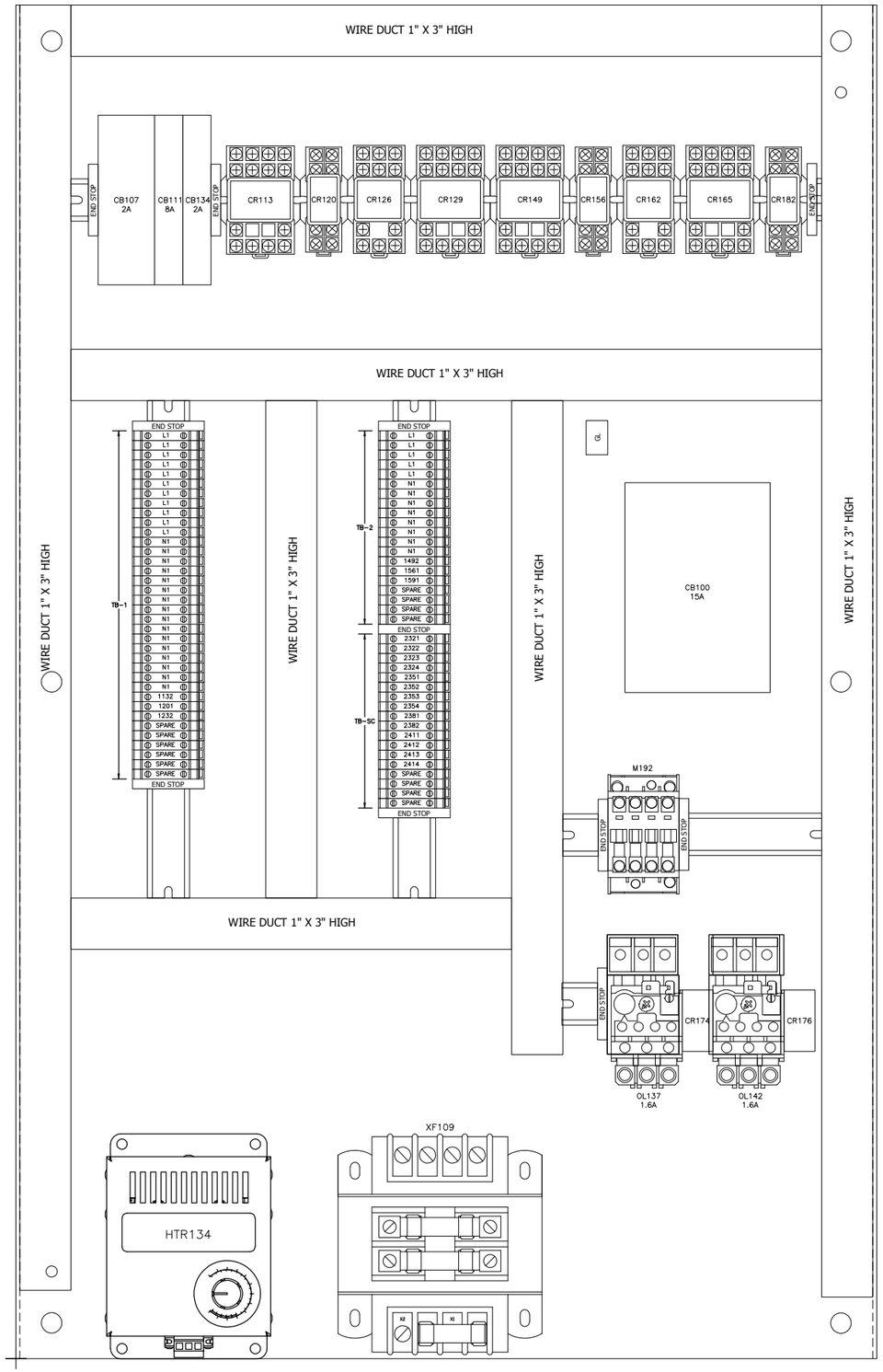
ITEM	QTY	CATALOG	DESC	MFG	TAGS
1	1	A36H2408SSLP	WALL-MOUNT ENCLOSURE, WITH CLAMPS, 36" X 24" X 8", 304 SS, NEMA 4X.	HOFFMAN	ENC
2	1	A36P24	ENCLOSURE, BACK PANEL, 36" X 24"	HOFFMAN	ENC
3	1	T2H015TW	MOLDED CASE CIRCUIT BREAKER, THREE POLE, THERMAL MAGNETIC FIXED, 15 AMP, 480 VAC RATED, SCCR 65 KA	ABB	CB100
4	1	OHB80L6	CIRCUIT BREAKER EXTERNAL HANDLE, NEMA 4/4X, BLACK	ABB	CB100
5	1	KT3VD-M OXP6X430	CIRCUIT BREAKER MECHANISM WITH SHAFT 16.9 INCHES	ABB	CB100
6	1	A9-30-10-84	A-LINE CONTACTOR, AC OPERATED, RATED FOR 7.5 HP, 9 AMPS	ABB	M192
7	1	CA5-22E	AUXILIARY CONTACT BLOCK, FRONT MOUNT, 2 N.O. + 2 N.C. CONTACTS	ABB	M192
8	2	TA25DU1.8	TA THERMAL OVERLOAD RELAY, 1.3-1.8 AMPS	ABB	OL137, OL142
9	2	DB25	MOUNTING KIT FOR STANDALONE MOUNTING OF THERMAL OVERLOAD RELAY	ABB	OL137, OL142
10	2	DR25-A-110	OVERLOAD RESET COIL FOR REMOTE RESET, 120VAC	ABB	CR174, CR176
11	1	S202UP-K2	S200UP MINIATURE MOLDED CASE CIRCUIT BREAKER, PRO M COMPACT, 2 AMP, 2-POLE	ABB	CB107
12	1	SP750ACP	CONTROL TRANSFORMER 480V TO 120VAC, 750 VA	HAMMOND	XF109
13	1	S201UP-K8	S200UP MINIATURE MOLDED CASE CIRCUIT BREAKER, PRO M COMPACT, 5 AMP, 1-POLE	ABB	CB111
14	3	RH2B-ULC-120	RELAY, DPDT, WITH INDICATOR AND CHECK BUTTON	IDEC	CR120, CR156, CR182
15	3	SH2B-05	SOCKET, RELAY	IDEC	CR120, CR156, CR182
16	2	RH3B-ULC-120	RELAY, 3PDT, WITH INDICATOR AND CHECK BUTTON	IDEC	CR126, CR162
17	2	SH3B-05	SOCKET, RELAY	IDEC	CR126, CR162
18	4	RH4B-ULC-120	RELAY, 4PDT, WITH INDICATOR AND CHECK BUTTON	IDEC	CR113, CR129, CR149, CR165
19	4	SH4B-05	SOCKET, RELAY	IDEC	CR113, CR129, CR149, CR165
20	6	APD199DN-A-120V	AMBER PILOT LIGHT - STANDARD, ROUND OILTIGHT	IDEC	LT124, LT115, LT131, LT160, LT151, LT167
21	2	APD199DN-R-120V	RED PILOT LIGHT - STANDARD, ROUND OILTIGHT	IDEC	LT195, LT197
22	2	ABD111N-B	PUSH BUTTON - MOMENTARY, NEMA 4/4X, BLACK, WITH 1 N.O. + 1 N.C. CONTACTS	IDEC	PB113, PB182
23	1	ASD211N	2-POSITION SELECTOR SWITCH, MAINTAINED, BLACK KNOB, WITH 1 N.O. + 1 N.C. CONTACTS	IDEC	SS192
24	11	GRAVOPLY ULTRA	GENERIC OPERATOR TAG - ENGRAVE AS SHOWN ON ALL DOOR OPERATORS	GRAVOGRAPH	AS SHOWN
25	1	350-120-30 WITH K8435666A	VIBRATONE HORN FOR ALARM, 120 VAC WITH PANEL MOUNTING GASKET KIT FOR NEMA 4X APPLICATION	FEDERAL SIGNAL	AH180
26	1	LP3S-120-R	STROBE LIGHT, SURFACE MOUNT, RED, 120 VAC, NEMA 4X	FEDERAL SIGNAL	LT178
27	1	DAH1001A	ENCLOSURE ANTI-CONDENSATION HEATER, WITH THERMOSTAT, 100 WATT, 120 VAC	HOFFMAN	HTR134
28	74	0115 116.07	TERMINAL BLOCK - M 4/6	ENTRELEC	TB-1, TB-2, TB-SC
29	11	0206 351.16	END STOP	ENTRELEC	AS SHOWN
30	A/R	QD100X150HW	WIRE DUCT 1" X 3" HIGH	ABB	AS SHOWN
31	1	49046A	NAME PLATE - "DANGER"	OVIVO	AS SHOWN
32	1	679002	NAME PLATE (ETCH AS SHOWN)	OVIVO	AS SHOWN
33	1	592273	ENLCOUSRE EQUIPMENT TAG ID	OVIVO	AS SHOWN
34	1	199-DR1	DIN-RAIL	ABB	AS SHOWN
35	1	KA2U	GROUND LUG	BURNDY	GL

DOOR OPERATOR LAYOUT AND BILL OF MATERIALS

OVIVO Worldwide Experts in Water Treatment

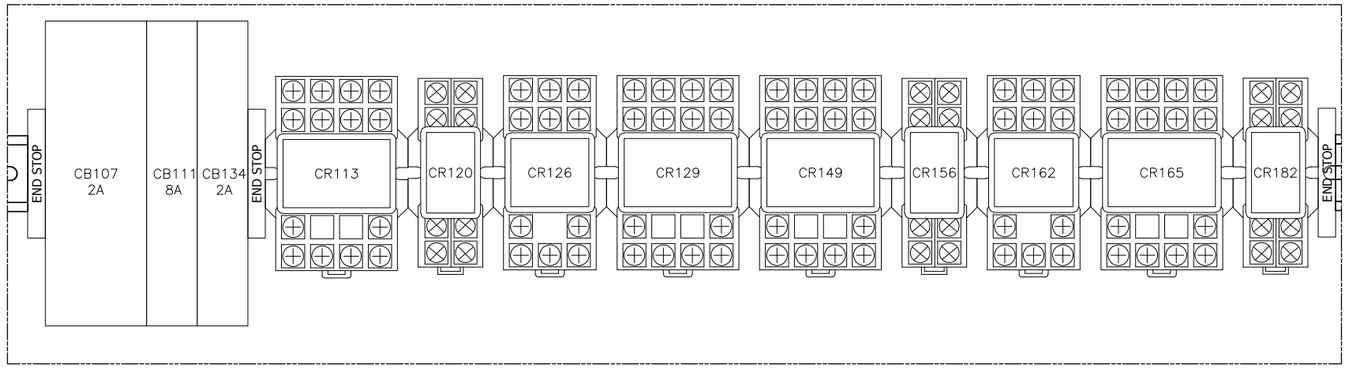
D	DO NOT SCALE PRINTS	DWG. NO.	RSW1000-121	SHEET 2 OF 5	REV A

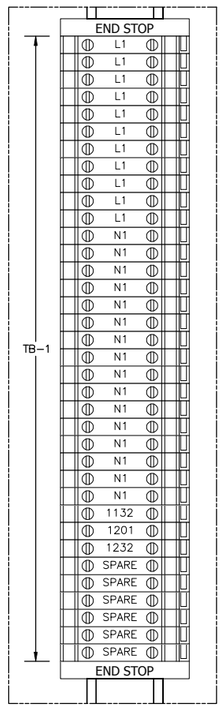
WORKMANSHIP STANDARD ES0001 APPLIES

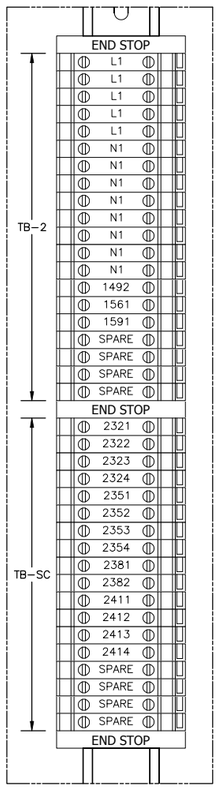


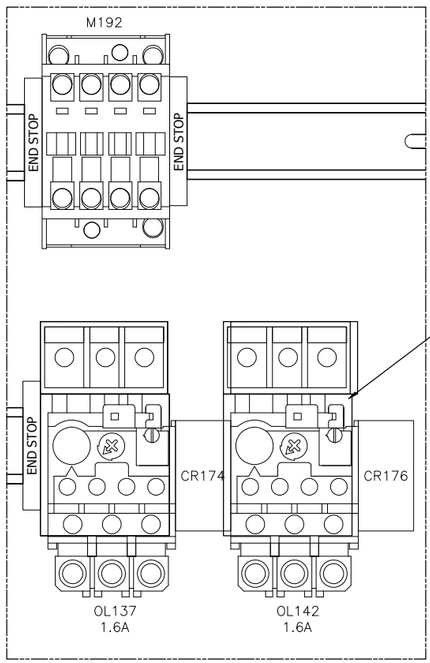
SUB-PANEL LAYOUT

EXPANDED VIEWS







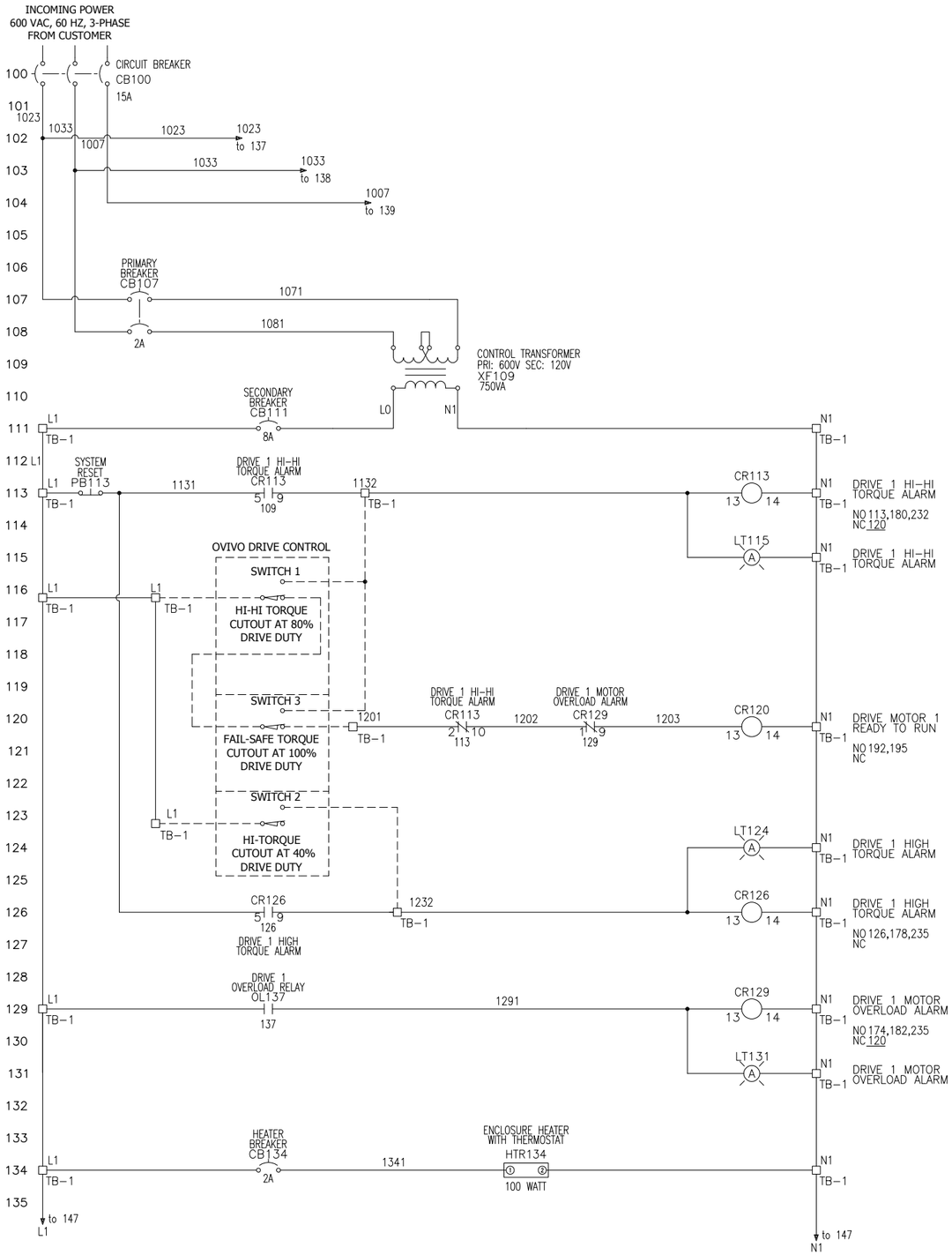


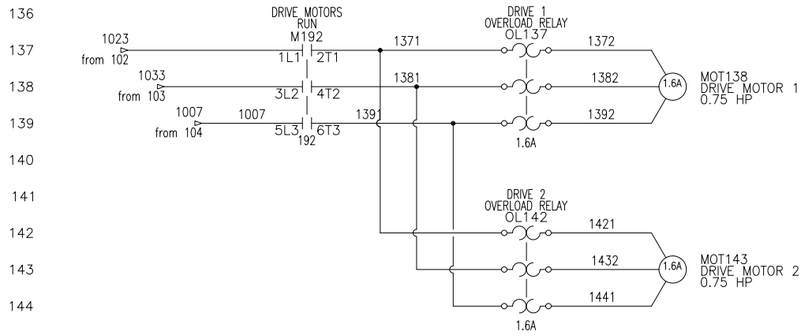
SUB-PANEL LAYOUT AND EXPANDED VIEWS

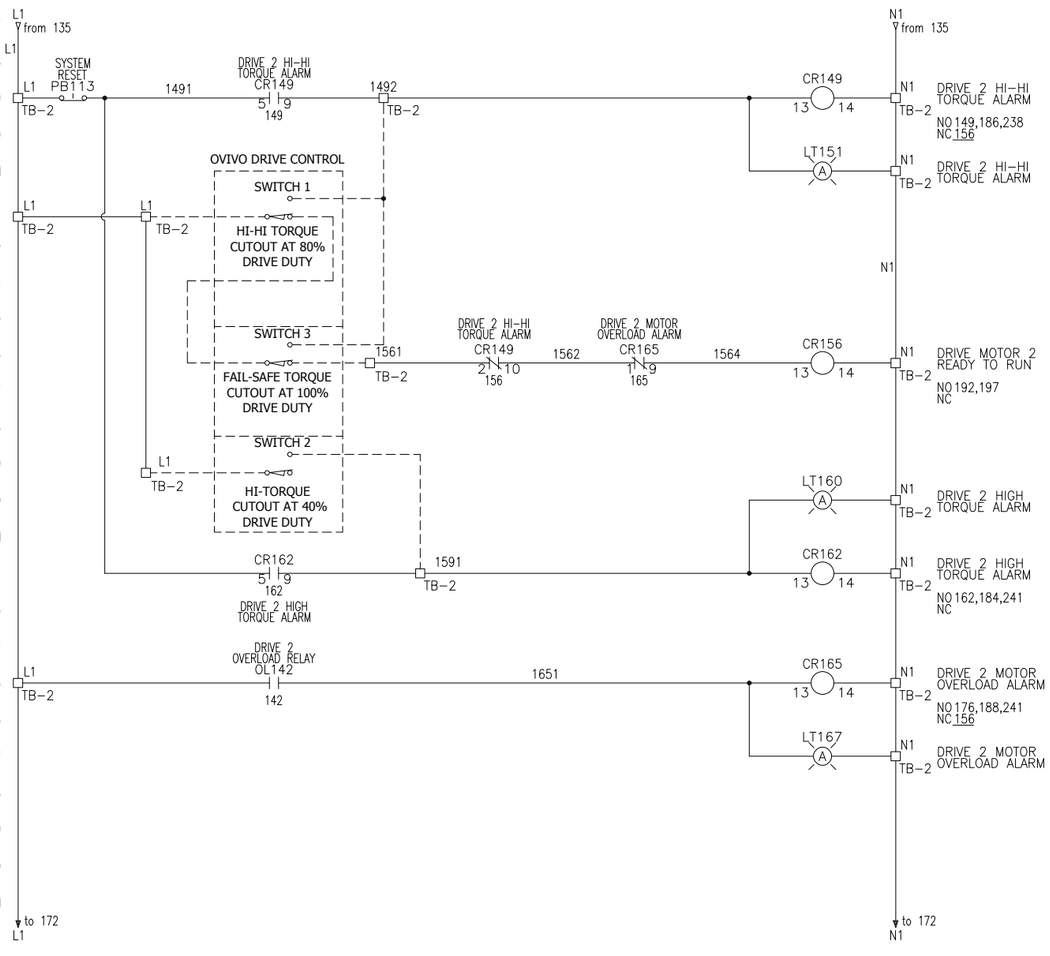
OVIVO
Worldwide Experts in Water Treatment

