SUNDYNE
Canned Motor Pumps

SURE VIEW®
Predictive Maintenance Monitor

Instruction Manual Supplement

SUNDSTRAND™
FLUID HANDLING

SureView software is designed by Sundstrand Fluid Handling Corporation
specifically for the SureView Sealless Pump monitor
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SAFETY WARNING

Sundstrand Fluid Handling Corp manufactures equipment to exacting International Quality Management System Standards (ISO 9001 - 1987) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories have been specifically designed and tested for use with these products to ensure continued product quality and performance. As Sundstrand Fluid Handling Corp cannot test all parts and accessories sourced from other vendors, incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorized Sundstrand Fluid Handling Corp parts and accessories is considered misuse and damage or failure caused by misuse is not covered by Sundstrand Fluid Handling Corp's warranty. Additionally, modification of Sundstrand Fluid Handling Corp products or removal of original components may impair the safety of these products and their effective operation.

EUROPEAN UNION MACHINERY DIRECTIVE
(CE Mark System)
(where applicable)

This document incorporates information relevant to the Machinery Directive 89/392/EEC. It should be read prior to the use of any of our equipment. Individual maintenance manuals which also conform to the EU Directive should be read when dealing with specific models.

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Suggested Safety Instructions:

During installation, maintenance or repair operations of Sundstrand Fluid Handling pumps or compressors, systems for safety shall be applied before commencement of work.

Failure to follow safety quidelines may lead to operator injury.

Personal Protective Equipment ("PPE") Safety Glasses with side shields shall be worn by all personnel installing or performing maintenance or repair on the equipment. If equipment is to be manually lifted over (7kg) 15 pounds, or if pallet jacks or forklifts are to be used, the person shall wear safety toed shoes. When testing the equipment, hearing protectors are recommended to be worn if noise levels exceed 85 dB over the work day. Chemical resistant gloves shall be used if chemical use is required (see chemical use for additional information). If chemicals have warnings regarding fumes and/or dust/mists, ensure a dust mask respirator is available for use.

When selecting one piece of PPE to be used with another, consider the compatibility between them - for example, safety glasses should not interfere with the seal from ear muffs to protect hearing. Be sure the clean the PPE after each use.

Use of Forklifts: All forklift drivers must have a current recognized license. If using a forklift, first ensure that the lift is in safe operating condition.

Installation/Service/Repair: Ensure all electrical sources are off and safe to install/service/repair the equipment. A recognized Lockout/Tagout program should be followed - Locks and/or tags should be provided warning employees that the equipment is being installed/serviced/repaired. Once the work is completed, the person installing the lock and/or tag shall remove it and inform others of start-up. Should there be a shift change, the lock and/or tag shall be removed by the first authorized person and the lock and/or tag shall be installed by the second shift authorized person.

Testing Equipment: Persons in the immediate area shall be warned when a test is to be performed.

Tools: Tools shall be insulated from electrical shock. Ensure all tools are clean and free of oil and the insulation is not damaged in any way.

Chemical Use: Any chemicals to be used shall be accompanied by a relevant Hazard Data Sheet, in accordance with your government legislation. If applicable, chemical proof gloves shall be used. An eye wash station (or equivalent) should be available in the event of injury. Should any hazardous or flammable chemicals have flowed through the equipment a complete decontamination of the equipment is required.

Fall Protection: When working over six feet from the ground, fall protection is required.

Machine Guarding: Guards shall remain in place on all equipment. Only during maintenance/repair can the guards be removed, and prior to start-up, the guard must be replaced.

Table of Contents

1.0 INTRODUCTION

The SureView™ monitoring system is a modern tool specifically designed for rotor dynamics analysis, predictive maintenance, and real-time analysis of operating conditions of the Sundyne Canned Motor Pump™. Utilizing a simple, intuitive display format, the SureView monitoring system . . .