D	DO NOT SCALE PRINTS	DWG. NO.	RSW1000-121	SHEET 3 OF 5	REV A

WORKMANSHIP STANDARD ES0001 APPLIES







WIRING LEGEND:

- - - - - - FIELD WIRING (NOT BY OVIVO)

———— INTERNAL WIRING (BY OVIVO)

POWER AND CONTROL SCHEMATICS

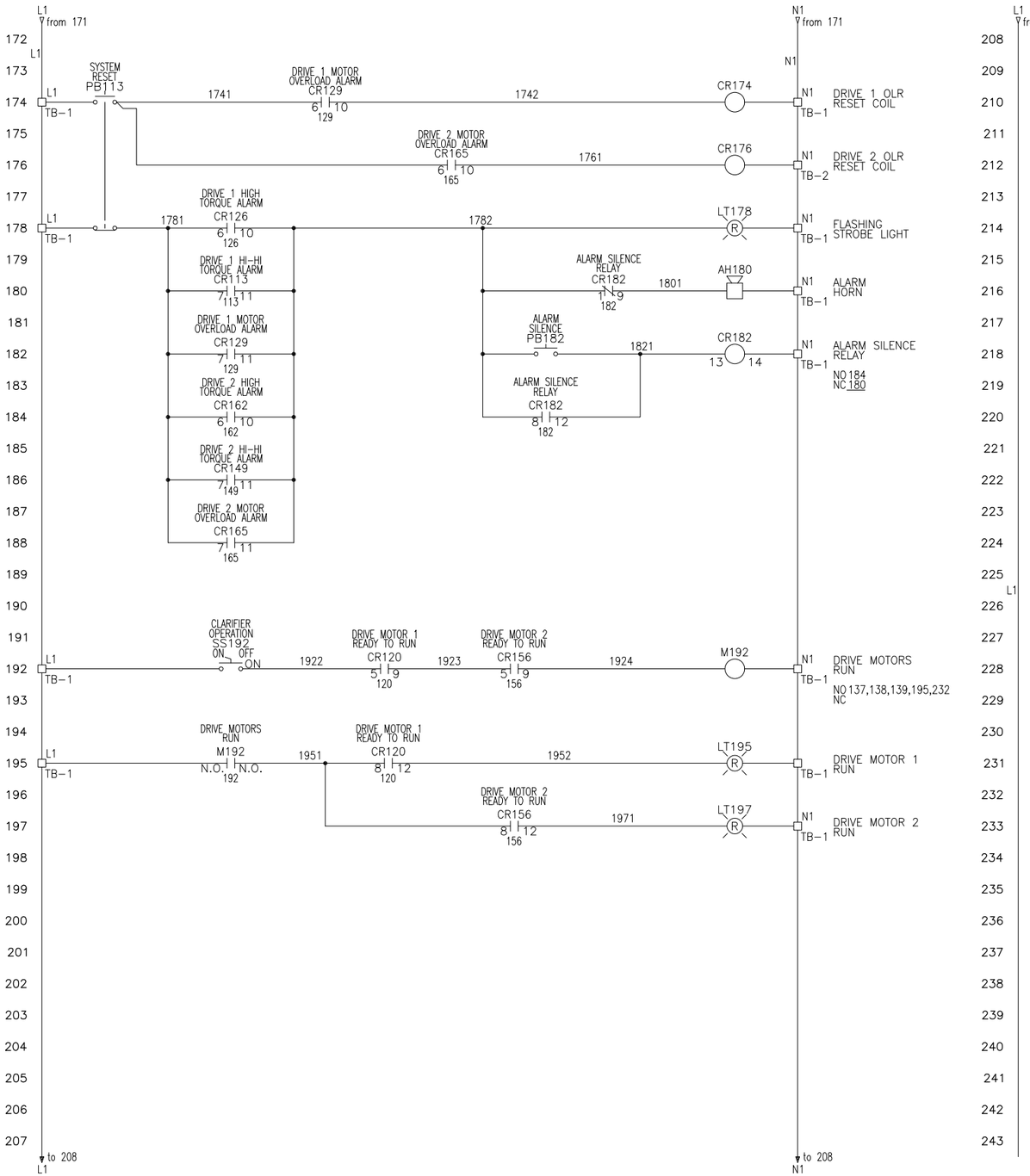
OVIVO
Worldwide Experts in Water Treatment

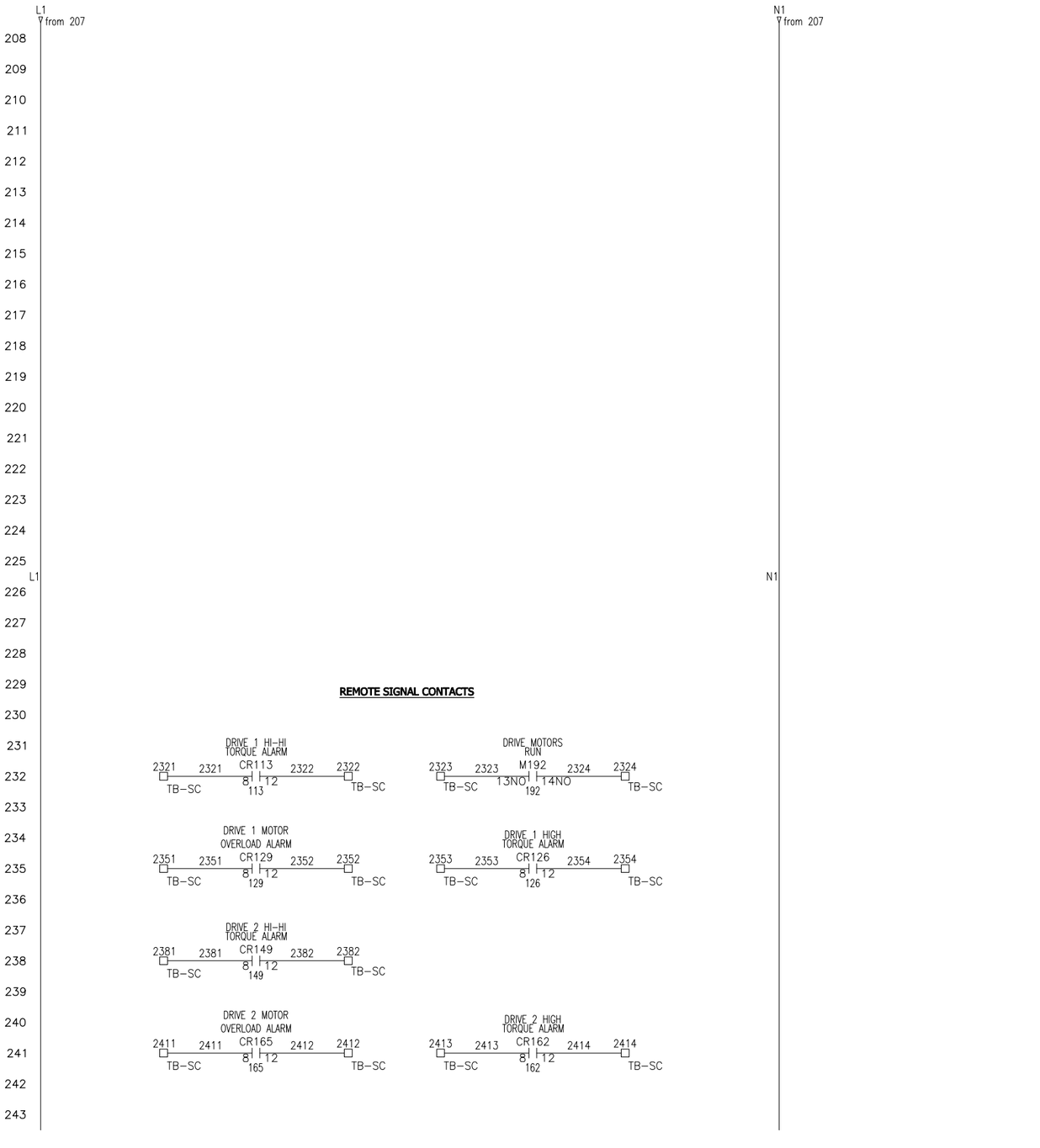
D

DO NOT SCALE PRINTS

WORKMANSHIP STANDARD ES0001 APPLIES

DWG. NO.	SHEET	REV
RSW1000-121	4 OF 5	A





REMOTE SIGNAL CONTACTS

CONTROL SCHEMATICS AND BILL OF MATERIALS

OVIVO Worldwide Experts in Water Treatment

D	DO NOT SCALE PRINTS	DWG. NO.	RSW1000-121	SHEET 5 OF 5	REV A

WORKMANSHIP STANDARD ES0001 APPLIES

STANDARD TORQUE VALUES FOR METAL INDUSTRIAL FASTENERS (FT.-LBS.) ** (75% OF PROOF LOAD)

GRADE MARKING/ DESCRIPTION	SPECIFICATION	MATERIAL	SIZE RANGE	PROOF LOAD (PSI)	TENSILE STRENGTH MINIMUM (PSI)	SCREW OR BOLT DIAMETER																				
						4	6	8	10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2
CAPSCREW	ASTM A-307 SAE 2 STEEL	LOW CARBON STEEL	1/4 - 2 1/2	33,000	60,000					6 (5)	11 (10)	19 (17)	30 (27)	45 (40)	66 (59)	93 (84)	150 (135)	202 (182)	300 (270)	474 (427)	659 (593)	884 (796)	1057 (951)	1884 (1696)	2722 (2450)	3117 (2805)	4380 (3942)
CAPSCREW	SAE 3 STEEL	MEDIUM CARBON STEEL	1/4 - 2 1/2	70,000	100,000					9 (8)	17 (15)	30 (27)	47 (42)	69 (62)	103 (93)	145 (130)	234 (211)	372 (335)	551 (496)	872 (785)	1211 (1090)	1624 (1462)	1943 (1749)	3463 (3117)	5427 (4884)	7226 (6503)	8049 (7244)
CAPSCREW	ASTM A-449 SAE 5 STEEL	MEDIUM CARBON STEEL QUENCHED TEMPERED	1/2 - 1 1 1/8 - 1 1/2 1 3/4 - 2 1/2	85,000 74,000 55,000	120,000 105,000 90,000					9 (8)	18 (16)	31 (28)	50 (45)	75 (67)	110 (99)	150 (135)	250 (225)	378 (340)	583 (525)	782 (704)	1097 (987)	1461 (1315)	1748 (1573)	3114 (2803)	4504 (4054)	6497 (5847)	7144 (6430)
CAPSCREW	SAE 6 STEEL	MEDIUM CARBON STEEL QUENCHED TEMPERED	1/4 - 1 1/2	105,000	133,000					13 (12)	24 (22)	43 (39)	69 (62)	106 (95)	150 (135)	209 (188)	350 (315)	550 (495)	825 (743)	1304 (1174)	1815 (1634)	2434 (2191)	2913 (2622)				
CAPSCREW	SAE 7 STEEL	MEDIUM CARBON ALLOY STEEL QUENCHED TEMPERED	1/4 - 1 1/2	105,000	133,000					13 (12)	24 (22)	43 (39)	69 (62)	106 (95)	150 (135)	209 (188)	350 (315)	550 (495)	825 (743)	1304 (1174)	1815 (1634)	2434 (2191)	2913 (2622)				
CAPSCREW	SAE 8 STEEL	MEDIUM CARBON ALLOY STEEL QUENCHED TEMPERED	1/4 - 1 1/2	120,000	150,000					13 (12)	28 (25)	46 (41)	75 (67)	115 (104)	165 (149)	225 (203)	370 (333)	591 (532)	893 (804)	1410 (1269)	1964 (1768)	2633 (2370)	3150 (2835)				
BOLT	ASTM A-325	LOW TO MEDIUM CARBON STEEL QUENCHED TEMPERED	1/2 - 1 1 1/8 - 1 1/2	85,000 74,000	120,000 105,000									100 (90)		200 (180)	355 (320)	525 (473)	790 (711)	1060 (954)	1495 (1346)	1960 (1764)	2600 (2340)				
CAPSCREW	ASTM 354BB	ALLOY STEEL QUENCHED TEMPERED	1/4 - 2 1/2	80,000	105,000					9 (8)	18 (16)	31 (28)	50 (45)	75 (67)	110 (99)	150 (135)	250 (225)	378 (340)	583 (525)	782 (704)	1097 (987)	1461 (1315)	1748 (1573)	3114 (2803)	4504 (4054)	6497 (5847)	7144 (6430)
CAPSCREW	ASTM A-354-BC STEEL	ALLOY STEEL QUENCHED TEMPERED	1/4 - 2 1/2	105,000	125,000					11 (10)	20 (18)	34 (31)	54 (49)	81 (73)	119 (107)	167 (150)	269 (242)	427 (384)	644 (580)	1002 (902)	1392 (1253)	1868 (1681)	2234 (2011)	3982 (3584)	5749 (5174)	8308 (7477)	9255 (8330)
BOLT	A-354-BD A-490	ALLOY STEEL QUENCHED TEMPERED	1/4 - 1 1/2	120,000	150,000							55 (50)	90 (81)	138 (124)	198 (178)	270 (243)	444 (400)	709 (638)	1071 (964)	1692 (1523)	2360 (2124)	3159 (2843)	3780 (3402)				
SOCKET CAPSCREW	SOCKET HEAD CAP SCREW	HIGH CARBON ALLOY STEEL QUENCHED TEMPERED		140,000	160,000					14 (13)	30 (27)	50 (45)	81 (73)	121 (109)	176 (158)	240 (216)	395 (356)	629 (566)	964 (868)	1523 (1371)	2120 (1908)	2843 (2559)	3402 (3062)	6063 (5457)	8751 (7876)	12645 (11381)	17503 (15753)
SOCKET SETSCREW	SOCKET SET SCREW	HIGH CARBON ALLOY STEEL QUENCHED TEMPERED		N/A	212,000		9 (8)	16 (14)	30 (27)	70 (63)	140 (126)	18 (16)	29 (26)	43 (39)	63 (57)	100 (90)	146 (131)										
CAP/MACH. SCREW	STAINLESS STEEL	18-8		30,000 YIELD	75,000 (MIN)	3 3	6 (5)	10 (9)	15 (13)	36 (32)	74 (66)	11 (10)	17 (16)	27 (24)	38 (35)	53 (48)	94 (85)	152 (136)	227 (205)	322 (290)	454 (409)		703 (633)				
CAP/MACH. SCREW	STAINLESS STEEL	304 / 316		30,000 YIELD	90,000	3 3	6 (5)	10 (9)	15 (13)	36 (32)	74 (66)	11 (10)	17 (16)	27 (24)	38 (35)	53 (48)	94 (85)	152 (136)	227 (205)	322 (290)	454 (409)		732 (659)				
CAP/MACH. SCREW	YELLOW BRASS ALLOY 270	Cu 63% Zn 37% Pb 0.1% Fe 0.07%		30,000 YIELD	60,000	4 (4)	8 (7)	16 (14)	19 (17)	60 (54)	107 (96)	16 (14)	26 (23)	35 (32)	47 (42)	76 (68)	102 (92)	156 (140)	212 (191)	318 (286)	394 (355)		575 (518)				
CAP/MACH. SCREW	SILICON BRONZE GRADE 661	Cu 94% (Min) Si 2.8 - 3.5% Mn 1.5% (Max) Pb 0.2 - 0.8%		30,000 YIELD	70,000	4 (3)	7 (6)	12 (11)	17 (16)	42 (38)	86 (77)	13 (11)	20 (18)	31 (28)	45 (40)	62 (56)	110 (99)	177 (159)	240 (216)	361 (325)	447 (402)		651 (586)				
CAP/MACH. SCREW	ALUMINUM 2024-T4	Cu 3.8 - 4.9 % Mg 1.2 - 1.8 % Mn 0.3 - 0.9 %		30,000 YIELD	55,000	3 (3)	5 (4)	11 (10)	14 (13)	39 (35)	80 (72)	12 (11)	19 (17)	26 (23)	34 (31)	60 (54)	80 (72)	125 (113)	166 (149)	251 (226)	308 (277)		450 (405)				
CAP/MACH. SCREW	MONEL	Ni 67 % Cu 30 % Fe 1.4 %			82,000	5 (4)	10 (9)	20 (18)	26 (23)	85 (77)	149 (134)	22 (20)	35 (32)	49 (44)	65 (59)	110 (99)	149 (134)	229 (206)	310 (279)	470 (423)	575 (518)		840 (756)				
SEMS/MACH. SCREW	HEAT TREATED STEEL	SAE 5.1		85,000	120,000	7 (6)	14 (13)	25 (23)	35 (32)	85 (77)	195 (176)	27 (24)															
STRESS AREA						COARSE	.00604	.00909	.01400	.01750	.0318	.0524	.0775	.1063	.1419	.1820	.2260	.3340	.4620	.6060	.7630	.9690	1.155	1.405	1.90	2.50	3.25	4.00
						FINE	.00661	.01015	.01474	.02000	.0364	.0580	.0878	.1187	.1599	.2030	.2560	.3730	.5090	.6630	.8560	1.073	1.315	1.581				

DATA IS FROM "PROPOSED STANDARD TORQUE VALUES FOR INDUSTRIAL FASTENERS (METAL)" WHICH IS LOCATED IN THE M&I STANDARDS DEPT.

** = [ ] BOXED TORQUE VALUES ARE EXPRESSED IN IN.-LBS.

DRY TORQUE (IN IN.-LBS.) = (SAFETY FACTOR)*(PROOF LOAD)*(STRESS AREA)*(BASIC MAJOR DIA.)*(MECH. EFF.)
SAFETY FACTOR = 0.75
MECH. EFF. = 0.200 (FOR DRY APPLICATION - NO LUBRICANTS)
LUBRICATED TORQUE = (0.90)*(DRY TORQUE)

1. USE NON-BRACKETED TORQUE FIGURES DIRECTLY WHEN USING STANDARD INDUSTRIAL FASTENERS AS FURNISHED BY THE MANUFACTURER (NON-PLATED FASTENERS). USE THE BRACKETED ( ) TORQUE VALUES WHEN LUBRICANTS OF HIGH STRESS ABILITY, SUCH AS NEVER-SEEZ COMPOUND, GRAPHITE AND OIL, MOLYBDENUM DI-SULPHITE, COLLOIDAL COPPER OR WHITE LEAD, ARE USED.
2. MULTIPLY THE TORQUE VALUES IN THE CHART BY THE FACTOR 0.90 WHEN CAPSCREWS ARE ZINC PLATED. MULTIPLY BY 0.80 WHEN NUTS AND BOLTS ARE ZINC PLATED. △E
3. THE STANDARD FOR FASTENERS OF EWT DRIVES AND LIFTS IS SAE GRADE 5 CAPSCREWS. HOWEVER, WHEN THE JOINTS ARE OF CAST IRON, USE THE A-307 (SAE 2) TORQUE VALUES UNLESS SPECIFIED OTHERWISE.
4. FOR STUDS, USE TORQUE VALUES CORRESPONDING TO THE SAME SIZE AND GRADE OF CAPSCREWS.

△C

HIGH STRENGTH (H.S.) BOLTS (ASTM A325) MUST BE USED WHERE SHOWN AND SPECIFIED. ASSEMBLY INSTRUCTIONS. TURN-OF-NUT METHOD.

ALL JOINT SURFACES SHALL BE FREE OF LOOSE MILL SCALE, BURRS, AND FOREIGN MATERIAL.