- Lowers Total Cost of Ownership
- Improves Operational "Up-Time"
- Improves maintenance predictability by:
    - independently monitoring both front and rear stator-to-rotor clearance conditions
    - independently monitoring the axial position of the rotor
    - directly detecting dry run conditions (not indirectly as with a kW meter)
    - utilizing a user-friendly display board that illustrates all pertinent information in real-time
    - requiring no field calibration with bearing replacement
    - making it possible to directly monitor shaft movement and to do vibration analysis similar to standard vibration analysis systems (time waveforms, shaft orbit plots, FFT/spectrum analysis) using software designed specifically for SureView.
    - providing multiple output features provided as *standard* (RS-485 serial communication link, 4-20 mA rotor position indicator, dry run and rotor position relays)
    - using non-intrusive sensors

2.0 Using the standard (non-SureView) Instruction Manual

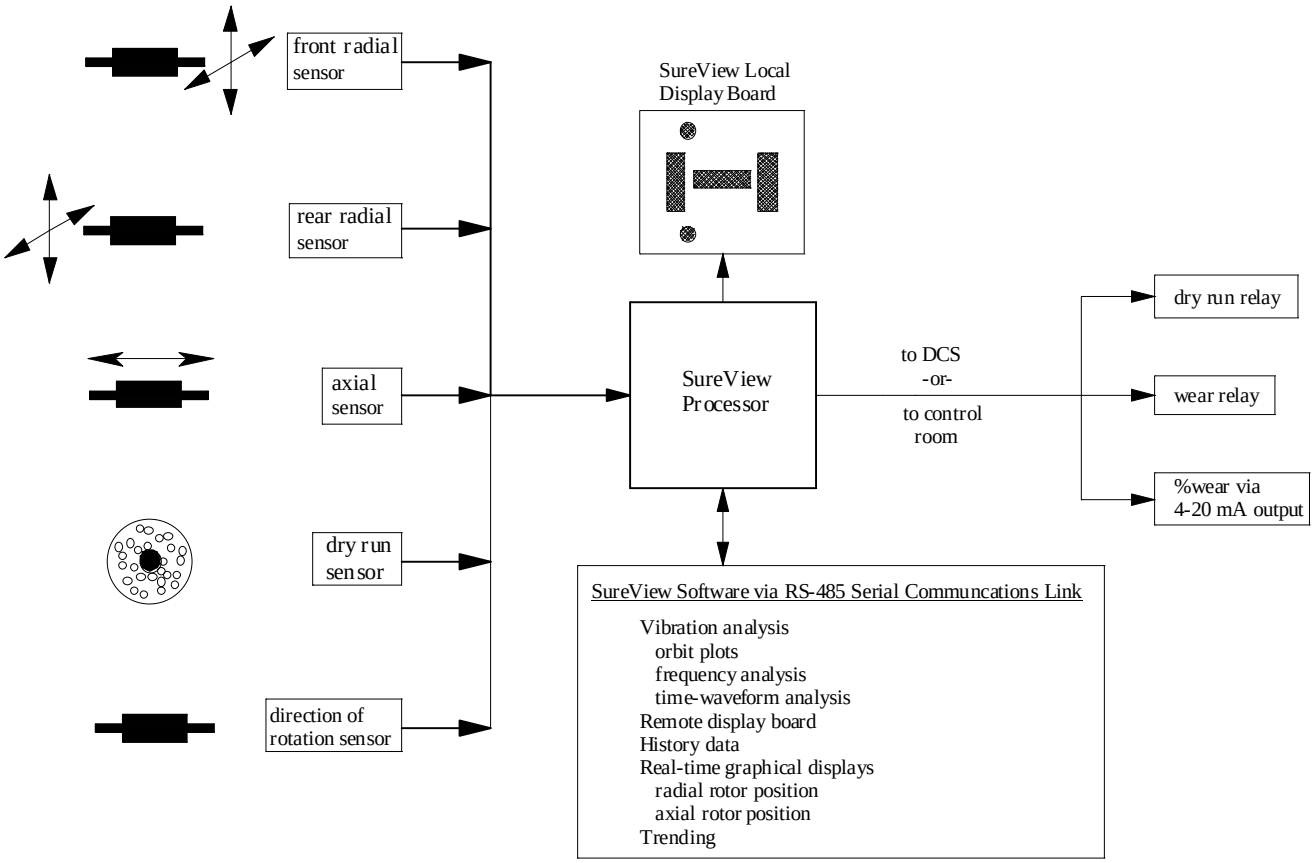
The following information in the standard instruction manual is still valid:

- Canned Motor Pump's general introduction and warnings (HRP series)
- circulation configuration information (HN, HQ, HT, HS, HP)
- construction
- installation
- operation
- maintenance
- non-SureView/non-electronic related troubleshooting

NOTE: Disregard information regarding the mechanical bearing monitor.

3.0 Basic Theory of Operation

3.1 SureView Schematic



3.2 Radial Rotor-to-Stator Position (Front & Rear, where "front" is the pump case end)

The purpose of the radial sensing portion of SureView is to prevent the stator and rotor liners from contacting as the bearings wear. Using proximity sensors that are located on the outer (dry) side of the stator's protective liner, SureView compares the rotor's current radial position to a maximum allowable boundary position. This is done independently at both the front (pump case end) and the rear end. The boundary is set so that the maximum life is obtained from a pair of bearings, without allowing the rotor and stator liners to contact. As the rotor gets closer to the boundary, more radial lights are illuminated. On the display board, the vertical bank of 10 lights on the left is for the rear radial sensor, and the set on the right is for the front radial sensor. Radial rotor motion is dynamic, and the magnitude of the motion can be affected by how close the pump is running relative to its design point. The radial lights are programmed to turn on and turn off as the rotor position changes so that the user can see and learn where the unit runs the smoothest on its curve. The radial lights *can* be programmed to "lock on," but the default is to display the instantaneous rotor position by allowing the lights to turn on and off as the rotor position and rotor dynamics changes.

See the *Interpreting the local display board* section for more information about the lights.

3.3 Axial Rotor Position

The purpose of the axial sensing portion of SureView is to prevent the impeller from contacting the pump case or liner disc by telling the user how much bearing wear he has left before the axial clearance is used up. SureView compares the rotor's axial position to axial boundary limits for both the front (pump case end) and the rear end. As the rotor moves toward the boundary limit, more lights on the display panel illuminate. While the rotor is within its normal endplay, only one light for the rear direction and one light for the front (pump case end) direction are illuminated. As the rotor position shifts (usually due to bearing wear), additional lights come on. Because the axial position of the shaft is relatively non-dynamic, once each axial light comes on, it will stay on -- it *locks on*. Therefore, *if* the rotor moves close to the axial boundary limit (usually due to bearing wear), but then shifts back to a more centered position, the axial history of the pump and its worst case axial condition are still displayed. However, the lights *can* be programmed to *not* lock on if the user prefers.

In addition to displaying how close the rotor has come to its axial boundary limit in either direction, SureView also displays the rotor's real-time position and direction of thrust. If the rotor is thrusted forward, the appropriate front (pump case end) axial light flashes. If the rotor is thrusted to the rear, the appropriate rear axial light flashes. This allows the axial display LEDs to show where the rotor is currently located, regardless of how close the rotor has previously come to the axial boundary limits.

See the *Interpreting the local display board* section for more information about the lights.

3.4 Dry Run

Dry run is a critical fault condition for all Sealless pumps because process fluid is used to cool the motor and lubricate the bearings. To avoid damage to the pump due to dry run conditions, SureView directly detects 2-phase flow or the presence of vapor bubbles within the motor using ultrasonic technology. If enough vapor is detected, the dry run light on the display circuit board changes from green to flashing red. If the dry run light stays red for the duration of the nuisance timer, the dry run relay is tripped. The nuisance timer is provided for the dry run relay to avoid unnecessary shut-downs or alarms.

3.5 Direction of Rotation

The correct direction of rotation is confirmed by the SureView Monitor each time the pump power is applied. If the direction of rotation is correct, the direction of rotation display light turns green. If the direction of rotation is backwards, the display light flashes red.