ENOUGH BOLTS SHALL BE BROUGHT TO A "SNUG TIGHT" CONDITION TO INSURE THAT THE PARTS OF THE JOINT ARE PROPERLY COMPACTED, I.E., BROUGHT INTO FULL CONTACT WITH EACH OTHER. SNUG TIGHT SHALL BE DEFINED AS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF A IMPACT WRENCH OR THE FULL EFFORT OF A MAN USING AN ORDINARY SPUD WRENCH. FOLLOWING THE INITIAL TIGHTENING, BOLTS SHALL BE PLACED IN ANY REMAINING HOLES IN THE CONNECITON AND BROUGHT TO SNUG TIGHTNESS.

ALL BOLTS IN THE JOINT SHALL BE TIGHTEDED ADDITIONALLY BY THE APPLICABLE AMOUNT OF NUT ROTATION SPECIFIED BELOW, WITH TIGHTENING PROGRESSING SYSTEMATICALLY FROM THE MOST RIGID PART OF THE JOINT TO ITS FREE EDGES.

Bolt Length (as measured from underside of head to extreme end of point)	Dispostion of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (beveled washers not used)	Both faces sloped not more than 1:20 from normal to bolt axis (bevel washers not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn

NUT ROTATION IS ROTATION RELATIVE TO BOLT, REGARDLESS OF THE ELEMENT (NUT OR BOLT) BEING TURNED. TOLERANCE ON ROTATION: 30° OVER OR UNDER. FOR OTHER THAN TURN-OF-NUT METHOD, FOLLOW PROCEDURES OUTLINED IN LATEST EDITION OF THE AISC STEEL CONSTRUCTION MANUAL.

△D △F

REVISION	ECO	BY	CHECK'D	DATE	
ADDED THE NUT TURN CHART	35895	CKT	RGP	6/26/09	F
TITLE BLOCK UPDATE	35052	DJN	CKT	2/10/09	E
ADDED 304 STAINLESS TO THE LIST	34901	CKT	RGP	1/19/09	D
REVISED TO UPDATE TITLE BLOCK AND REMOVE NOTES	34709	CKT	RGP	12/11/08	C
INITIAL RELEASE					A

REVISION			
C			
B	9820	2/7/92	
A	5819	1-12-83	
	D/R	DATE	

EIMCO WATER TECHNOLOGIES — A GLV COMPANY — THIRD ANGLE PROJECTION — D

TOTAL WT: -

ORIGINAL S.O. -

DATE 1/8/81 | DRAWN GBH | CHECK'D JKM

TORQUE VALUES FOR MACHINERY CONNECTIONS FOR INDUSTRIAL CONNECTIONS

DO NOT SCALE PRINTS

REF. FROM: -

SHEET 1 OF 1

DWG. NO. 114808 REV F

Accessories

TAB 1

CONTINUOUS HINGE WITH CLAMPS, TYPE 4X

APPLICATION

For use in indoor and outdoor corrosive environments that require a water-tight seal, this enclosure's seamless foam-in-place gasket and screw-down clamps provide a secure seal against contaminants.

SPECIFICATIONS

- 14 gauge Type 304 or Type 316L stainless steel bodies and doors
- Seams continuously welded and ground smooth
- Seamless foam-in-place gasket
- Rolled lip around three sides of door
- Stainless steel door clamp assembly
- Hasp and staple for padlocking
- Door removed by pulling stainless steel continuous hinge pin
- Data pocket is high-impact thermoplastic
- Collar studs provided for mounting optional panels
- Exterior hardware on Type 316L stainless steel enclosures matches enclosure material
- Bonding provision on door; grounding stud on body

FINISH

Door, sides, top and bottom have smooth #4 brushed finish.

ACCESSORIES

Fast-Operating Clamp Assembly
Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Junction Box and Wall-Mount Enclosure Swing-Out Panel Kit
Steel, Stainless Steel and Non-Metallic Window Kits
H2OMIT Vent Drains, Type 4X
H2OMIT Thermoelectric Dehumidifier
Steel, Stainless Steel and Non-Metallic Window Kits
PANELITE Enclosure Lights
Hol-Sealers Hole Seals
Themoelectric Temperature Controller

INDUSTRY STANDARDS

UL 508A Listed; Type 3R, 4, 4X, 12; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 3R, 4, 4X, 12; File No. E61997

NEMA/EEMAC Type 3, 3R, 4, 4X, 12, 13
CSA File No. 42186: Type 4, 4X, 12
IEC 60529, IP66
Meets NEMA Type 3RX requirements

MODIFICATION AND CUSTOMIZATION

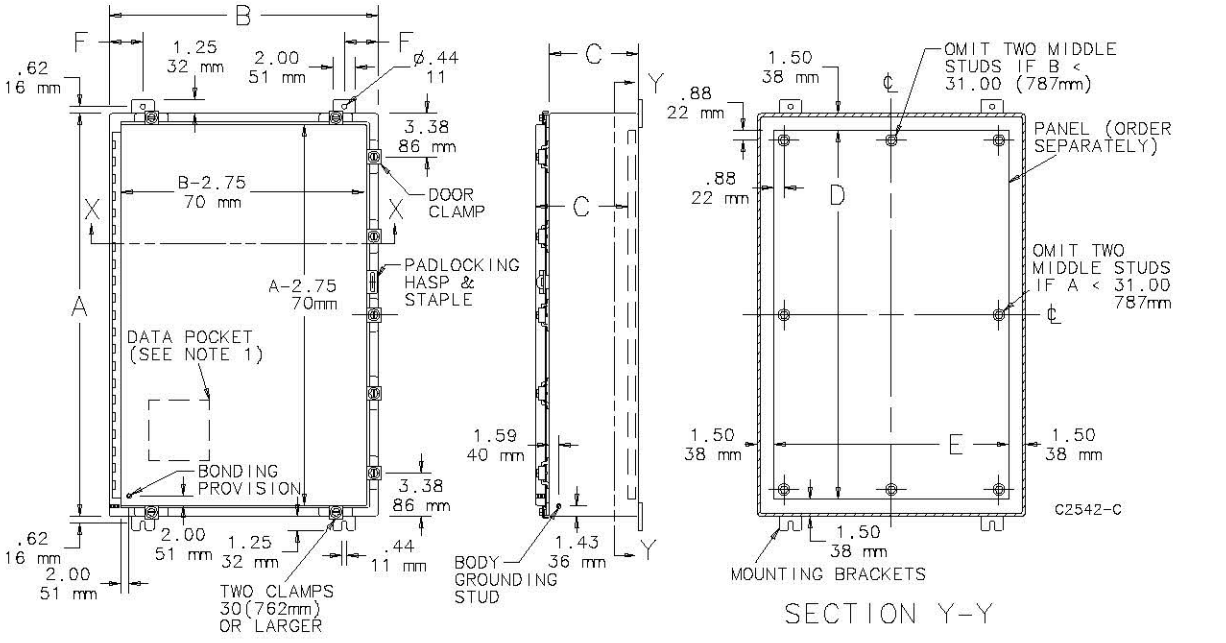
Hoffman excels at modifying and customizing products to your specifications. Contact your local Hoffman sales office or distributor for complete information.

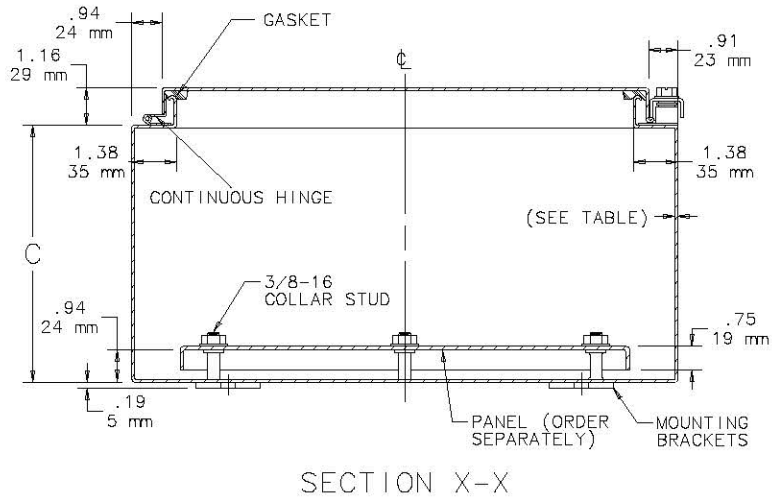
BULLETIN: A4S

Standard Product

Catalog Number	AxBxC in./mm	Stainless Steel Type	Steel Panel	Conductive Steel Panel	Stainless Steel Panel	Panel Size D x E in./mm	F in./mm	Clamps Qty.	Data Pocket
A16H1206SSLP	16.00 x 12.00 x 6.00 406 x 305 x 152	304	A16P12	A16P12G	A16P12SS6	13.00 x 9.00 330 x 229	1.25 32	4	Small
A16H1206SS6LP	16.00 x 12.00 x 6.00 406 x 305 x 152	316L	A16P12	A16P12G	A16P12SS6	13.00 x 9.00 330 x 229	1.25 32	4	Small
A16H1606SSLP	16.00 x 16.00 x 6.00 406 x 406 x 152	304	A16P16	A16P16G	A16P16SS6	13.00 x 13.00 330 x 330	3.00 76	4	Small
A16H1606SS6LP	16.00 x 16.00 x 6.00 406 x 406 x 152	316L	A16P16	A16P16G	A16P16SS6	13.00 x 13.00 330 x 330	3.00 76	4	Small
A16H2006SSLP	16.00 x 20.00 x 6.00 406 x 508 x 152	304	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A16H2006SS6LP	16.00 x 20.00 x 6.00 406 x 508 x 152	316L	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H1606SSLP	20.00 x 16.00 x 6.00 508 x 406 x 152	304	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H1606SS6LP	20.00 x 16.00 x 6.00 508 x 406 x 152	316L	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H2006SSLP	20.00 x 20.00 x 6.00 508 x 508 x 152	304	A20P20	A20P20G	A20P20SS6	17.00 x 17.00 432 x 432	3.00 76	4	Small
A20H2006SS6LP	20.00 x 20.00 x 6.00 508 x 508 x 152	316L	A20P20	A20P20G	A20P20SS6	17.00 x 17.00 432 x 432	3.00 76	4	Small
A24H2006SSLP	24.00 x 20.00 x 6.00 610 x 508 x 152	304	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A24H2006SS6LP	24.00 x 20.00 x 6.00 610 x 508 x 152	316L	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A24H2406SSLP	24.00 x 24.00 x 6.00 610 x 610 x 152	304	A24P24	A24P24G	A24P24SS6	21.00 x 21.00 533 x 533	3.00 76	5	Small
A24H2406SS6LP	24.00 x 24.00 x 6.00 610 x 610 x 152	316L	A24P24	A24P24G	A24P24SS6	21.00 x 21.00 533 x 533	3.00 76	5	Small

Catalog Number	AxBxC in./mm	Stainless Steel Type	Steel Panel	Conductive Steel Panel	Stainless Steel Panel	Panel Size D x E in./mm	F in./mm	Clamps Qty.	Data Pocket
A16H1208SSLP	16.00 x 12.00 x 8.00 406 x 305 x 203	304	A16P12	A16P12G	A16P12SS6	13.00 x 9.00 330 x 229	1.25 32	4	Small
A16H1208SS6LP	16.00 x 12.00 x 8.00 406 x 305 x 203	316L	A16P12	A16P12G	A16P12SS6	13.00 x 9.00 330 x 229	1.25 32	4	Small
A20H1608SSLP	20.00 x 16.00 x 8.00 508 x 406 x 203	304	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H1608SS6LP	20.00 x 16.00 x 8.00 508 x 406 x 203	316L	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H2008SSLP	20.00 x 20.00 x 8.00 508 x 508 x 203	304	A20P20	A20P20G	A20P20SS6	17.00 x 17.00 432 x 432	3.00 76	4	Small
A20H2008SS6LP	20.00 x 20.00 x 8.00 508 x 508 x 203	316L	A20P20	A20P20G	A20P20SS6	17.00 x 17.00 432 x 432	3.00 76	4	Small
A20H2408SSLP	20.00 x 24.00 x 8.00 508 x 610 x 203	304	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	4	Small
A20H2408SS6LP	20.00 x 24.00 x 8.00 508 x 610 x 203	316L	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	4	Small
A24H1608SSLP	24.00 x 16.00 x 8.00 610 x 406 x 203	304	A24P16	A24P16G	A24P16SS6	21.00 x 13.00 533 x 330	3.00 76	5	Small
A24H1608SS6LP	24.00 x 16.00 x 8.00 610 x 406 x 203	316L	A24P16	A24P16G	A24P16SS6	21.00 x 13.00 533 x 330	3.00 76	5	Small
A24H2008SSLP	24.00 x 20.00 x 8.00 610 x 508 x 203	304	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A24H2008SS6LP	24.00 x 20.00 x 8.00 610 x 508 x 203	316L	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A24H2408SSLP	24.00 x 24.00 x 8.00 610 x 610 x 203	304	A24P24	A24P24G	A24P24SS6	21.00 x 21.00 533 x 533	3.00 76	5	Small
A24H2408SS6LP	24.00 x 24.00 x 8.00 610 x 610 x 203	316L	A24P24	A24P24G	A24P24SS6	21.00 x 21.00 533 x 533	3.00 76	5	Small
A24H3008SSLP	24.00 x 30.00 x 8.00 610 x 762 x 203	304	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	7	Small
A24H3008SS6LP	24.00 x 30.00 x 8.00 610 x 762 x 203	316L	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	7	Small
A30H2008SSLP	30.00 x 20.00 x 8.00 762 x 508 x 203	304	A30P20	A30P20G	A30P20SS6	27.00 x 17.00 686 x 432	3.00 76	5	Small
A30H2008SS6LP	30.00 x 20.00 x 8.00 762 x 508 x 203	316L	A30P20	A30P20G	A30P20SS6	27.00 x 17.00 686 x 432	3.00 76	5	Small
A30H2408SSLP	30.00 x 24.00 x 8.00 762 x 610 x 203	304	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	5	Large
A30H2408SS6LP	30.00 x 24.00 x 8.00 762 x 610 x 203	316L	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	5	Large
A30H3008SSLP	30.00 x 30.00 x 8.00 762 x 762 x 203	304	A30P30	A30P30G	A30P30SS6	27.00 x 27.00 686 x 686	3.00 76	7	Large
A30H3008SS6LP	30.00 x 30.00 x 8.00 762 x 762 x 203	316L	A30P30	A30P30G	A30P30SS6	27.00 x 27.00 686 x 686	3.00 76	7	Large
A36H2408SSLP	36.00 x 24.00 x 8.00 914 x 610 x 203	304	A36P24	A36P24G	A36P24SS6	33.00 x 21.00 838 x 533	3.00 76	5	Large
A36H2408SS6LP	36.00 x 24.00 x 8.00 914 x 610 x 203	316L	A36P24	A36P24G	A36P24SS6	33.00 x 21.00 838 x 533	3.00 76	5	Large
A36H3008SSLP	36.00 x 30.00 x 8.00 914 x 762 x 203	304	A36P30	A36P30G	A36P30SS6	33.00 x 27.00 838 x 686	3.00 76	7	Large
A36H3008SS6LP	36.00 x 30.00 x 8.00 914 x 762 x 203	316L	A36P30	A36P30G	A36P30SS6	33.00 x 27.00 838 x 686	3.00 76	7	Large
A42H3608SSLP	42.00 x 36.00 x 8.00 1067 x 914 x 203	304	A42P36	A42P36G	A42P36SS6	39.00 x 33.00 991 x 838	3.00 76	8	Large
A42H3608SS6LP	42.00 x 36.00 x 8.00 1067 x 914 x 203	316L	A42P36	A42P36G	A42P36SS6	39.00 x 33.00 991 x 838	3.00 76	8	Large
A48H3608SSLP	48.00 x 36.00 x 8.00 1219 x 914 x 203	304	A48P36	A48P36G	A48P36SS6	45.00 x 33.00 1143 x 838	3.00 76	8	Large
A48H3608SS6LP	48.00 x 36.00 x 8.00 1219 x 914 x 203	316L	A48P36	A48P36G	A48P36SS6	45.00 x 33.00 1143 x 838	3.00 76	8	Large
A20H1610SSLP	20.00 x 16.00 x 10.00 508 x 406 x 254	304	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A20H1610SS6LP	20.00 x 16.00 x 10.00 508 x 406 x 254	316L	A20P16	A20P16G	A20P16SS6	17.00 x 13.00 432 x 330	3.00 76	4	Small
A24H2010SSLP	24.00 x 20.00 x 10.00 610 x 508 x 254	304	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A24H2010SS6LP	24.00 x 20.00 x 10.00 610 x 508 x 254	316L	A24P20	A24P20G	A24P20SS6	21.00 x 17.00 533 x 432	3.00 76	5	Small
A30H2410SSLP	30.00 x 24.00 x 10.00 762 x 610 x 254	304	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	5	Large
A30H2410SS6LP	30.00 x 24.00 x 10.00 762 x 610 x 254	316L	A30P24	A30P24G	A30P24SS6	27.00 x 21.00 686 x 533	3.00 76	5	Large
A36H2410SSLP	36.00 x 24.00 x 10.00 914 x 610 x 254	304	A36P24	A36P24G	A36P24SS6	33.00 x 21.00 838 x 533	3.00 76	5	Large
A36H2410SS6LP	36.00 x 24.00 x 10.00 914 x 610 x 254	316L	A36P24	A36P24G	A36P24SS6	33.00 x 21.00 838 x 533	3.00 76	5	Large
A36H3010SSLP	36.00 x 30.00 x 10.00 914 x 762 x 254	304	A36P30	A36P30G	A36P30SS6	33.00 x 27.00 838 x 686	3.00 76	7	Large





NOTE:
1. Removable data pocket included (see table for size). Large data pocket 12.00 x 12.00 (305mm x 305mm); small data pocket 6.00 x 6.00 (152mm x 152mm).
2. Maximum spacing between door clamps is 15.00 (382mm)

ELECTRIC HEATERS

115/230 Volt
100/200 Watt

115/230 Volt
400/800 Watt

115/230 Volt
1300 Watt

INDUSTRY STANDARDS

UL 508A Component Recognized; File No. E61997

CSA Certified, CSA File No. LR42186
CE

APPLICATION

Protect mechanical, electrical and electronic equipment from low temperatures, condensation and corrosion with this thermostatically controlled, fan-driven heater that maintains a stable enclosure temperature.
Fan draws cool air from the bottom of the enclosure and passes this air across the thermostat and heating element before being released into enclosure cavity. Heated air is discharged through the top of the heater unit.

SPECIFICATIONS

- Aluminum housing
- Thermostat range adjustable from 0 F to 100 F (-18 C to 38 C)
- Four 10-32 x self-tapping screws are included with each heater
- Ball bearing fan
- Terminal strip with clamp connector that accepts both solid and stranded wire

FINISH

- Brushed aluminum

⚠ CAUTION

These electric heaters are not designed for use in dusty, dirty, corrosive, or hazardous locations. Portions of the heater can get hot. Adequate protection must be taken to protect people from potential burns, and to protect other components from this heat. Pentair Technical Products recommends this heater only be installed in a totally-enclosed metal enclosure.

DO NOT INSTALL HEATERS ON WOOD PANELS. Heat sensitive components should not be placed near the heater discharge area since this air can be quite warm. The clearance range defines the space that must be kept free of these components for proper and safe operation of the heater.

Performance Data **100 and 200 Watt Heaters**

CATALOG NUMBERS	DAH1001A	DAH1002A	DAH2001A	DAH2002A
ELECTRICAL DATA				
Rated Voltage	**115**	**230**	**115**	**230**
Frequency (Hz)	50/60	50/60	50/60	50/60
Power Consumption (Watts)	100	100	200	200
Nominal Current (Amps)	0.98	0.49	1.89	0.95
HEATING PERFORMANCE				
Watts	**100**	**100**	**200**	**200**
UNIT CONSTRUCTION				
Weight (lb./kg)	1.6/0.73	1.6/0.73	1.6/0.73	1.6/0.73
X (in./mm)	4.00/102	4.00/102	6.00/152	6.00/152

Performance Data **400 and 800 Watt Heaters**

CATALOG NUMBERS	DAH4001B	DAH4002B	DAH8001B	DAH8002B
ELECTRICAL DATA				
Rated Voltage	**115**	**230**	**115**	**230**
Frequency (Hz)	50/60	50/60	50/60	50/60
Power Consumption (Watts)	400	400	800	800
Nominal Current (Amps)	3.72	1.86	7.37	3.69
HEATING PERFORMANCE				
Watts	**400**	**400**	**800**	**800**
UNIT CONSTRUCTION				
Weight (lb./kg)	2.2/1.00	2.2/1.00	2.2/1.00	2.2/1.00
X (in./mm)	6.00/152	6.00/152	8.00/203	8.00/203

Performance Data **1300 Watt Heaters**

CATALOG NUMBERS	DAH13001C	DAH13002C
ELECTRICAL DATA		
Rated Voltage	**115**	**230**
Frequency (Hz)	50/60	50/60
Power Consumption (Watts)	1300	1300
Nominal Current (Amps)	11.5	5.7
HEATING PERFORMANCE		
Watts	**1300**	**1300**
UNIT CONSTRUCTION		
Weight (lb./kg)	3.4/1.54	3.4/1.54
X (in./mm)	8.00/203	8.00/203

T2
100A, 480V Δ
Thermal-magnetic/electronic/current limiting

Tmax MCCBs

T2

Dimensions 3P Fixed Version 5.12H x 3.54W x 2.76D
Weight 2.84 (lbs)

General
The T2 breaker family ranges from 15 through 100 amperes. The T2 trip units are non-interchangeable and use the very latest technology in electromagnetic relays for overcurrent trip protection as well as a version with microprocessor-based electronic trip unit. Thermal overload protection is provided by heat sensitive bimetals. State of the art construction in contacts and arcing chambers aid in limiting damaging fault currents through the protected circuits.

Standards
The UL489/CSA 22.2 version of T2 also carries an IEC-60947-2 rating.

Versions
The T2 frame is available in four versions:
- T = Thermal-magnetic, fixed
- B = Adjustable LS/I electronic
- M = Magnetic only (MCP)
- E5 = Electronic Instantaneous only (MCP)

Trip functions
These tripping functions are available:
- L = Long time
- S = Short time
- I = Instantaneous

Performance levels
The T2 breaker has two performance levels available:
- S = Standard
- H = High - UL Current Limiting

Number of poles
The T2 is available in three and four pole versions. Estimate 4 pole pricing by adding 35% to the 3 pole price and contact your ABB sales person for details.

UL489 / CSA C22.2 Interrupting capacity (kA RMS)

Voltage	Continuous rating	S	H
240VAC	15 – 100A	65	100
480VAC Δ	15 – 100A	35	65

IEC 60947-2 Interrupting capacity (kA RMS)

Voltage	Continuous rating	B (1 pole)	N
230VAC	15 – 100A	85	100
415VAC	15 – 100A	50	70
690VAC	15 – 100A	7	8
500VDC 2 pole series	15 – 100A	50	70

16

T2
100A, 480V Δ
Thermal-magnetic/current limiting

T2 — 100A TMF thermal magnetic fixed

Breaker	IC at 480VAC	Rating	Magnetic trip	3 pole, 480VAC catalog number	List price
T2S	35kA	15A	500A	T2S015TW	$ 690
		20A	500A	T2S020TW	
		25A	500A	T2S025TW	
		30A	500A	T2S030TW	
		40A	500A	T2S040TW	
		50A	500A	T2S050TW	
		60A	600A	T2S060TW	
		70A	700A	T2S070TW	793
		80A	800A	T2S080TW	
		90A	900A	T2S090TW	
		100A	1000A	T2S100TW	

Breaker	IC at 480VAC	Rating	Magnetic trip	3 pole, 480VAC catalog number	List price
T2H UL Current Limiting	65kA	15A	500A	T2H015TW	$ 942
		20A	500A	T2H020TW	
		25A	500A	T2H025TW	
		30A	500A	T2H030TW	
		40A	500A	T2H040TW	
		50A	500A	T2H050TW	
		60A	600A	T2H060TW	
		70A	700A	T2H070TW	1,153
		80A	800A	T2H080TW	
		90A	900A	T2H090TW	
		100A	1000A	T2H100TW	

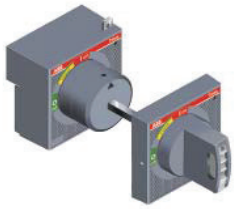
T2 – 100A TMF, 100% rated thermal magnetic fixed

Breaker	IC at 480VAC	Rating	Magnetic trip	3 pole, 480VAC catalog number	List price
T2S	35kA	15A	500A	T2SQ015TW	$ 760
		20A	500A	T2SQ020TW	
		25A	500A	T2SQ025TW	
		30A	500A	T2SQ030TW	
		40A	500A	T2SQ040TW	
		50A	500A	T2SQ050TW	
		60A	600A	T2SQ060TW	
		70A	700A	T2SQ070TW	872
		80A	800A	T2SQ080TW	
		90A	900A	T2SQ090TW	
		100A	1000A	T2SQ100TW	

Breaker	IC at 480VAC	Rating	Magnetic trip	3 pole, 480VAC catalog number	List price
T2H UL Current Limiting	65kA	15A	500A	T2HQ015TW	$ 1,025
		20A	500A	T2HQ020TW	
		25A	500A	T2HQ025TW	
		30A	500A	T2HQ030TW	
		40A	500A	T2HQ040TW	
		50A	500A	T2HQ050TW	
		60A	600A	T2HQ060TW	
		70A	700A	T2HQ070TW	1,268
		80A	800A	T2HQ080TW	
		90A	900A	T2HQ090TW	
		100A	1000A	T2HQ100TW	

Accessories
Mechanical T1-T6
Locking Devices and Handle Operators

OHB65J6



KT5VD-M, KT5VD-S, KT5VD-H

KT5RH

Variable Depth Handle Operators

Frame	NEMA Rating	Mechanism Part Number	List Price	Shaft Part Number	List Price	Handle Part Number	List Price
T1-T2-T3	1, 3R, 12	KT3VD-M		OXP6X430 (16.9")		OHB65J6 OHY65J6	
	4, 4X					OHB80L6 OHY80L6	
	1			KT3VD-S (11.8")		KT3VD-H	
Ts3	1, 3R, 12	KTs3VD-M		OXP10X500 (19.7")		OHB125J10X	
	4, 4X					OHB125L10	
	1			KTs3VD-S (20")		KTs3VD-H	
T4-T5	1, 3R, 12	KT5VD-M		OXP10X500 (19.7")		OHB125J10X	
	4, 4X					OHB125L10	
	1			KT5VD-S (19.7")		KT5VD-H	
T6	1, 3R, 12	KT6VD-M		OXP10X500 (19.7")		OHB125J10X	
	4, 4X					OHB125L10	
	1			KT5VD-S (19.7")		KT6VD-H	

Note: Discount schedule DS-H applies for part-numbers starting with OH and OX

Direct Mount Rotary

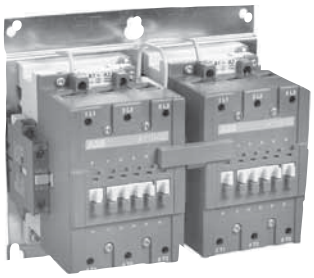
Frame	Breaker Mounting	Part Number	List Price
T1-T2-T3	Fixed, Plug-In	KT3RH	
Ts3	Fixed, Plug-In	KTs3RH	
Ts3	Draw-Out	KTs3RHW	
T4-T5	Fixed, Plug-In	KT5RH	
T4-T5	Draw-Out	KT5RHW	
T6	Fixed, Plug-In	KT6RH	
T6	Draw-Out	KT6RHW	

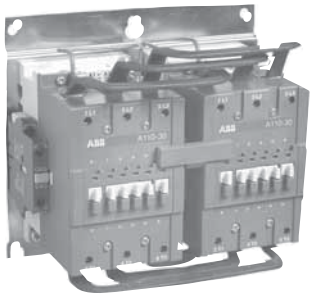
Early Make Contact

Frame	Part Number	List Price
T2-T3	KT3EM	
T4-T5	KT5EM	
T6	KT6EM	

A9 - A300, AC operated
Non-reversing, mechanically interlocked, reversing
UL rated, 3 phase


A26-30-10-84


A110M-30-11-84


A110R-30-11-84

UL general purpose current	UL motor switching current	Maximum motor horsepower ratings				Standard Aux. contacts		Non-reversing		Mechanically interlocked		Reversing	
		208V	240V	480V	575/600V	NO	NC	Catalog number	List price	Catalog number	List price	Catalog number	List price
AC1		UL rated											
21	9	2	2	5	7.5	1 0	0 1	A9-30-10-84 A9-30-01-84	**$ 78**	A9M-30-10-84 A9M-30-01-84	**$ 255**	A9R-30-10-84 A9R-30-01-84	**$ 315**
25	11	3	3	7.5	10	1 0	0 1	A12-30-10-84 A12-30-01-84	**84**	A12M-30-10-84 A12M-30-01-84	**315**	A12R-30-10-84 A12R-30-01-84	**375**
30	17	5	5	10	15	1 0	0 1	A16-30-10-84 A16-30-01-84	**102**	A16M-30-10-84 A16M-30-01-84	**345**	A16R-30-10-84 A16R-30-01-84	**413**
40	28	7.5	10	20	25	1 0	0 1	A26-30-10-84 A26-30-01-84	**183**	A26M-30-10-84 A26M-30-01-84	**405**	A26R-30-10-84 A26R-30-01-84	**480**
50	34	10	10	25	30	1 0	0 1	A30-30-10-84 A30-30-01-84	**252**	A30M-30-10-84 A30M-30-01-84	**548**	A30R-30-10-84 A30R-30-01-84	**623**
60	42	10	15	30	40	1 0	0 1	A40-30-10-84 A40-30-01-84	**297**	A40M-30-10-84 A40M-30-01-84	**639**	A40R-30-10-84 A40R-30-01-84	**750**
80	54	15	20	40	50	1	1	A50-30-11-84	**330**	A50M-30-11-84	**713**	A50R-30-11-84	**810**
90	65	20	25	50	60	1	1	A63-30-11-84	**372**	A63M-30-11-84	**870**	A63R-30-11-84	**1013**
105	80	25	30	60	75	1	1	A75-30-11-84	**413**	A75M-30-11-84	**1155**	A75R-30-11-84	**1298**
125	95	30	30	60	75	1	1	A95-30-11-84	**450**	A95M-30-11-84	**1230**	A95R-30-11-84	**1425**
140	110	30	40	75	100	1	1	A110-30-11-84	**480**	A110M-30-11-84	**1365**	A110R-30-11-84	**1628**
230	130	40	50	100	125	1	1	A145-30-11-84	**825**	A145M-30-11-84	**2235**	A145R-30-11-84	**2250**
250	156	50	60	125	150	1	1	A185-30-11-84	**1290**	A185M-30-11-84	**3360**	A185R-30-11-84	**3375**
300	192	60	75	150	200	1	1	A210-30-11-84	**1635**	A210M-30-11-84	**4035**	A210R-30-11-84	**4050**
350	248	75	100	200	250	1	1	A260-30-11-84	**1815**	A260M-30-11-84	**4485**	A260R-30-11-84	**4500**
400	302	100	100	250	300	1	1	A300-30-11-84	**1875**	A300M-30-11-84	**5460**	A300R-30-11-84	**5475**
550	414	125	150	350	400	1	1						
650	480	150	200	400	500	1	1						
750	602	200	250	500	600	1	1						
900	810	250	300	600	700	1	1						
1350	960	—	400	800	900	1	1						
1650	1080	—	450	900	1000	1	1						

See Type AF contactors, page 1.9

Coil voltage selection

All AC operated catalog numbers include a 120VAC coil. To select other coil voltages, substitute the code from the Coil Voltage Selection Chart for the two digits after the last dash in the catalog number.

Ex.: A 240V coil is required for an A75 contactor: A75-30-11-**80**

Auxiliary contact blocks

For additional auxiliary contact blocks, see catalog number explanation on page 1.2. Add $ 20 to list price for each additional auxiliary, and see page 1.18 for available combinations. Only side-mounted blocks are allowed to be factory installed. If auxiliary contacts are not required for A50 - A300, subtract $ 40 from list price and change catalog number to “00” instead of “11.”

Mechanical interlock

Mechanically interlocked contactors are designed for reversing, 2 speed, reduced voltage, etc. type starter applications. The complete assembly consists of two mechanically and electrically interlocked contactors mounted as follows with line and load terminals:

- A9 - A16 — mounted on 35mm DIN rail
- A26 - A300 — mounted on common baseplate

Power wiring is not included. The NC electrical interlock is provided with the mechanical interlock for A9 - A110 contactors.

Coil voltage selection chart

Hz	Cntr type	Volts															
		12	24	48	110	120	125	208	220	240	277	380	415	440	480	500	600
60	A		81	83	84	84		34	36	80	42		86	86	51	53	55
50	A		81	83	84				80			85	86			55	

For other voltages, see page 1.26.

Reversing

Reversing contactors are designed for reversing type starter applications. The complete assembly consists of two mechanically and electrically interlocked contactors mounted as follows with line and load terminals:

- A9 - A16 — mounted on 35mm DIN rail
- A26 - A300 — mounted on common baseplate

The NC electrical interlock is provided with the mechanical interlock for A9 - A110 contactors.

Accessories
for A/AF/AL & AE contactors

CAL5-11

CA5-10

Auxiliary contact blocks – Standard

Positioning	Maximum number of contact blocks	Contact Description	Catalog number	List price
Front mounting (single pole)	4 blocks: A9 – A26 AE9 – AE26 AL9 – AL26	1 N.O. 1 N.C.	CA5-10 CA5-01	**$ 15**
	5 blocks: A30, A40, AE30, AE40, AL30, AL40 6 blocks: A45 – A110 AE45 - AE110 AF45 - AF110	1 N.O. Early make 1 N.C. Late break	CC5-10 CC5-01	
Front mounting (4 pole)	1 block: A9 – A26-40-00 A30 – A110 AE9 – AE110	4 N.O. 3 N.O. & 1 N.C. 2 N.O. & 2 N.C. 4 N.C. 2 N.O./2 N.C.①	CA5-40E CA5-31E CA5-22E CA5-04E CA5-11/11E	**30**
	1 block: A9 – A40-30-10 AL9 – AL40-30-10	3 N.O. & 1 N.C. 2 N.O. & 2 N.C. 1 N.O. & 3 N.C. 4 N.C. 4 N.O. 2 N.O./2 N.C.①	CA5-31M CA5-22M CA5-13M CA5-04M CA5-40N CA5-11/11M	
Side mounting (2 pole)	2 blocks: A9 – A75, AE9-AE45 1 block: AE50 – AE75, AL9 – AL40	1 N.O. & 1 N.C.	CAL5-11	
	1 block: A/AE/AF95 - A/AE/AF110	1 N.O. & 1 N.C.	CAL18-11	
	2 blocks: A145 – A300, AF145-AF1650 2 blocks: A145 – A300, AF145-AF1650	1 N.O. & 1 N.C. (inside L or R) 1 N.O. & 1 N.C. (outside, L or R)	CAL18-11 CAL18-11B	

Auxiliary contact blocks – Front mounting, switching low voltage and low current

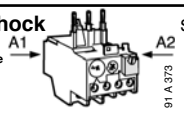
Positioning	Maximum number of contact blocks	Contact Description	Degree of protection	Catalog number	List price
Front mounting (single pole)	4 blocks: A9 – A26	1 N.O.	IP40	CE5-10D0.1	**$ 38**
	AE9 – AE26	1 N.C.	IP40	CE5-01D0.1	
	AL9 – AL26	1 N.O.	IP40	CE5-10D2	
		1 N.C.	IP40	CE5-01D2	
	5 blocks: A30, A40, AE30, AE40, AL30, AL40 6 blocks: A45 – A110 AE45 - AE110 AF45 - AF110	1 N.O. 1 N.C. 1 N.O. 1 N.C.	IP67 IP67 IP67 IP67	CE5-10W0.1 CE5-01W0.1 CE5-10W2 CE5-01W2	**42**

① Includes 1 N.O. & 1 N.C. overlapping

Thermal overload relays T

Technical data

General technical data

Type		T7DU	TA25DU		TA42DU	TA75DU
Standards: (major international European and national standards)		IEC 947–4–1, VDE 0660, NFC 63 650, BS 4941, EN 60947–4–1				
Approvals, certificates		see page 24				
Rated insulation voltage U_i to IEC 158–1, IEC 947–4–1	V	690	660/690			
Impulse withstand voltage Uimp to IEC 947–4–1	kV	6	6			
Permissible ambient temperature						
– Storage temperature	°C	– 40 to +70				
– for operation (compensated)	°C	– 25 to +55 (limit values, see page 18)				
Climatic resistance to DIN 50017		Resistant to changeable climate KFW, 30 cycles				
Mounting position		any, but please avoid vertical mounting position wherever possible				
Resistance to shock at rated current I_e • critical shock direction A1, A2 	shock duration ms	10	15			
	multiple of g	10	12			
Resistance to vibration: (±1 mm, 50 Hz)	multiple of g	4	8			
Mounting – onto contactor – with AB.. mounting kit		hooking beneath the contactor, screwing on its main terminals by screws: 2 x M4 or ⊓ 35 mm EN 50022				
Connection terminals and attachment type **Main conductors** (motor side)			TA25DU setting ranges: 0.1…0.16 A 24…32 A to 18…25 A			
• Screw terminals						
– Screw terminal		M3.5	M4	–	M6	
– with terminal block		–	–	M5	–	
– with busbars or cable lugs		–	–	–	–	
• Connection cross-sections						
– single-core or stranded	mm²	2 x 0.75 ... 2.5			1 x 2.5 ... 25 or 2 x 2.5 ... 16	
– flexible with wire end ferrule	mm²	2 x 0.5 ... 1.5			1 x 2.5 ... 25 or 2 x 2.5 ... 10	
– busbars	mm	–	–	–	–	
Connections and auxiliary connectors						
• Screw terminal (screw size) – with self-disengaging clamping piece		M 3.5				
• Connection cross-section						
– single-core or stranded	mm²	2 x 0.75 ... 2.5	2 x 0.75 … 4			
– flexible with wire end ferrule	mm²	2 x 0.5 ... 1.5	2 x 0.75 … 2.5			
Enclosure to IEC 144, IEC 529		All terminals are safe from finger-touch and safe from touch by the back of the hand to VDE 0106, Part 100 (no extra terminal shrouds are required up to and including TA 110 DU)				

Technical data of the conducting paths

Type	T7DU	TA25DU	TA42DU	TA75DU	TA80DU	TA110DU	T/TA200DU	T/TA450DU	T900DU	T/TA450SU/T900SU
Number of paths	3									
Setting ranges	see Ordering detais									
Tripping class to IEC 947–4-1 / VDE 0660, Part 1021	10									30
Frequency range Hz	0 … 400							50/60		
Switching frequency without early tripping	up to 15 ops./h or 60 ops./h with 40 % if the breaking current does not exceed 6 x I_n and the starting time does not exceed 1 s									
Resistance per phase in mΩ and heat dissipation per phase in W at maximum setting current	see page 20 and 21									
Required fuses for short-circuit protection	see page 20 and 21									