3.6 Remote Outputs

3.6.1 Relay Outputs

Two relay outputs are provided. One is activated by dry run, the second is activated by the rotor position reaching 90% of the maximum boundary condition, either radially or axially. Both relays have nuisance timers, and the timer length is

adjustable through the SureView Host software and the RS-485 serial communication link. (see the *SureView "Host" software* section)

The dry run relay is activated if a dry run condition exists continuously for the duration of the nuisance timer. The dry run nuisance timer is preset for 20 seconds. The rotor position relay is activated when either the radial or axial rotor position reaches 90% of the boundary limit and remains there for the duration of the nuisance timer. The rotor position nuisance timer is preset for 15 seconds.

Both relay outputs will reset to a non-tripped condition if the alarm condition is corrected.

3.6.2 4-20 mA Analog Output

A standard 4-20 mA analog output is included. This output provides an analog signal of how close the rotor is to its boundary conditions. The 4-20 readout should be set up in percent (0% to 100%). Since there are both radial and axial boundaries, the output displays the greatest excursion that is currently occurring either radially or axially. The 4-20 mA signal will tell you the maximum percent wear observed at any bearing, but will not tell you which bearing is worn. The 4-20 mA circuit needs to be externally powered with between 12 and 48 volts. The farther the signal needs to be transmitted to the control room, the more voltage needs to be provided. The transmission lines should be well shielded and grounded to protect the signal from electrical noise. 4-20 mA readouts that have the built-in capability of powering the 4-20 mA circuit can be purchased off the shelf.

3.6.3 Serial Communication (RS-485)

The following **stored parameters** are both available and modifiable using the SureView Host software in conjunction with the RS-485 link:

- Max. front (pump case end) radial rotor position in %: highest value recorded is retained
- Max. rear radial rotor position in %: the highest value recorded is retained
- Max. axial rotor position in %: the highest value recorded is retained
- Dry run state: the last state detected (dry or wet) is retained
- Direction of rotation: direction detected at last startup is retained (correct or backwards)
- Number of dry run events: number of times the dry run light has turned red
- Number of dry run alarms: number of dry run alarms lasting longer then the nuisance timer
- Length of time for the wear relay nuisance timer: number of seconds that a radial or axial red light (90%) must stay on before the relay trips
- Length of time for the dry run nuisance timer: number of seconds that the dry run light must stay red before the relay is tripped
- Total run time, hours
- Total number of starts

3.7 Stored Operating History Data

The stored history parameters (listed above) show a clear picture of the operating history of the pump as well as the operating conditions that were present when the pump was last shut down. This information is critical when trying to investigate a pump failure or when performing a pump reliability study.

3.8 the SureView "Host" Software (via RS-485 serial communication link)

The SureView HOST software has the following capabilities:

- shaft position and vibration analysis via the SureView radial and axial proximity probes:
  - √ orbital analysis
  - √ time waveform analysis
  - √ spectrum/frequency analysis (FFT)
- capability to see the real-time position of the shaft, both radially and axially (in graphical form)
- access to the history data that is automatically recorded -- number of dry runs, maximum % wear, number of starts, total run time, most recent dry run state (wet or dry), most recent direction of rotation state (correct or backwards)
- replication of the SureView display board in real-time (on-screen)
- ability to change adjustable parameters, such as the nuisance timers
- trending of axial rotor position
- capability to print hard-copies of all above-mentioned data and data screens
- capability to save all above-mentioned data, and to reload it and view it at a later date