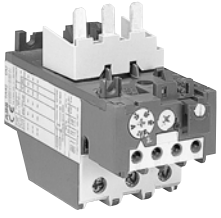
Thermal overload relays

T7DU, TA25DU, TA25DU... V1000, TA42DU, TA42DU... V1000

Ordering details

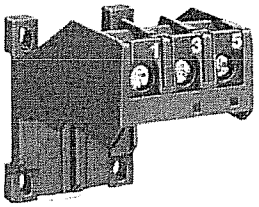
T7DU

TA25DU

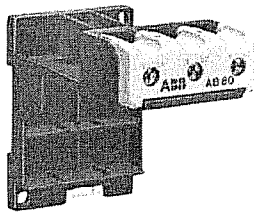


TA42DU

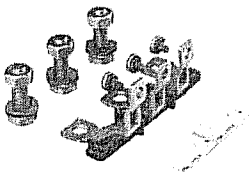
Type	Order code	Setting range A ... A	Max.fuse See page 20 aM A	gL/gG A	Price / piece	Packing unit piece	Weight per piece kg
T7DU Thermal overload relays for mini contactors B6, BC6, B6S, BC6, VB6, VBC6, B7, BC7, B7S, BC7, VB7, VBC7,							
T 7DU 0.16	**1SAZ 111 301 R 0001**	0.1 ... 0.16		0.5		1	0.070
T 7DU 0.24	**1SAZ 111 301 R 0002**	0.16 ... 0.24		1		1	0.070
T 7DU 0.4	**1SAZ 111 301 R 0003**	0.24 ... 0.4		2		1	0.070
T 7DU 0.6	**1SAZ 111 301 R 0004**	0.4 ... 0.6		2		1	0.070
T 7DU 1.0	**1SAZ 111 301 R 0005**	0.6 ... 1.0		4		1	0.070
T 7DU 1.6	**1SAZ 111 301 R 0006**	1.0 ... 1.6		6		1	0.070
T 7DU 2.4	**1SAZ 111 301 R 0007**	1.6 ... 2.4		6		1	0.070
T 7DU 4.0	**1SAZ 111 301 R 0008**	2.4 ... 4.0		10		1	0.070
T 7DU 6.0	**1SAZ 111 301 R 0009**	4.0 ... 6.0		10		1	0.070
T 7DU 9.0	**1SAZ 111 301 R 0010**	6.0 ... 9.0		10		1	0.070
T 7DU12.0	**1SAZ 111 301 R 0011**	9.0 ... 12.0		20		1	0.070
TA25DU for contactors A9 ... A40 and BC9 ... BC30							
TA25DU 0.16	**1SAZ 21 1201 R1005**	0.1 ... 0.16	–	0.5		1	0.150
TA25DU 0.25	**1SAZ 21 1201 R1009**	0.16 ... 0.25	–	0.63		1	0.150
TA25DU 0.4	**1SAZ 21 1201 R1013**	0.25 ... 0.4	–	1.25		1	0.150
TA25DU 0.63	**1SAZ 21 1201 R1017**	0.4 ... 0.63	–	2		1	0.150
TA25DU 1.0	**1SAZ 21 1201 R1021**	0.63 ... 1.0	2	4		1	0.150
TA25DU 1.4	**1SAZ 21 1201 R1023**	1.0 ... 1.4	2	4		1	0.150
TA25DU 1.8	**1SAZ 21 1201 R1025**	1.3 ... 1.8	4	6		1	0.150
TA25DU 2.4	**1SAZ 21 1201 R1028**	1.7 ... 2.4	4	6		1	0.150
TA25DU 3.1	**1SAZ 21 1201 R1031**	2.2 ... 3.1	6	10		1	0.150
TA25DU 4.0	**1SAZ 21 1201 R1033**	2.8 ... 4.0	6	10		1	0.150
TA25DU 5.0	**1SAZ 21 1201 R1035**	3.5 ... 5.0	10	16		1	0.150
TA25DU 6.5	**1SAZ 21 1201 R1038**	4.5 ... 6.5	16	20		1	0.150
TA25DU 8.5	**1SAZ 21 1201 R1040**	6.0 ... 8.5	20	25		1	0.150
TA25DU 11	**1SAZ 21 1201 R1043**	7.5 ... 11	25	35		1	0.150
TA25DU 14	**1SAZ 21 1201 R1045**	10 ... 14	25	35		1	0.150
TA25DU 19	**1SAZ 21 1201 R1047**	13 ... 19	35	50		1	0.150
TA25DU 25	**1SAZ 21 1201 R1051**	18 ... 25	50	63		1	0.150
TA25DU 32	**1SAZ 21 1201 R1053**	24 ... 32 (1)	63	80		1	0.170
(1) With terminal block DX25: 1 x 16 mm²							
TA25DU ... V1000 (EEx e) for contactors A9 ... A40, BC9 ... BC30							
TA25DU 0.16	**V1000 1SAZ 21 1301 R1005**	0.1 ... 0.16	–	0.50		1	0.150
TA25DU 0.25	**V1000 1SAZ 21 1301 R1009**	0.16 ... 0.25	–	0.63		1	0.150
TA25DU 0.4	**V1000 1SAZ 21 1301 R1013**	0.25 ... 0.4	–	1.25		1	0.150
TA25DU 0.63	**V1000 1SAZ 21 1301 R1017**	0.4 ... 0.63	–	2		1	0.150
TA25DU 1.0	**V1000 1SAZ 21 1301 R1021**	0.63 ... 1.0	2	4		1	0.150
TA25DU 1.4	**V1000 1SAZ 21 1301 R1023**	1.0 ... 1.4	2	4		1	0.150
TA25DU 1.8	**V1000 1SAZ 21 1301 R1025**	1.3 ... 1.8	4	6		1	0.150
TA25DU 2.4	**V1000 1SAZ 21 1301 R1028**	1.7 ... 2.4	4	6		1	0.150
TA25DU 3.1	**V1000 1SAZ 21 1301 R1031**	2.2 ... 3.1	6	10		1	0.150
TA25DU 4.0	**V1000 1SAZ 21 1301 R1033**	2.8 ... 4.0	6	10		1	0.150
TA25DU 5.0	**V1000 1SAZ 21 1301 R1035**	3.5 ... 5.0	10	16		1	0.150
TA25DU 6.5	**V1000 1SAZ 21 1301 R1038**	4.5 ... 6.5	16	20		1	0.150
TA25DU 8.5	**V1000 1SAZ 21 1301 R1040**	6.0 ... 8.5	20	25		1	0.150
TA25DU 11	**V1000 1SAZ 21 1301 R1043**	7.5 ... 11.0	25	35		1	0.150
TA25DU 14	**V1000 1SAZ 21 1301 R1045**	10 ... 14	25	35		1	0.150
TA25DU 19	**V1000 1SAZ 21 1301 R1047**	13 ... 19	35	50		1	0.150
TA25DU 25	**V1000 1SAZ 21 1301 R1051**	18 ... 25	50	63		1	0.150
TA25DU 32	**V1000 1SAZ 21 1301 R1053**	24 ... 32 (1)	63	80		1	0.170
(1) With terminal block DX25: 1 x 16 mm²							
TA 42DU for contactors A30, A40 and BC30							
TA 42DU 25	**1SAZ 31 1201 R1001**	18 ... 25	50	63		1	0.330
TA 42DU 32	**1SAZ 31 1201 R1002**	22 ... 32	63	80		1	0.330
TA 42DU 42	**1SAZ 31 1201 R1003**	29 ... 42	80	100		1	0.330
TA42DU ... V1000 (EEx e) for contactors A30, A40 and BC30							
TA42DU 25	**V1000 1SAZ 31 1301 R1001**	18 ... 25	50	63		1	0.330
TA42DU 32	**V1000 1SAZ 31 1301 R1002**	22 ... 32	63	80		1	0.330
TA42DU 42	**V1000 1SAZ 31 1301 R1003**	29 ... 42	80	100		1	0.330



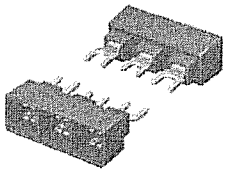
DB25/25A



DB80



DB200



LC26-B1

Separate mounting kits

For O/L relays	Amps	Catalog number	List price
TA25DU	0.1 – 25	DB25/25A	$ 30
TA25DU	24 – 32	DB25/32A	38
TA42DU, TA75DU, TA80DU	18 – 80	DB80	45
TA110DU, TA200DU	100 – 200	DB200	60

Flat pin terminal blocks

Mounting on:	Catalog number	List price
TA25DU relay DB25/25A or DB25/32A	LC30-T LC26-B1	$ 6

Terminal block — AWG #8 cable

Mounting on:	Catalog number	List price
TA25DU (25A or less) or DB25/25A	DX25	$ 15

LC terminal blocks can be used to convert standard connections into Faston connections: 2 x 6.3mm or 4 x 2.8mm per pole. The connections are protected against accidental contact.

The LC30-T has a terminal block for the 3 power terminals and a second for the 4 auxiliary terminals of a TA25DU thermal O/L relay.

The LC26-B1 has two identical terminal blocks each for 3 power terminals. This block allows the power terminals to be mounted with two DB25 kits or a TA25DU thermal O/L relay and DB25 kit assembly.

NOTE: According to DIN 46429 part 1 and NFC 20-120 the max. capacity of a Faston connection is 25 A.

Mounting kit – for TA450 overload relay

For contactor	Catalog number	List price
A145 – A185 A210 – A300	DT450/A185 DT450/A300	$ 225

Terminal shrouds – for contactors and overload relays

Contactor	Overload relay	Catalog number	List price
A9 – A16 A26 – A40	TA25DU	Included	—
A30 – A40	TA42DU	Included	—
A50 – A75	TA75DU	Included	—
A95 – A110	TA80DU TA110DU	Included	—
A145 – A185	TA200DU	LT185-AY	$ 10
A145 – A185	Load side of TA200DU	LT200A185	50

Terminal lug kits

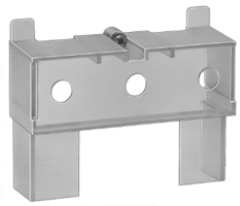
Wire range	For overloads	Catalog number	List price
6 – 250MCM	TA110DU, TA200DU	EHTK210	$ 90
4 – 400MCM	TA450DU185	ATK300HK	78
(2) 4 – 500MCM	TA450DU310	ATK300/2HK	120

Discount schedule ABA — A-contactor accessories
Discount schedule TAA — TA25
Discount schedule TBA — TA42, TA75
Discount schedule TCA — TA80, TA110, TA200, TA450

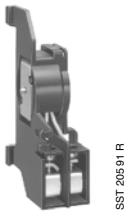
Thermal overload relays

Accessories

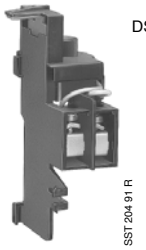
Ordering details



LT ...



DS25-A



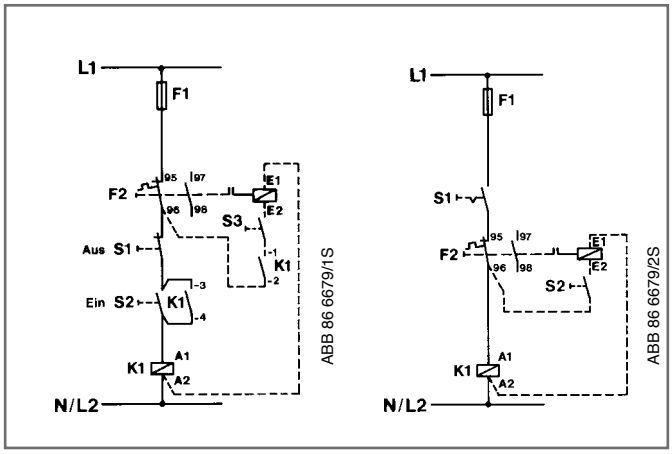
DR25-A

Type	Order code	Mounting onto :	Price / piece	Pack. unit piece	Weight / piece kg
Terminal shroud (for protection against direct contact). Contactor terminals and TOL terminals are covered					
LT900/700	**GJZ 520 1935 R 0002**	T900 DU/SU + EH370/550/700			0.450
LT900/800	**GJZ 520 1937 R 0002**	T900DU/SU + EH800			0.600
Terminal shroud for TA200					
LTA185-AY between A145/185 and TA200DU	**1SFN 12 4704 R1000**	A145, A185		1	1.000
LT200/A Load Side TA200	**1SAZ 401 901 R1001**	A145, A185			0.070

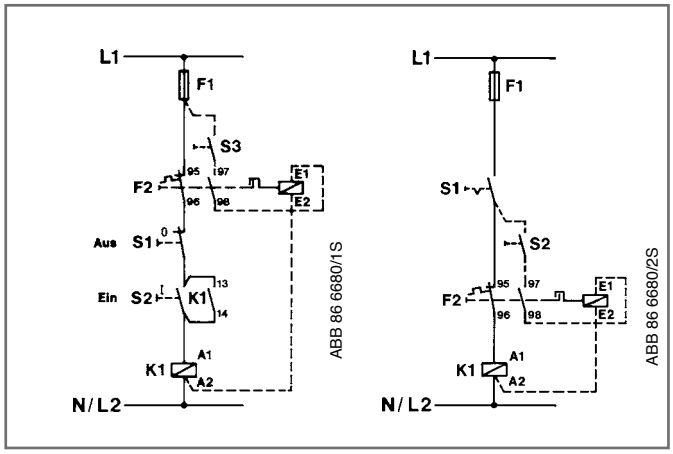
Type	Order code	For relay/ description		Price / piece	Pack. unit piece	Weight / piece kg
Remote tripping control						
The coil serves to remotely trip the thermal overload relays TA25DU, T450/900DU/SU. **The coil is not approved for continuous operation. Pulse duration 0.2 ... 0.35 s.**						
DS25-A-24	**1SAZ 201 501 R0001**	24 V	Operating-voltage U_c at 50/60 Hz		1	0.100
DS25-A-48	**1SAZ 201 501 R0002**	48 V			1	0.100
DS25-A-110	**1SAZ 201 501 R0003**	110 V			1	0.100
DS25-A-220/380	**1SAZ 201 501 R0005**	220/380 V			1	0.100
DS25-A-500	**1SAZ 201 501 R0006**	500 V			1	0.100
Remote reset coil						
The coil serves to reset the thermal overload relays TA25DU, T450/900DU/SU. The overload relay must be set to "manual reset" for this purpose. **The coil is not approved for continuous operation. Pulse duration 0.2 ... 0.35 s.**						
DR25-A-24	**1SAZ 201 504 R0001**	24 V	Operating-voltage U_c at 50/60 Hz		1	0.100
DR25-A-48	**1SAZ 201 504 R0002**	48 V			1	0.100
DR25-A-110	**1SAZ 201 504 R0003**	110 V			1	0.100
DR25-A-220/380	**1SAZ 201 504 R0005**	220/380 V			1	0.100
DR25-A-500	**1SAZ 201 504 R0006**	500 V			1	0.100

Circuit diagrams

TA25DU with DS25-A



TA25DU with DR25-A



S200UP-K, 480Y/277 VAC
Branch circuit protection
UL 489, CSA 22.2 No. 5

K

No. of poles	Rated current	Catalog number	No. of poles	Rated current	Catalog number
1	0.2	S201UP-K0.2	3	0.2	S203UP-K0.2
	0.3	S201UP-K0.3		0.3	S203UP-K0.3
	0.5	S201UP-K0.5		0.5	S203UP-K0.5
	0.75	S201UP-K0.75		0.75	S203UP-K0.75
	1	S201UP-K1		1	S203UP-K1
	1.6	S201UP-K1.6		1.6	S203UP-K1.6
	2	S201UP-K2		2	S203UP-K2
	3	S201UP-K3		3	S203UP-K3
	4	S201UP-K4		4	S203UP-K4
	5	S201UP-K5		5	S203UP-K5
	6	S201UP-K6		6	S203UP-K6
	8	S201UP-K8		8	S203UP-K8
	10	S201UP-K10		10	S203UP-K10
	15	S201UP-K15		15	S203UP-K15
	16	S201UP-K16		16	S203UP-K16
	20	S201UP-K20		20	S203UP-K20
	25	S201UP-K25		25	S203UP-K25
2	0.2	S202UP-K0.2	4	0.2	S204UP-K0.2
	0.3	S202UP-K0.3		0.3	S204UP-K0.3
	0.5	S202UP-K0.5		0.5	S204UP-K0.5
	0.75	S202UP-K0.75		0.75	S204UP-K0.75
	1	S202UP-K1		1	S204UP-K1
	1.6	S202UP-K1.6		1.6	S204UP-K1.6
	2	S202UP-K2		2	S204UP-K2
	3	S202UP-K3		3	S204UP-K3
	4	S202UP-K4		4	S204UP-K4
	5	S202UP-K5		5	S204UP-K5
	6	S202UP-K6		6	S204UP-K6
	8	S202UP-K8		8	S204UP-K8
	10	S202UP-K10		10	S204UP-K10
	15	S202UP-K15		15	S204UP-K15
	16	S202UP-K16		16	S204UP-K16
	20	S202UP-K20		20	S204UP-K20
	25	S202UP-K25		25	S204UP-K25

S201UP-K

S202UP-K

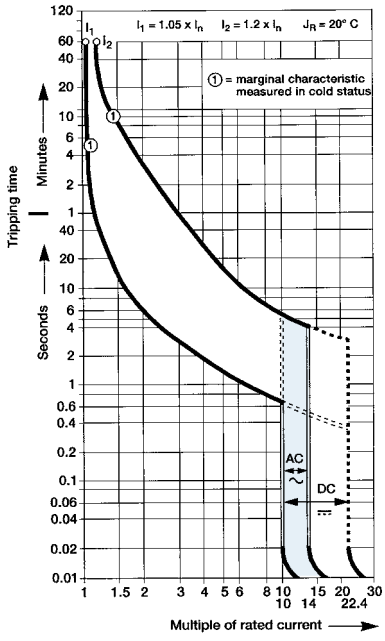
S203UP-K

S204UP-K

Tripping characteristic K
UL 489
480Y/277 VAC
10 kA

Inductive loads
- K Curve
- Designed for allowing higher in-rush currents during system start up
- Example: motors, transformers

Accessories & technical data
Accessories – See page 15.9 - 15.13
Technical data – See page 15.14 -15.16



Note: This breaker for AC use only

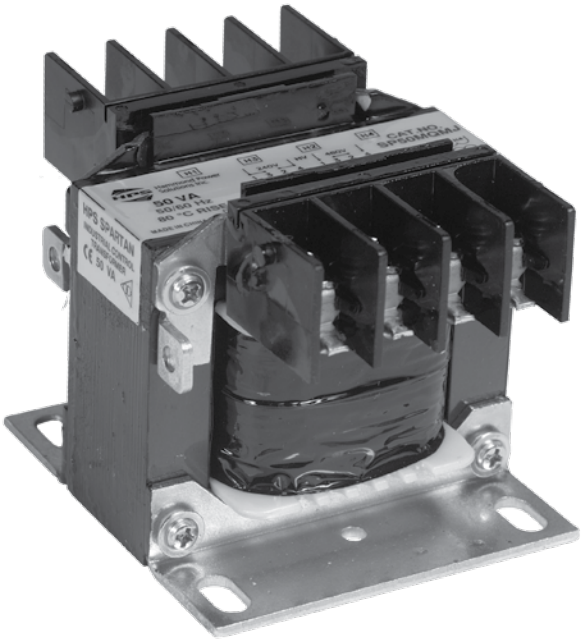
HPS Spartan® Industrial Open-Style Control Transformer

The Economical Solution

The HPS Spartan® line of industrial control transformers are ideally suited for general purpose, industrial and light duty loads. Designed for applications where high inrush or machine tool duty are not necessary, the HPS Spartan industrial open-style control transformer offers an efficient and economical solution. These units are well suited for HVAC applications, signal and alarm systems, motor control circuits, lighting and circuit isolation.

The HPS Spartan control transformer is an open style unit with molded terminal blocks up to 3000 VA or 30 amps. Optional Finger guards and a fuse block adapter kit are available upon request.

For an economical approach to control transformers, the HPS Spartan is the transformer of choice.



STANDARDS

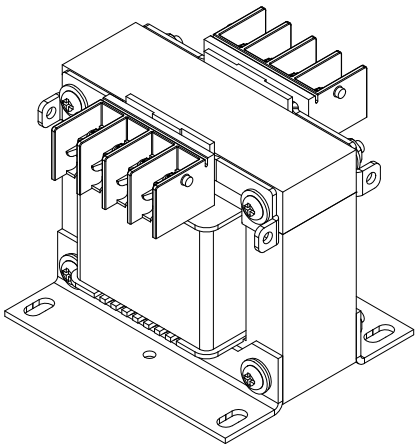
The HPS Spartan Control Transformers meet or exceed the standards established by UL, CSA, IEC and NEMA.

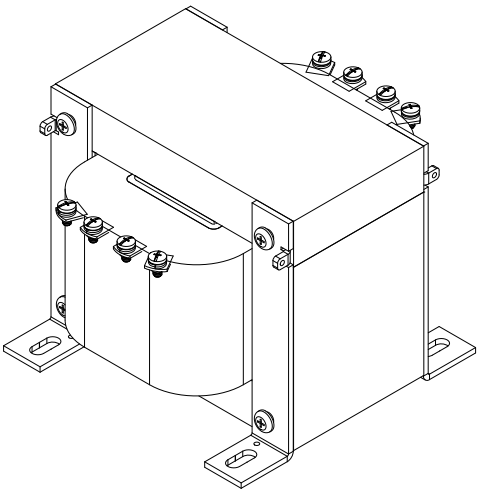
Standard	File #	VA Size
UL (ANSI/UL506)	E50394	All
CSA	LR3902	All
IEC 61558		All
NEMA (ST-1)		All

Features and Benefits

- Molded terminal blocks for primary and secondary connections[1]
- Coil face termination over 3000VA or 30 amps
- Vacuum Impregnated with Polyester Resin and oven cured
- Bolted core construction
- Bolt-on mounting brackets
- All terminal blocks utilize a combination slot/Phillips #6 screw with a SEMS washer (suitable for 18 AWG to 14 AWG for solid wire and 18 AWG to 12 AWG for stranded wire). Coil face terminations utilize a ¼ - 20 UNC X 0.50" combination slot/Phillips screw and a spring lock washer
- All units supplied with primary and secondary voltage links/jumpers
- 50/60 Hz (60 Hz on SP***ACP and SP***AR)
- Copper wound coils with high dielectric strength insulation
- Seismically certified in accordance with IBC 2009; Section 1613 Earthquake Loads, for S_{DS} <= 2.00g , z/h = 1.0, and I_p = 1.5
- CSA Certified, UL Listed, CE Marked and RoHS compliant
- Meets NEMA standards
- Superior insulating materials. The HPS Spartan series transformers offer the following insulation systems:
  Up to 1500 VA: 80°C rise, 130°C temperature class (B)
  2000 VA to 5000 VA: 115°C rise, 180°C temperature class (F)
- "Premium Packaging"[1] which feature:
  - Premium fluted cartons
  - Custom molded foam inserts
  - Easy removal and repacking
  - Industry's best box label
- Supplied with trilingual installation and wiring instruction sheets
- 15 year warranty
- Optional finger guards available[1]
- Optional fuse block adapter kit available[1]

[1] up to and including 3000VA or 30 amps





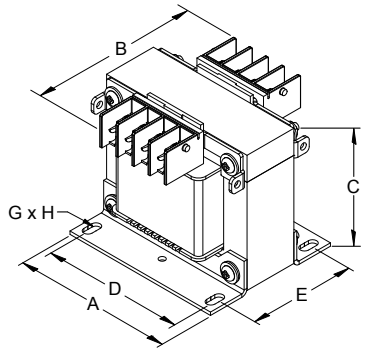


FIGURE A

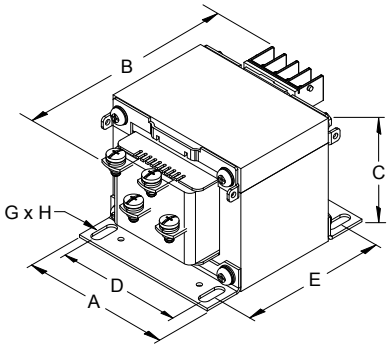


FIGURE B

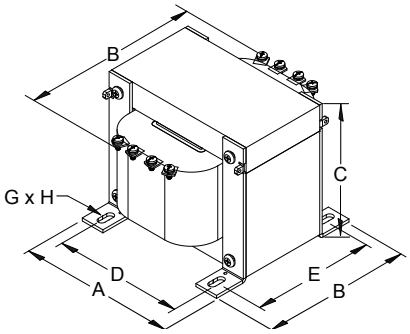


FIGURE C

Group A

Primary Voltage: **600/480** | 575/460 | 550/440
Secondary Voltage: **120 X 240** | 115 X 230 | 110 X 220

60 Hertz

VA Rating	CE VA Rating	Catalog Number	Mtg. Fig.	Output Amps	Overall Dimensions			Mounting Centers		Mounting Slot	Height with Finger Guard	Height with Fuse Block Adapter	Approx. Ship Weight Lbs.
					A	B	C	D	E	G X H			
50	50	**SP50ACP**	A	0.42/0.21	2.60	3.82	2.60	2.13	2.64	0.22 x 0.44	2.98	2.79	2.2
100	100	**SP100ACP**	A	0.83/0.42	2.99	3.74	2.85	2.52	2.60	0.22 x 0.44	3.23	3.04	3.3
150	150	**SP150ACP**	A	1.25/0.63	2.99	4.29	2.85	2.52	3.15	0.22 x 0.44	3.23	3.04	4.4
250	160	**SP250ACP**	A	2.08/1.04	3.78	4.09	3.40	3.31	2.99	0.22 x 0.44	3.78	3.59	6.4
350	250	**SP350ACP**	A	2.92/1.46	3.78	4.49	3.40	3.31	3.39	0.22 x 0.44	3.78	3.59	7.5
500	300	**SP500ACP**	A	4.17/2.08	4.49	4.69	3.78	3.78	3.66	0.31 x 0.81	4.16	3.97	11
750	500	**SP750ACP**	A	6.25/3.13	5.25	5.08[1]	4.37	4.50	4.06	0.31 x 0.81	4.75	4.56	18
1000	650	**SP1000ACP**	A	8.33/4.17	5.25	5.47[1]	4.37	4.50	4.45	0.31 x 0.81	4.75	4.56	21
1500	1000	**SP1500ACP**	A	12.5/6.25	5.25	6.85[1]	4.37	4.50	5.83	0.31 x 0.81	4.56	4.37	28
2000	1300	**SP2000ACP**	A	16.7/8.33	6.38	5.87[1]	5.31	5.75	4.84	0.31 x 0.81	5.69	5.50	34
3000	2000	**SP3000ACP**	A	25.0/12.5	7.50	7.50	6.50	6.30	6.85	0.44 x 1.00	6.50	6.50	60
5000	3000	**SP5000ACP**	C	41.7/20.8	8.98	9.88	7.76	7.40	7.13	0.44 x 1.00	N/A	N/A	93

Primary and Secondary voltage links/jumpers supplied standard with all transformers.
Refer to page 73 for wiring schematic drawing. Custom voltages and VA sizes available upon request.
All dimensions in inches
[1] Note: For 750 through 2000 VA units actual overall depth is 0.24" plus the value in column B.

Group B

Primary Voltage: **600** | 575 | 550
Secondary Voltage: **12 X 24** | 11.5 X 23 | 11 X 22

60 Hertz

VA Rating	CE VA Rating	Catalog Number	Mtg. Fig.	Output Amps	Overall Dimensions			Mounting Centers		Mounting Slot	Height with Finger Guard	Height with Fuse Block Adapter	Approx. Ship Weight Lbs.
					A	B	C	D	E	G X H			
50	50	**SP50AR**	A	4.17/2.08	2.60	3.23	2.60	2.13	2.05	0.22 x 0.44	2.98	2.79	1.5
100	100	**SP100AR**	A	8.33/4.17	2.99	3.74	2.85	2.52	2.60	0.22 x 0.44	3.23	3.04	3.3
150	150	**SP150AR**	A	12.5/6.25	2.99	4.09	2.85	2.52	2.95	0.22 x 0.44	3.23	3.04	3.9
250	160	**SP250AR**	A	20.8/10.4	3.78	3.70	3.40	3.31	2.60	0.22 x 0.44	3.78	3.59	5.2
350	250	**SP350AR**	A	29.2/14.6	3.78	4.29	3.40	3.31	3.19	0.22 x 0.44	3.78	3.59	7.1
500	300	**SP500AR**	B	41.7/20.8	4.49	5.08	3.78	3.78	3.27	0.31 x 0.81	4.16	3.97	9.9

Primary and Secondary voltage links/jumpers supplied standard with all transformers.
Refer to page 73 for wiring schematic drawing. Custom voltages and VA sizes available upon request.
All dimensions in inches

RH Series Compact Power Relays

Key features

- SPDT through 4PDT, 10A contacts
- Compact power type relays
- Miniature power relays with a large capacity
- 10A contact capacity
- Compact size saves space

Part Number Selection

Contact	Model	Part Number: Blade Terminal	Part Number: PCB Terminal	Coil Voltage Code (Standard Stock in bold)
SPDT 	Standard	RH1B-U □	RH1V2-U □	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH1B-UL □	—	
	With Check Button	RH1B-UC □	—	
	With Indicator and Check Button	RH1B-ULC □	—	
	Top Bracket Mounting	RH1B-UT □	—	
	With Diode (DC coil only)	RH1B-UD □	RH1V2-UD □	DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH1B-ULD □	—	**DC12V**, **DC24V**, DC48V, DC110V
DPDT 	Standard	RH2B-U □	RH2V2-U □	AC6V, AC12V, **AC24V**, **AC110-120V**, **AC220-240V** DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator	RH2B-UL □	RH2V2-UL □	
	With Check Button	RH2B-UC □	—	
	With Indicator and Check Button	RH2B-ULC □	—	
	Top Bracket Mounting	RH2B-UT □	—	
	With Diode (DC coil only)	RH2B-UD □	RH2V2-UD □	DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RH2B-ULD □	RH2V2-ULD □	
3PDT 	Standard	RH3B-U □	RH3V2-U □	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH3B-UL □	RH3V2-UL □	
	With Check Button	RH3B-UC □	—	
	With Indicator and Check Button	RH3B-ULC □	—	
	Top Bracket Mounting	RH3B-UT □	—	
	With Diode (DC coil only)	RH3B-UD □	—	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH3B-ULD □	—	
4PDT 	Standard	RH4B-U □	RH4V2-U □	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH4B-UL □	RH4V2-UL □	
	With Check Button	RH4B-UC □	—	
	With Indicator and Check Button	RH4B-ULC □	—	
	Top Bracket Mounting	RH4B-UT □	—	
	With Diode (DC coil only)	RH4B-UD □	RH4V2-UD □	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH4B-ULD □	—	

PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information

When ordering, specify the Part No. and coil voltage code:

(example) **RH3B-U** (Part No.) **AC120V** (Coil Voltage Code)

Sockets (for Blade Terminal Models)

Relays	Standard DIN Rail Mount [1]	Finger-safe DIN Rail Mount [1]	Through Panel Mount	PCB Mount
RH1B	SH1B-05	SH1B-05C	SH1B-51	SH1B-62
RH2B	SH2B-05	SH2B-05C	SH2B-51	SH2B-62
RH3B	SH3B-05	SH3B-05C	SH3B-51	SH3B-62
RH4B	SH4B-05	SH4B-05C	SH4B-51	SH4B-62
				

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

Appearance	Item	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket
	Pullover Wire Spring	RH1B	SY2S-02F1 [2]	SY4S-51F1
		RH2B	SY4S-02F1 [2]	
		RH3B	SH3B-05F1 [2]	
		RH4B	SH4B-02F1 [2]	
	Leaf Spring (side latch)	RH1B, RH2B, RH3B, RH4B	SFA-202 [3]	SFA-302 [3]
	Leaf Spring (top latch)	RH1B, RH2B, RH3B, RH4B	SFA-101 [3]	SFA-301 [3]

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip part number is Y778-011.
3. Two required per relay.

AC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C								Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	AC 50Hz				AC 60Hz										
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	170	240	330	387	150	200	280	330	330	9.4	6.4	5.4	110%	80% maximum	30% minimum
12	86	121	165	196	75	100	140	165	165	39.3	25.3	21.2			
24	42	60.5	81	98	37	50	70	83	83	153	103	84.5			
110	9.6	—	18.1	21.6	8.4	—	15.5	18.2	18.2	—	2,200	1,800			
110-120	—	9.4-10.8	—	—	—	8.0-9.2	—	—	—	—	—	—			
120	8.6	—	16.4	19.5	7.5	—	14.2	16.5	16.5	—	10,800	7,360			
220	4.7	—	8.8	10.7	4.1	—	7.7	9.1	9.1	—	10,800	7,360			
220-240	—	4.7-5.4	—	—	—	4.0-4.6	—		—	18,820	—	—			
240	4.9	—	8.2	9.8	4.3	—	7.1	8.3	8.3	—	12,100	9,120			

DC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C				Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	128	150	240	250	47	40	25	24	110%	80% maximum	10% minimum
12	64	75	120	125	188	160	100	96			
24	32	36.9	60	62	750	650	400	388			
48	18	18.5	30	31	2,660	2,600	1,600	1,550			
100-110	—	8.2-9.0	—	—	—	12,250	—	—			
110	8	—	12.8	15	13,800	—	8,600	7,340			

Standard coil voltages are in **BOLD**.

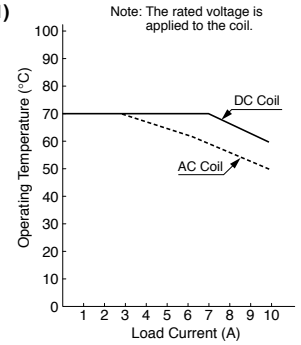
Specifications

Contact Material		Silver cadmium oxide	
Contact Resistance [1]		50mΩ maximum	
Minimum Applicable Load		24V DC, 30 mA; 5V DC, 100 mA (reference value)	
Operating Time [2]	SPDT DPDT	20ms maximum	
	3PDT 4PDT	25ms maximum	
Release Time [2]	SPDT DPDT	20ms maximum	
	3PDT 4PDT	25ms maximum	
Power Consumption (approx.)	SPDT	AC: 1.1VA (50Hz), 1VA (60Hz)	DC: 0.8W
	DPDT	AC: 1.4VA (50Hz), 1.2VA (60Hz)	DC: 0.9W
	3PDT	AC: 2VA (50Hz), 1.7VA (60Hz)	DC: 1.5W
	4PDT	AC: 2.5VA (50Hz), 2VA (60Hz)	DC: 1.5W
Insulation Resistance		100MΩ minimum (500V DC megger)	
Dielectric Strength [3]	SPDT	Between live and dead parts: Between contact and coil: Between contacts of the same pole:	2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute
	DPDT 3PDT 4PDT	Between live and dead parts: Between contact and coil: Between contacts of different poles: Between contacts of the same pole:	2,000V AC, 1 minute 2,000V AC, 1 minute 2,000V AC, 1 minute 1,000V AC, 1 minute
Operating Frequency		Electrical: Mechanical:	1,800 operations/hour maximum 18,000 operations/hour maximum
Vibration Resistance		Damage limits: Operating extremes:	10 to 55Hz, amplitude 0.5 mm 10 to 55Hz, amplitude 0.5 mm
Shock Resistance		Damage limits: Operating extremes:	1,000m/s^2 (100G) 200m/s^2 (20G - SPDT, DPDT) 100m/s^2 (10G - 3PDT, 4PDT)
Mechanical Life		50,000,000 operations minimum	
Electrical Life	DPDT	500,000 operations minimum (120V AC, 10A)	
	SPDT 3PDT 4PDT	200,000 operations minimum (120V AC, 10A)	
Operating Temperature [4]	SPDT DPDT 3PDT 4PDT	–25 to +70°C (no freezing)	
Operating Humidity		45 to 85% RH (no condensation)	
Weight (approx.)		SPDT: 24g, DPDT: 37g, 3PDT: 50g, 4PDT: 74g	

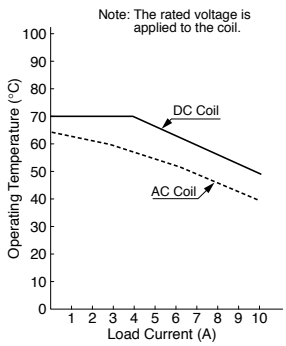
Note: Above values are initial values.
1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
   Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000V AC, 1 minute
4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is –25 to +40°C.

Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

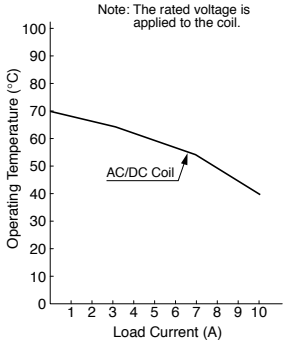
(RH1)



(RH2)



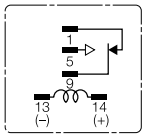
(RH3/RH4)



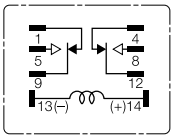
Internal Connection (View from Bottom)

Basic Type

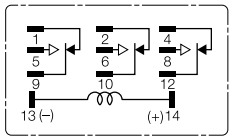
SPDT



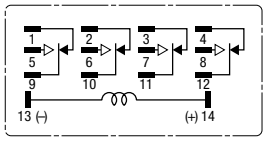
DPDT



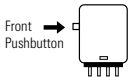
3PDT



4PDT

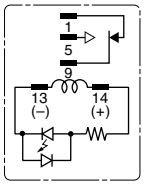
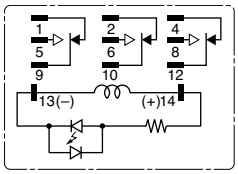
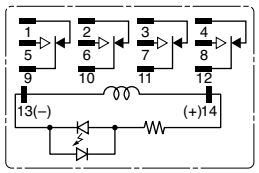
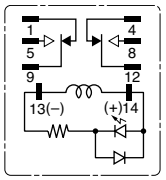
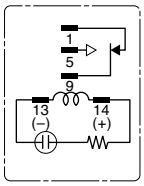
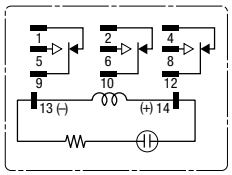
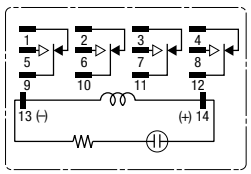
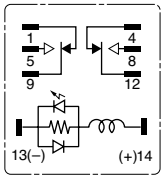


With Check Button



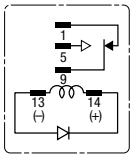
Contacts can be operated by pressing the check button.

With Indicator (-L type)

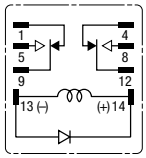
	SPDT	3PDT	4PDT		DPDT	
Below 100V AC/DC				Below 24V AC/DC		When the relay is energized, the indicator goes on. • Relay coils less than 100V DC do not contain a protection diode (except DPDT). • Relay coils below 100V use LED indicator, coils above 100V use neon lamp indicator. • LED color of DPDT model is green
100V AC/DC and over				24V AC/DC and over		

With Diode (-D type)

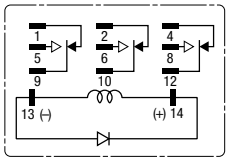
SPDT



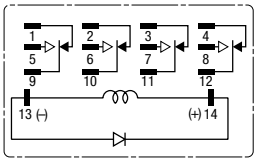
DPDT



3PDT



4PDT



Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC coil only.

- Diode Characteristics
  Reverse withstand voltage: 1,000V
  Forward current: 1A

Pilot Lights (Assembled)

Assembled Pilot Lights

A P D 1 126 D N – R – ( )

Function
P: Pilot Light

Series Designation
D: TWTD Series

Lens Shape
1: Dome

Rated Operational Voltage (Primary)

Transformer Type	Full Voltage Type
126: 120V AC	99: Full Voltage
246: 240V AC	
486: 480V AC	

Lamp Voltage
(full voltage illuminated units only)
6V: 6V AC/DC
12V: 12V AC/DC
24V: 24V AC/DC
120V: 120V AC (LED only)
240V: 240V AC (LED only)

Lens Color Code
A: Amber
G: Green
R: Red
S: Blue
W: White
Y: Yellow

Lamp Type
Blank: Incandescent
D: LED

Use only when interpreting part numbers. Do not use for developing part numbers.

LED and Incandescent Pilot Lights

Style	Operating Voltage	Part Number	
		LED	Incandescent
Transformer Dome 	120V AC 240V AC 480V AC	APD1126DN-② APD1246DN-② APD1486DN-②	APD1126N-② APD1246N-② APD1486N-②
Full Voltage Dome 	—	APD199DN-②-③	APD199N-②-③

1. In place of ②, specify the Lens/LED Color Code.
2. In place of ③, specify the Full Voltage Code (lamp voltage).
3. Yellow pilot light comes with white LED.