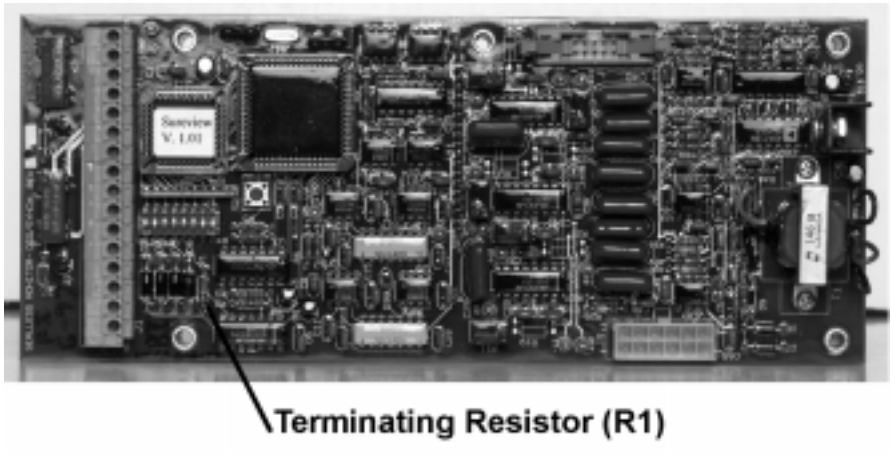
PC or laptop requirements: HOST can run on Windows 3.1, NT 4.0, or Windows 95

3.8.1 Addressability (daisy-chaining of up to 64 pumps)

the SureView advanced software can communicate with up to 64 pumps using one input line to one computer. This is accomplished by daisy-chaining the RS-485 serial communication links, and allowing the software to recognize each pump by it's unique address. Daisy-chaining greatly reduces the cost of wiring multiple SureView units to the control room or to a vibration specialist's personal computer.

3.8.2 Daisy-chain Installation Instructions:

To "daisy-chain" (network) the pumps together, insert the four RS-485 wires to ports 3, 4, 5 & 6 on the first pump just as you would for a non-networked pump. Then wire the second pump to the first pump by connecting ports 3, 4, 5 & 6 on the first pump to ports 3, 4, 5 & 6 on the second pump (connect port 3 on pump #1 to port 3 on pump #2, and so on). Note that the daisy-chain cannot have any branches (in other words, the pumps must be wired in a single chain). Finally, the "terminating resistor" must be removed on ALL the circuit boards in the daisy-chain EXCEPT the last one. The terminating resistor on the last circuit board is not removed in order to minimize electrical reflections which could cause data errors.



To remove a terminating resistor:

WARNING: Disconnect power to the unit before proceeding.

- On the top of the circuit board, locate the resistor labeled "R1." It is located about 1 inch from both the 16-port terminal strip used for connections and the bank of 8 dip switches.
- Using a small pair of wire cutters, gently clip out the resistor by clipping through the two resistor "legs."

Be careful not to scratch the circuit board's surface with the wire cutters. Excessive scratching of the circuit board can destroy the delicate traces that lie on the circuit board's surface.

- Coat the two "legs" of the resistor that remain on the circuit board with an insulating varnish or GLPT to prevent them from becoming future corrosion sites. The proper varnish or GLPT can be obtained from Sundstrand Fluid Handling if necessary (Sundstrand part #: 77-078).

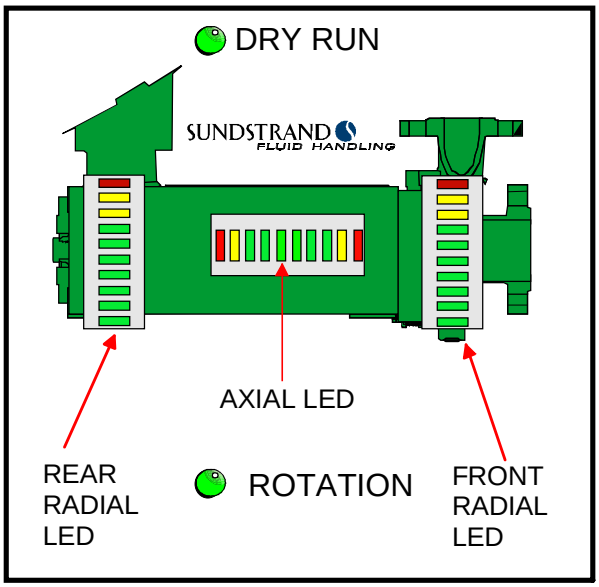
Do NOT use silicone RTV, as it emits an acid when it cures that can corrode the circuit board.