② Lens Color Codes

Color	Code
Amber	A
Green	G
Red	R
Blue	S
White	W
Yellow	Y

③ Full Voltage Codes

Voltage	Code
6V AC/DC	6V
12V AC/DC	12V
24V AC/DC	24V
120V AC	120V
240V AC	240V (LED only)

Non-Illuminated Pushbuttons (Assembled)

Non-Illuminated Pushbuttons

Style		Contacts	Momentary	Maintained
Flush		1NO	ABD110N-①	AOD110N-①
		1NC	ABD101N-①	AOD101N-①
		1NO-1NC	ABD111N-①	AOD111N-①
		2NO	ABD120N-①	AOD120N-①
		2NC	ABD102N-①	AOD102N-①
Extended		1NO	ABD210N-①	AOD210N-①
		1NC	ABD201N-①	AOD201N-①
		1NO-1NC	ABD211N-①	AOD211N-①
		2NO	ABD220N-①	AOD220N-①
		2NC	ABD202N-①	AOD202N-①
Extended with Neoprene Boot†		1NO	ABPD210N-①	AOPD210N-①
		1NC	ABPD201N-①	AOPD201N-①
		1NO-1NC	ABPD211N-①	AOPD211N-①
		2NO	ABPD220N-①	AOPD220N-①
		2NC	ABPD202N-①	AOPD202N-①
Recessed		1NO	ABFD110N-①	AOFD110N-①
		1NC	ABFD101N-①	AOFD101N-①
		1NO-1NC	ABFD111N-①	AOFD111N-①
		2NO	ABFD120N-①	AOFD120N-①
		2NC	ABFD102N-①	AOFD102N-①
Extended with Full Shroud		1NO	ABFD210N-①	AOFD210N-①
		1NC	ABFD201N-①	AOFD201N-①
		1NO-1NC	ABFD211N-①	AOFD211N-①
		2NO	ABFD220N-①	AOFD220N-①
		2NC	ABFD202N-①	AOFD202N-①
ø 40mm Mushroom Head		1NO	ABD310N-①	AOD310N-①
		1NC	ABD301N-①	AOD301N-①
		1NO-1NC	ABD311N-①	AOD311N-①
		2NO	ABD320N-①	AOD320N-①
		2NC	ABD302N-①	AOD302N-①
ø 40mm Mushroom Head with Full Shroud		1NO	ABGD310N-①	AOGD310N-①
		1NC	ABGD301N-①	AOGD301N-①
		1NO-1NC	ABGD311N-①	AOGD311N-①
		2NO	ABGD320N-①	AOGD320N-①
		2NC	ABGD302N-①	AOGD302N-①
ø 65mm Jumbo Mushroom Head		1NO	ABD410N-①	AOD410N-①
		1NC	ABD401N-①	AOD401N-①
		1NO-1NC	ABD411N-①	AOD411N-①
		2NO	ABD420N-①	AOD420N-①
		2NC	ABD402N-①	AOD402N-①
ø 65mm Jumbo Mushroom Head with Shallow Shroud		1NO	ABGD410N-①	AOGD410N-①
		1NC	ABGD401N-①	AOGD401N-①
		1NO-1NC	ABGD411N-①	AOGD411N-①
		2NO	ABGD420N-①	AOGD420N-①
		2NC	ABGD402N-①	AOGD402N-①
ø 65mm Jumbo Mushroom Head With Deep Shroud		1NO	ABFD410N-①	AOFD410N-①
		1NC	ABFD401N-①	AOFD401N-①
		1NO-1NC	ABFD411N-①	AOFD411N-①
		2NO	ABFD420N-①	AOFD420N-①
		2NC	ABFD402N-①	AOFD402N-①

1. In place of ①, specify the Button Color Code.
2. For sub-assembly part numbers, see next page.
3. For accessories, see page 632.
4. †Neoprene boot available only in Black (B), Green (G), Red (R) and Yellow (Y).

① Button Color Codes

Color	Code
Black	B
Green	G
Red	R
Blue	S
Yellow	Y
White	W

1. 65mm Jumbo mushroom not available in white.
2. Neoprene boot is not available in blue or white.

Non-Illuminated Selector Switches (Assembled)

Assembled Selector Switches

A S D 2 ( ) ( ) 11 N – ( )

Function

S: Selector Switch

Series Designation

D: TWTD Series

Number of Positions

2: 2-Position
3: 3-Position

Spring Return Action

Blank: Maintained
1: Spring return from Right
2: Spring return from Left
3: 2-Way spring return from Left and Right

Circuit Number

(See Circuit # column of Selector Switch Contact Arrangement Chart on beginning on page 679.)

Contact Arrangement Code

10: 1NO	01: 1NC
20: 2NO	02: 2NC
40: 4NO	04: 4NC
11: 1NO-1NC	22: 2NO-2NC

Operator Style Code

Blank: Knob Operator
L: Lever Operator
K: Key Operator

1. Use only when interpreting part numbers. Do not use for developing part numbers.
2. Custom key removal codes available. Please contact IDEC for details.

Non-Illuminated Selector Switches (Assembled)

Non-Illuminated 2-Position Selector Switches

Style					Part Number		
Contact	Mounting	Operator Position L	Operator Position R		Maintained	Spring Return from Right	Spring Return from Left
							
1NO	1 2	0 0	X 0	Knob Lever Key	ASD210N ASD2L10N ASD2K10N	ASD2110N ASD21L10N ASD21K10N	ASD2210N ASD22L10N ASD22K10N
1NC	1 2	X 0	0 0	Knob Lever Key	ASD201N-116 ASD2L01N-116 ASD2K01N-116	ASD2101N-116 ASD21L01N-116 ASD21K01N-116	ASD2201N-116 ASD22L01N-116 ASD22K01N-116
1NO 1NC	1 2	X 0	0 X	Knob Lever Key	ASD211N ASD2L11N ASD2K11N	ASD2111N ASD21L11N ASD21K11N	ASD2211N ASD22L11N ASD22K11N
2NO	1 2	0 0	X X	Knob Lever Key	ASD220N ASD2L20N ASD2K20N	ASD2120N ASD21L20N ASD21K20N	ASD2220N ASD22L20N ASD22K20N
2NC	1 2	X X	0 0	Knob Lever Key	ASD202N-104 ASD2L02N-104 ASD2K02N-104	ASD2102N-104 ASD21L02N-104 ASD21K02N-104	ASD2202N-104 ASD22L02N-104 ASD22K02N-104
2NO 2NC	1 2 3 4	0 X 0 X	X 0 X 0	Knob Lever Key	ASD222N ASD2L22N ASD2K22N	ASD2122N ASD21L22N ASD21K22N	ASD2222N ASD22L22N ASD22K22N
2NO 2NC	1 2 3 4	0 0 X X	X X 0 0	Knob Lever Key	ASD222N-111 ASD2L22N-111 ASD2K22N-111	ASD2122N-111 ASD21L22N-111 ASD21K22N-111	ASD2222N-111 ASD22L22N-111 ASD22K22N-111

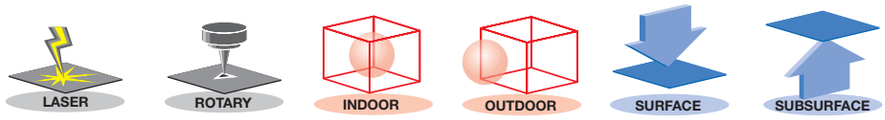
1. The truth table indicates the operating position of contact block when the operator is switched to that position.
   X = On (closed contacts) O = Off (open contacts)
   X⟷X = Overlapping Contacts: Remain on (closed contacts) when switch is moved between these two positions.
2. All knob and lever selector switches come in black. Other colors are available by ordering the knob or lever separately.
3. Custom contact arrangements available, see page 679.

Non-Illuminated 3-Position Selector Switches

Style						Part Number			
Contact	Mounting	Operator Position L	Operator Position C	Operator Position R		Maintained	Spring Return from Right	Spring Return from Left	Spring Return Two-Way
									
2NO	1 2	X 0	0 0	0 X	Knob Lever Key	ASD320N ASD3L20N ASD3K20N	ASD3120N ASD31L20N ASD31K20N	ASD3220N ASD32L20N ASD32K20N	ASD3320N ASD33L20N ASD33K20N
2NC	1 2	0 X	X⟷X	X 0	Knob Lever Key	ASD302N ASD3L02N ASD3K02N	ASD3102N ASD31L02N ASD31K02N	ASD3202N ASD32L02N ASD32K02N	ASD3302N ASD33L02N ASD33K02N
2NO 2NC	1 2 3 4	X 0 0 X⟷X	0 0 X⟷X	0 X X 0	Knob Lever Key	ASD322N ASD3L22N ASD3K22N	ASD3122N ASD31L22N ASD31K22N	ASD3222N ASD32L22N ASD32K22N	ASD3322N ASD33L22N ASD33K22N
2NO 2NC	1 2 3 4	X X⟷X 0 0	0 X 0 0	X 0 0 X	Knob Lever Key	ASD322N-309 ASD3L22N-309 ASD3K22N-309	ASD3122N-309 ASD31L22N-309 ASD31K22N-309	ASD3222N-309 ASD32L22N-309 ASD32K22N-309	ASD3322N-309 ASD33L22N-309 ASD33K22N-309
2NO 2NC	1 2 3 4	0 0 0 0	X 0 X 0	0 X 0 X	Knob Lever Key	ASD322N-310 ASD3L22N-310 ASD3K22N-310	ASD3122N-310 ASD31L22N-310 ASD31K22N-310	ASD3222N-310 ASD32L22N-310 ASD32K22N-310	ASD3322N-310 ASD33L22N-310 ASD33K22N-310
4NO	1 2 3 4	X 0 X 0	0 0 0 0	0 X 0 X	Knob Lever Key	ASD340N ASD3L40N ASD3K40N	ASD3140N ASD31L40N ASD31K40N	ASD3240N ASD32L40N ASD32K40N	ASD3340N ASD33L40N ASD33K40N
4NC	1 2 3 4	0 X⟷X 0 X⟷X	X⟷X X⟷X X⟷X	X 0 X 0	Knob Lever Key	ASD304N ASD3L04N ASD3K04N	ASD3104N ASD31L04N ASD31K04N	ASD3204N ASD32L04N ASD32K04N	ASD3304N ASD33L04N ASD33K04N

GRAVOPLY™ ULTRA

- **Badges**
- **Awards plaques**
- **Indoor and outdoor signage**



- Satin or matt finish
- Unique 0.5 mm (.002") cap layer for detailed engraving
- UV stable
- Excellent for photo lasering
- Reduce inventory with one material for rotary, laser, indoor and outdoor needs

Specifications

Surface	Satin or Matt
Composition	DR Acrylic
Rotary engraving depth	0.1 mm (.004")
Full sheet	1220 mm x 610 mm (24" x 48")
Half sheet	610 mm x 610 mm (24" x 24")
Quarter sheet	610 mm x 305 mm (12" x 24")

Capabilities

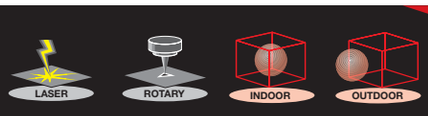
Interior	■	■	Exterior
Shear	■	■	Saw
Silk screen	■	■	Hot stamp
Scratch resistant	■	■	Flexible
Break resistant		■	UV resistant
		80ºC	Max. temp.

			Matt 2-ply		Satin 2-ply	
			0.5 mm	1.6 mm	1.6 mm	2.4 mm
	Surface colour	Core colour	.020"	1/16"	1/16"	3/32"
○	clear*	white	18965	19009		
●	clear*	black	18962	19006		
●	white	red		18997		
●	white	blue		18996		
●	white	black	18946	18984	29507	
●	yellow	black	18955	18993	29511	
●	orange	white		19000		
●	orange	black		29499		
●	red	white	18949	18987	29512	
●	red	black		29498		
●	red	gold		29503		
●	burgundy	white		18980		
●	burgundy	gold	18958	18999		
●	green apple	white	18970	19012	29513	
●	forest green	white		19001		
●	forest green	gold		18998		
●	pine green	white		29491		
●	blue	white	18952	18990	29510	
●	navy blue	white		29494		
●	royal blue	white		19015		
●	royal blue	gold	18942	18979		
●	brown	white		29495		
●	black	white	18943	18981	29508	29687
●	black	silver grey		19005		
●	glossy black	gold	18973			
●	matt black	gold	18976	19004		

* Suitable for subsurface engraving.

Gravoply™ Ultraglow Photoluminescent

NEW



			Matt 2-ply
	Surface colour	Core colour	0.8 mm (1/32")
○	glow	white	49884

Please note:
This product allows for white engraving on the photoluminescent surface. 0.8 mm (1/32") thickness may be used to cut profile letters for DDA tactile signage applications.
The glow times for this product meet the following norms: ISO:10012-1 & MIL-STD-45662A

Vibratone® Horns

Model 350

Model 350 Vibratone Horn produces a very loud horn tone by the electro-mechanical vibration of a diaphragm. Capable of reproducing coded blasts or sustained tones through the use of a number of control devices from a push button to a PLC. Federal Signal's Vibratone horn is excellent for general alarm, start and dismissal, coded paging, and process control signaling in areas of high ambient noise levels.

The Vibratone Model 350 is available in AC voltages; 12VAC, 24VAC, 120VAC and 240VAC. This model produces 100dBA @ 10', except for the 12VAC model which produces 94dBA @ 10'.

Vibratone mounting options provide for surface, flush or semi-flush mounting on walls, panels, in cabinets, on 4-inch square outlet boxes, or in concrete and deep wall constructions.

A Double Projector accessory (Model PR2) mounted on the front of the unit directs side sound output, optimizing signaling for long, narrow rooms or corridors.

Vibratone 350 horns are UL and cUL Listed, CSA Certified and FM Approved. They are designed and approved for use in Type 4X applications when installed with the Panel Mount Gasket Kit or Weatherproof Backbox (Model WB). They are approved for Type 4X and Type 12 applications when installed with the Surface Mount Trim Ring

The Vibratone 350 horn is enclosed in a zinc die-cast housing and sealed with grey powder-coat paint and features a stainless steel diaphragm. The rugged construction of the Vibratone horn resists vandalism and the effects of harsh industrial environments.

Compact size, loud output and heavy-duty construction make the 350 horn ideal for industrial and institutional signaling applications.

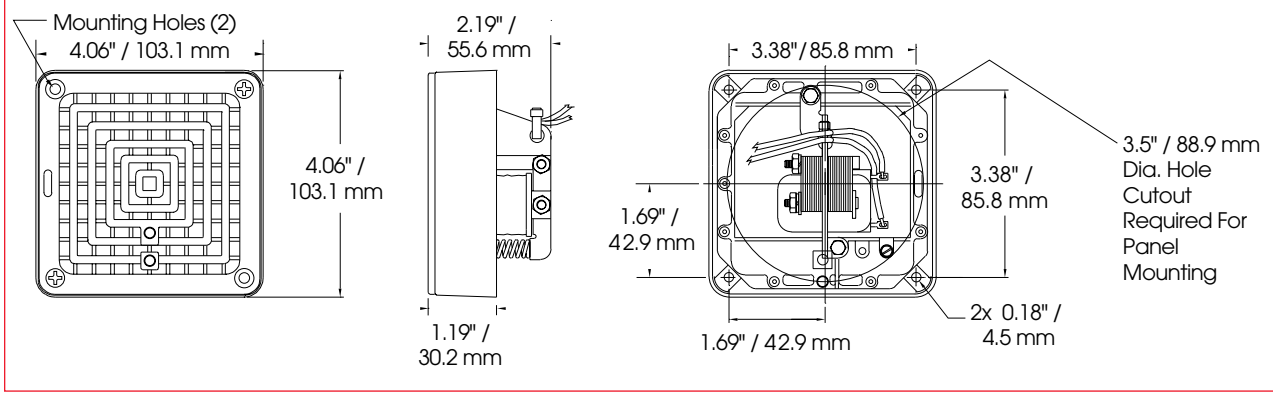
DESIGNED FOR ROUTINE SIGNALING

- Range of up to 200 feet
- Coded or sustained tones
- Available in – 12, 24, 120 and 240VAC
- Produces 100dBA at 10'
- Type 4X when installed with Panel Mount Gasket Kit or Weatherproof Backbox (Model WB); Type 4X and Type 12 when installed with Surface Mount Trim Ring (Model TR)
- UL and cUL Listed, CSA Certified and FM Approved

Model	Voltage	Operating Current	Decibels @ 10'	Decibels @ 1m
350-012-30	12VAC 50/60Hz	0.90 amps	94	104
350-024-30	24VAC 50/60Hz	0.90 amps	100	110
350-120-30	120VAC 50/60Hz	0.18 amps	100	110
350-240-30	240VAC 50/60Hz	0.09 amps	100	110

5 yr FEDERAL SIGNAL WARRANTY

VIBRATONE® HORN (350)



SPECIFICATIONS

Operating Temperature:	-65°F to 150°F	-54°C to 66°C
Net Weight:	1.4 lbs.	0.6 kg
Shipping Weight:	1.5 lbs.	0.7 kg
Height:	4.06"	103.1 mm
Width:	4.06"	103.1 mm
Depth:	2.19"	55.6 mm

HOW TO ORDER

- Specify model and voltage
- Specify accessories from list

ACCESSORIES

FB Wall box for flush mounting the Vibratone® horn in stud, 4" block, or other shallow wall construction; $4\frac{3}{8}$" square box; $2\frac{7}{8}$" deep; shipping weight 2 lbs. (0.91 kg)

FBL Same as FB, but $3\frac{13}{16}$" deep for 6" x 8" concrete block, cinder block or other deep wall construction; shipping wt. 3 lbs. (1.36 kg)

FG Flush grille which attaches to the basic unit and serves as the cover of the plastered-in FB flush box; 6" H x 6" W x $\frac{1}{8}$" D; shipping wt. 1 lb. (0.45 kg)

K8435666A Optional Panel Mounting Gasket Kit includes a gasket and hardware for surface or flush mounting the horn for NEMA Type 4X applications.

PR2 Double projector directs sounds to both sides when attached to the basic model units; ideal for use in hallways; 4" H x $11\frac{1}{2}$" W x 4" D; shipping weight 2 lbs. (0,91 kg)

SF Stamped surface plate used for installations on plastered-in 4" outlet switch boxes for semi-flush mountings; 6"H x 6" W x $\frac{1}{2}$" D; shipping weight 1 lb. (0.45 kg)

TR Gasketed trim ring allowing surface mount installations of unit while maintaining Type12 and Type 4X rating of enclosure.

WB Cast aluminum neoprene-gasketed weatherproof housing for outside use, complete with mounting lugs; tapped for $\frac{1}{2}$", $\frac{3}{4}$" conduit; $4\frac{3}{8}$" square box; 2" deep mounting lugs on $4\frac{1}{2}$" centers; shipping weight 1 lb. (0.45 kg)

REPLACEMENT PARTS

Description	*Part Number*
Panel Mount Gasket Kit	K8435666A
Volume Control Kit	K8435663B
Coil, 120VAC	KFC1516C

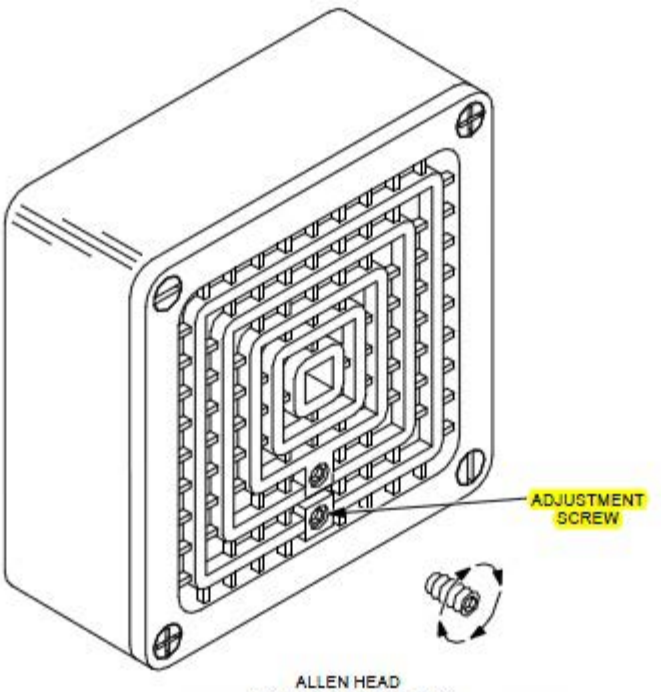
FEDERAL SIGNAL CORPORATION
Electrical Products Division

8435A536E
Rev. E Printed 6/04
Printed in U.S.A.

EXTERNAL VOLUME ADJUSTMENT FOR THE MODEL 350 VIBRATORY HORN (NOT FOR USE WITH THE 450 VIBRATORY HORN)

Vibratory horns are shipped with the volume set for maximum sound output. However, the sound level can be reduced to any desired level with the 3/32" hex socket set screw provided. If the horn is a Model 350, install the screw at the location shown in the figure.