WARNING: **once the terminating resistor has been removed from the circuit board, the circuit board can only communicate as part of a "daisy chain" network. To run as a stand-alone unit, the resistor must be reinstalled (which should only be done by a professional electronics technician).**

4.0 Interpreting Display Board

The following parameters are displayed on the SureView local display board:

- Front (pump case end) rotor-to-stator radial clearance
- Rear rotor-to-stator radial clearance
- Axial rotor clearance (front & rear)
- Real-time axial position of the rotor
- Real-time axial thrust direction of the rotor
- Dry run
- Direction of shaft rotation
- The SureView display is 100% real-time



4.1 Radial lights

The front (pump case end) and rear radial lights are the two banks of 10 LED lights that run vertically on the display board. The rear lights are on the left, and the front lights are on the right (the display board has an outline picture of a SureView pump on it, and the rear end corresponds to the end with the junction box). The bottom 7 lights are green, the next 2 lights are yellow, and the top light is red. If the shaft is running in unworn bearings, the bottom green light will be illuminated to show that the SureView monitor is on. Each of the remaining 9 lights represents 10% of the available rotor to stator clearance. So when the 10th (red) light comes on, 90% of the clearance has been used up, and the stator and rotor are close to contacting. In other words, light #1 represents 0% to 10% of the available clearance, light #2 represents 10% to 20% of the available clearance . . . light #10 represents 90% to 100% of the available clearance. Once the 10th (red) light comes on, all 10 lights will start to flash in order to attract attention that the pump requires immediate maintenance.

Sundstrand recommends replacing worn bearings when the first yellow light is illuminated (8th radial light).

During certain operating conditions, particularly away from the design point, flow instabilities and vibration may cause 1 or 2 additional radial lights to illuminate. This can be corrected by returning to the design point as soon as possible.

Since radial rotor motion is dynamic, the radial lights are programmed to turn on and turn off as the rotor position changes so that the user can see and learn where the unit runs the smoothest on its curve. However, the radial lights *can* be reprogrammed to "lock on."

4.2 Axial lights

The front (pump case end) and rear axial lights are grouped into one bank of 10 lights that runs horizontally in the center of the display board. The left 5 lights represent the rear axial allowable clearance. The right 5 lights represent the front axial allowable clearance. Light # 1 is the innermost light for both the front and the rear lights, and light #5 is the outermost light. When the pump is operating within its normal endplay, the #1 front light and the #1 rear light will be lit to show that the SureView monitor is on. As the axial clearance is used up, light #2 will come on, then #3, etc. For both front and rear, light #1 through #3 is green, light #4 is yellow, and light #5 is red. Light #1 represents 0% to 30% of the available clearance, light #2 represents 30% to 50% of the available clearance , light #3 represents 50% to 70% . . . light #5 represents 90% to 100% of the available clearance. Once the 5th light comes on for either direction, all 5 lights at that end will start to flash in order to attract attention that the pump requires immediate maintenance.

Sundstrand recommends replacing worn bearings when the first yellow light is illuminated (4th axial light in either direction).

Because the axial position of the shaft is relatively non-dynamic, each of the axial lights are programmed to lock on once they come on -- in other words, once each axial light comes on, it will stay on until the pump is shut off. Therefore, if axial wear occurs, but then the rotor shifts to a more centered position, the maximum axial wear is still displayed (by the locked lights). The *current* rotor position is always shown by the axial light that is flashing. However, the lights *can* be programmed to *not* lock on if the user prefers.

4.2.1 Real-time axial rotor position / Axial thrust direction

The actual position of the rotor is determined by the net thrust on the rotor. SureView tells the user where the rotor is presently running by flashing the axial light that represents the rotor's current location. For example, if the rotor is running within its normal endplay, only one axial rear light and one axial front light will be on. But if the rotor is thrusting forward, the forward axial light will flash. Or, if there are 4 rear axial lights locked on, and 3 front axial lights locked on, and the rotor is thrusting to the rear, the 4th rear light will flash. Or, if there are 4 rear axial lights locked on, and 3 front axial lights locked on (just as in the previous example), but the rotor's thrust is hydraulically balanced (the rotor is "floating" in the middle of its endplay), either the #1 rear axial light or the #1 front axial light will flash to indicate that the rotor is presently floating.