Before installing the set screw, thread hex washer head thread forming screw into the appropriate hole on the front of the horn. Remove the thread forming screw, and thread the set screw into the threaded hole. Use a 3/32 hex key wrench to rotate the set screw clockwise until the desired sound level is reached.



FEDERAL SIGNAL CORPORATION

StreamLine® Low Profile Strobe Light

Models LP3P, LP3S, LP3T

PERFECT SIZE MEETS SUPERIOR PERFORMANCE

- Available in 12-48VDC, 120VAC and 240VAC
- Surface mount, T-mount, or integrated 1/2-inch NPT pipe mount
- Five dome colors
- Screw-on lens
- Low profile — Model LP3S is only 5" high
- Type 4X, IP66 enclosure
- PLC and triac compatible
- Optional dome guard for LP3S and LP3T
- UL and cUL Listed, and CSA Certified

Model LP3 low profile strobe light is a Type 4X strobe that is available in five colors: Amber, Blue, Clear, Green and Red. An optional dome wire guard is available for the LP3S and LP3T.

The LP3 is offered in three mounting configurations. LP3P features an integrated 1/2-inch NPT pipe mount. LP3S features a three-hole surface mount — ideal for control panels and other flat or flush surfaces. The "T-mount" LP3T has a popular 2-hole design for wall or flush mounting.

Both the LP3S and LP3T include a surface gasket to complete the Type 4X installation. An optional dome guard is available for use with the LP3S and LP3T. All LP3 units feature a threaded screw-on lens that allows tool-free wiring and strobe tube replacement. The strobe tube is rated for 7,000 hours.

The LP3 comes in three voltage variations: 12-48VDC, 120VAC and 240VAC. The state-of-the-art strobe mechanism produces 2.2 joules of energy, while drawing relatively low level amperage.

StreamLine® strobes feature high-quality, long-life strobe lamps which are designed to reduce tungsten build-up for longer lamp maintenance cycles. Careful consideration is given to the relationship between lamp shape and lens design for maximum light output. StreamLine products make use of surface mount technology, which provides a more powerful light in a much smaller package. The dry-electrolyte capacitor used in StreamLine products runs cooler than those used in many competitive strobes, resulting in a more reliable product that won't fail due to overheating.

Model	Voltage	Operating Current	Flash Rate/ Minute	Candela Peak[1]	Candela ECP[2]
LP3*-012/048**	12-48VDC	0.44-0.10 amps	65-95	175,000	51.5
LP3*-120**	120VAC	0.10 amps	65-95	175,000	51.5
LP3*-240**	240VAC	0.07 amps	65-95	175,000	51.5

5 yr FEDERAL SIGNAL WARRANTY

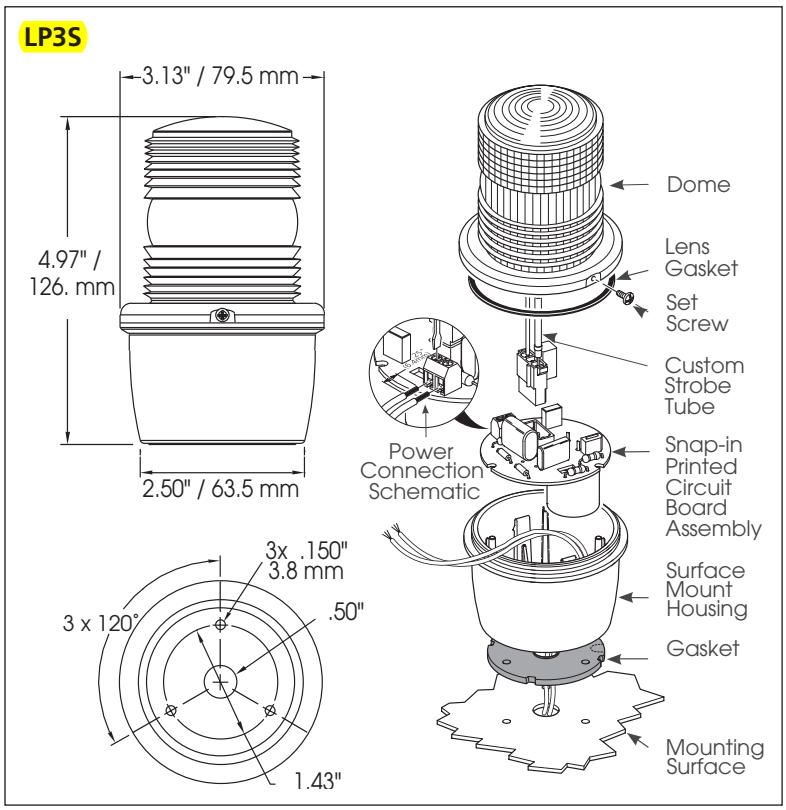
*Indicates Mounting Style: (S) Surface Mount, (P) Pipe Mount (T) T-Mount,

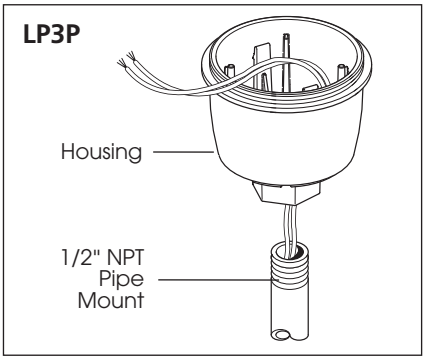
** Indicates color: (A) Amber, (B) Blue, (C) Clear, (G) Green or (R) Red

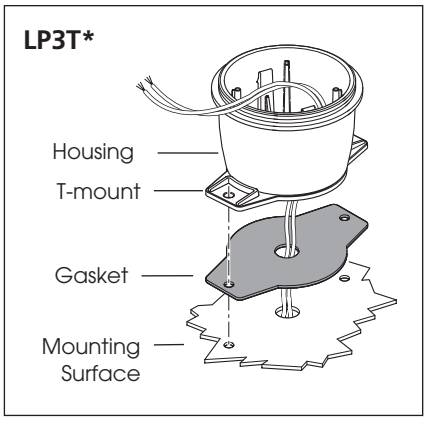
[1] Peak candela is the maximum light intensity generated by a flashing light during its light pulse

[2] ECP (Effective Candela) is the intensity that would appear to an observer if the light were burning steadily

StreamLine® Low Profile Strobe Light (LP3S/LP3P/LP3T)







*LP3T-120 & 240VAC shown

SPECIFICATIONS

Lamp Life:		4,000 Hours
Light Source:		Strobe tube
Operating Temperature:	-31°F to 151°F	-35°C to 66°C
Net Weight:	0.23 lbs	0.1 kg
Shipping Weight:	0.6 lbs	0.27 kg
Height:	2.61"	66.3 mm
Width:	2.33"	59.2 mm
Length:	5.05"	128.3 mm

REPLACEMENT PARTS

Description	Part Number
Dome, Amber	K8589063A
Dome, Blue	K8589063A-01
Dome, Clear	K8589063A-02
Dome, Green	K8589063A-03
Dome, Red	K8589063A-04
Strobe Tube	K149130A
Gasket Kit [1]	K858900353A

[1] Includes gasket for LP3S and LP3T

HOW TO ORDER

LP3 **S** – **120** **A**

TYPE
LP3

MOUNT
S Surface
P Pipe
T T-Mount

VOLTAGE
012-048 (12-48VDC)
120 (120VAC)
240 (240VAC)

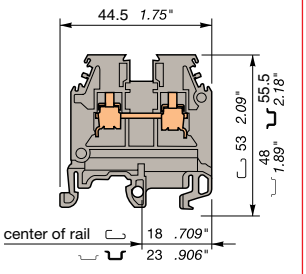
COLOR
A Amber
B Blue
C Clear
G Green
R Red

OPTIONAL ACCESSORIES

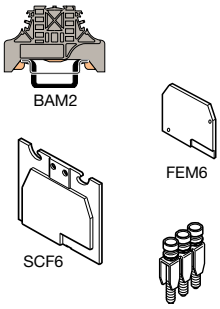
Description	Part Number
Wire/Dome Guard for LP3S and LP3T	LP3G

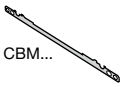
LP3G

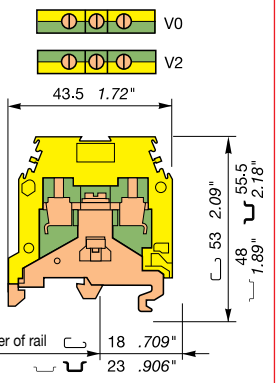
Feed through and ground terminal blocks
Screw clamp, ⊏ ⊔ DIN 1-3



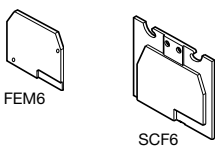
M 4/6







M 4/6.P



M 4/6 - 4 mm² blocks - 6 mm .238" spacing

Characteristics

		IEC NFC VDE	UL	CSA
Wire size mm² / AWG	Solid	0.2 - 4 mm²	22-10 AWG	22-10 AWG
	Stranded	0.22 - 4 mm²		
Voltage	V	800	600	600
Current	A	32	30	25
Short circuit current (M 4/6.PI)	A / s	480A/1s		
Rated wire size	mm² / AWG	4 mm²	10 AWG	10 AWG
Wire stripping length	mm / inches	9.5 mm / .37"		
Recommended torque	Nm / lb.in	0.5-0.8 Nm / 4.4-7.1 lb.in		

Selection

Description		Type	Order P/N	Packaging
Standard block grey		M 4/6	0115 116.07	50
Standard block blue		M 4/6.N	0125 116.01	50
Standard block yellow		M 4/6	0105 116.16	50
Standard block orange		M 4/6	0105 002.20	50
Standard block red		M 4/6	0105 032.15	50
Standard block black		M 4/6	0105 031.14	50
Standard block beige V0		M 4/6 V0	0195 116.00	50
Standard block brown		M 4/6	0105 209.14	50
Standard block white		M 4/6	0105 051.20	50
Standard block green		M 4/6	0105 001.27	50
Standard block violet		M 4/6	0206 404.05	50
Standard block blue V0		M 4/6 V0	0199 002.26	50
Ground block yellow body/ green marking (without rail contact)		M 4/6.PI	0165 275.00	50

Accessories

End stop			BAM2	9.9 mm	0206 351.16	50
End section	grey		FEM6	2.8 mm	0118 368.16	20
	blue		FEM6	2.8 mm	0128 368.10	20
	orange		FEM6	2.8 mm	0103 126.16	20
	yellow		FEM6	2.8 mm	0103 062.21	20
	green		FEM6	2.8 mm	0103 125.15	20
	white		FEM6	2.8 mm	0103 312.20	20
	beige V0		FEM6	2.8 mm	0198 368.17	20
	blue V0		FEM6	2.8 mm	0199 302.07	20
	yellow V0		FEM6	2.8 mm	0199 305.02	20
	black		FEM6	2.8 mm	0107 005.25	20
Separator end section	grey		SCF6	3 mm	0118 707.03	20
Assembled jumper bar (with IP20 protection)	2 poles		BJMI6	32 A	0176 663.00	10
	3 poles		BJMI6	32 A	0176 664.01	10
	4 poles		BJMI6	32 A	0176 665.02	10
	5 poles		BJMI6	32 A	0176 666.03	10
	10 poles		BJMI6	32 A	0176 667.04	10
Shield connector			CBM5	0.5 mm	0178 745.14	20
			CBM8	0.6 mm	0178 746.15	20

M 4/6.P - 4 mm² ground block with rail contact - 6 mm .238" spacing

Characteristics

		IEC NFC VDE	UL	CSA
Wire size mm² / AWG	Solid	0.2 - 4 mm²	22-10 AWG	24-10 AWG
	Stranded	0.22 - 4 mm²		
Short circuit current	A / s	480A/1s		
Rated wire size	mm² / AWG	4 mm²	10 AWG	10 AWG
Wire stripping length	mm / inches	9.5 mm / .37"		
Recommended torque	Nm / lb.in	0.5-0.8 Nm / 4.4-7.1 lb.in		

Selection

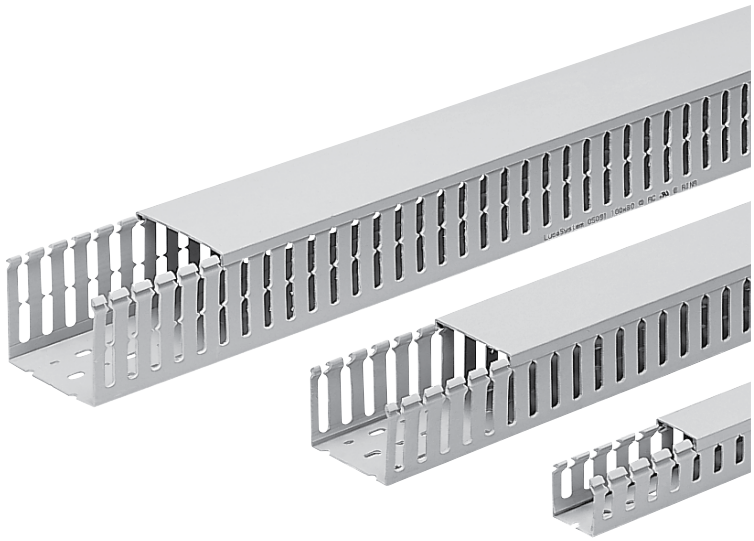
Description	Type	Order P/N	Packaging
Ground block V2 green/yellow	M 4/6.P	0165 113.16	50
Mounting on DIN 3 rail without screw :			
Ground block V0 green/yellow	D 4/6.P	0165 809.01	50

Accessories

End section	yellow	FEM6	2.8 mm	0103 062.21	20
	yellow V0	FEM6 V0	2.8 mm	0199 305.02	20
Separator end section	grey	SCF6	3 mm	0118 707.03	20

Q-Duct wiring duct

Q-Duct
Wiring duct



General information

ABB offers Q-Duct, a wide variety of wire duct and accessories. Bases are available in six different width sizes and heights from 17mm to 100mm (.67" to 3.94"). Top profile of the ribs of all wiring duct have been redesigned to make the cover easier to open and close. The new rounded shape prevents abrasions to the installer's hands. The score line at the base of each finger enables a clean break to create an opening to run wires through. ABB wiring duct is used in applications with rated voltage of up to 1000 VAC and 1500 VDC.

Catalog number explanation

QD 100 X 100 S G

Quality Duct

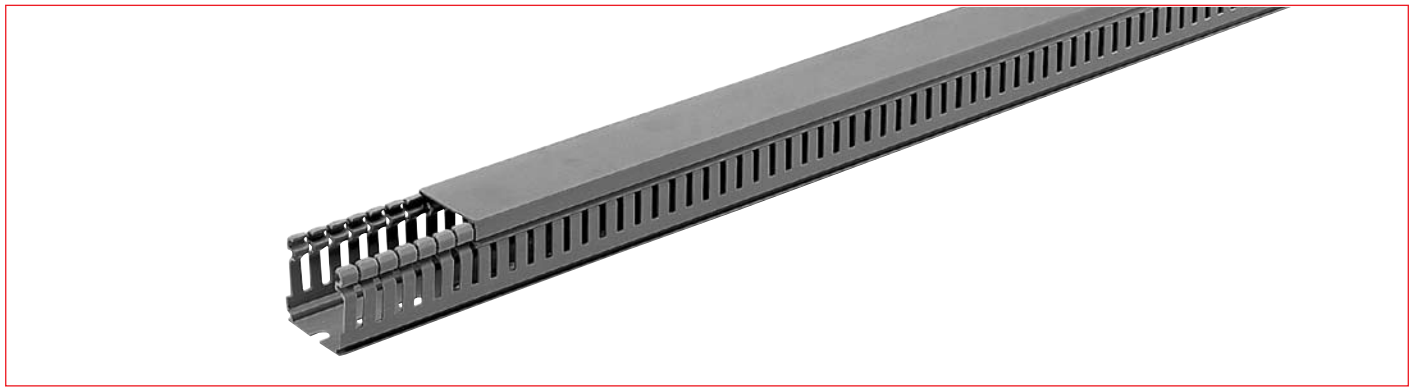
Size (HxW)

050 = 1/2"
100 = 1"
150 = 1 1/2"
200 = 2"
225 = 2 1/4"
250 = 2 1/2"
300 = 3"
400 = 4"
500 = 5"
600 = 6"

Color
G = Gray
W = White

Type
S = Standard
H = High Density

Q-Duct
High density, 4-6mm slot



Dimensions WXH (in)	**White** High Density 4-6mm Slot	**Gray** High Density 4-6mm Slot	Dimensions WXH (mm)	Feet per package	Meters per package	Pieces per package
1/2 x 5/8	QD050X050HW	QD050X050HG	15 x 17	151	46	23
1 x 1¼	QD100X125HW	QD100X125HG	25 x 30	190.5	58	29
1½ x 1¼	QD150X125HW	QD150X125HG	40 x 30	131.5	40	20
2¼ x 1¼	QD225X125HW	QD225X125HG	60 x 30	171	52	26
1 x 1½	QD100X150HW	QD100X150HG	25 x 40	157.5	48	24
1½ x 1½	QD150X150HW	QD150X150HG	40 x 40	98.5	30	15
2¼ x 1½	QD225X150HW	QD225X150HG	60 x 40	131	40	20
3 x 1½	QD300X150HW	QD300X150HG	80 x 40	105	32	16
4 x 1½	QD400X150HW	QD400X150HG	100 x 40	79	24	12
4¾ x 1½	QD475X150HW	QD475X150HG	120 x 40	66	20	10
1 x 2¼	QD100X225HW	QD100X225HG	25 x 60	111.5	34	17
1½ x 2¼	QD150X225HW	QD150X225HG	40 x 60	72	22	11
2¼ x 2¼	QD225X225HW	QD225X225HG	60 x 60	105	32	16
3 x 2¼	QD300X225HW	QD300X225HG	80 x 60	79	24	12
4 x 2¼	QD400X225HW	QD400X225HG	100 x 60	66	20	10
4¾ x 2¼	QD475X225HW	QD475X225HG	120 x 60	46	14	7
1 x 3	QD100X300HW	QD100X300HG	100 x 80	92	28	14
1½ x 3	QD150X300HW	QD150X300HG	40 x 80	118	36	18
2¼ x 3	QD225X300HW	QD225X300HG	60 x 80	79	24	12
3 x 3	QD300X300HW	QD300X300HG	80 x 80	52	16	8
4 x 3	QD400X300HW	QD400X300HG	100 x 80	52	16	8
4¾ x 3	QD475X300HW	QD475X300HG	120 x 80	39	12	6
1 x 4	QD100X400HW	QD100X400HG	25 x 100	65.5	20	10
1½ x 4	QD150X400HW	QD150X400HG	40 x 100	92	28	14
2¼ x 4	QD225X400HW	QD225X400HG	60 x 100	66	20	10
3 x 4	QD300X400HW	QD300X400HG	80 x 100	46	14	7
4 x 4	QD400X400HW	QD400X400HG	100 x 100	26	8	4
6 x 4	QD600X400HW	QD600X400HG	150 x 100	26	8	4

Sold in package quantity only. Order quantity must be equal to quantity shown in "Piece per package" column. Wire duct cover included.

On Line Catalog

BURNDY Catalog Number	KA2U
UPC Number	781810370056
Description	14STR-2STR DUAL RATED
Status	Active
Web Use	
BURNDY Product Line	

Dimensional	
Width (in)	0.5
Length (in)	1.16
Bolt Hole Size (in)	0.25
Thickness	0.1
D - in	0.63
Pad Width (in)	0.51
N (in)	0.31
General	
Number of Conductors	1
Number of Holes	1
Product Description	Aluminum Universal Terminal, 1 Hole, 14-2 AWG (Str), 1/4" Stud, 1 Screw, Al/Cu Rated, Tin Plated
Conductor(s)	
Aluminum Size (Range)	8-2
Copper Solid Size (Range)	N/A
Copper Stranded (Range)	14-2
Physical	
Installation Torque	50
Type of Plating	Tin
Connector Type	Terminal
Bolt Hole Size	1/4
Plated (Yes or No)	Y
Product Material	Aluminum
Approvals / Certifications	
Rated for Direct Burial	N
UL Listed	Y
CSA Certified	Y
ROHS Compatible	Exempt
UL Recognized	N
CULUS	N
Industry Standards	UL468A-468B
Documentation	

For further technical assistance, please contact us

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Monday - Friday
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