4.3 Dry run light

The dry run light can be green or red. Green means that the pump's motor cavity is free of vapor bubbles. Red means that a considerable amount of vapor bubbles have formed inside the motor, causing 2-phase flow to be lubricating the bearings. The health of the bearings could be in jeopardy if the cause is not corrected. If the dry run light stays red for the duration of the nuisance timer, the dry run relay will trip. If the dry run light turns green for any period of time, the relay and the nuisance timer will automatically reset.

4.4 Direction of Rotation light

The direction of rotation light can be green or red. Green means the rotor is turning in the correct direction. Red means the rotor is turning in the wrong direction. Before starting a pump, someone should be positioned at the pump's display board to view the color of the direction of rotation light when the pump is turned on. The pump must be turned on for at least 3 seconds before SureView is able to display what direction the rotor is rotating.

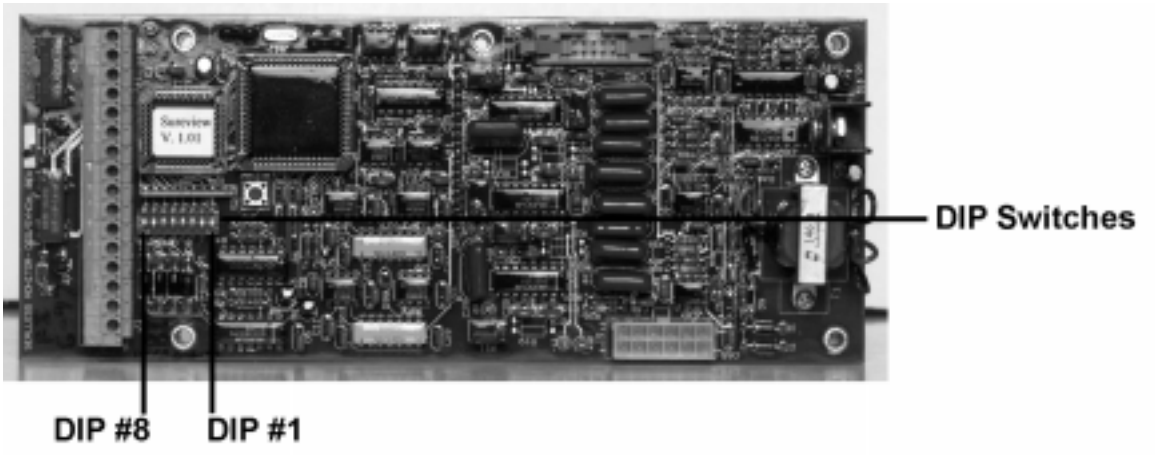
If the red light comes on, the pump should be immediately shut down, and any two of the three motor leads switched to provide proper direction of rotation. Restart the unit and verify that the direction or rotation light is green.

5.0 Bearing Replacement Procedure

If only the bearings, shaft sleeves, and thrust washers are replaced, no recalibration is needed. If other components are also replaced, see the *Axial Field Calibration Procedure* section. To replace worn bearings, disassemble the pump, and remove the old bearings in accordance with the *standard* (non-SureView) instruction manual.

Warning: **rear sensor housings are unique to each stator assembly (see the *SureView assembly procedure* section for more details). If repairing 2 or more units at once, take precautions to keep the rear sensor housings with their respective stators. If a rear sensor housing is put on a different unit, the axial calibration must be done before it can function properly**.

As an option, if you want to reset (to zero %) the maximum radial and axial wear percentages that the circuit board automatically monitors and saves as *historical data*, follow these instructions: **NOTE: THE LIGHTS ON THE DISPLAY BOARD WILL STILL WORK PROPERLY IF THIS OPTIONAL STEP IS NOT PERFORMED.** Performing this step simply resets (to 0%) the max. wear % *history data* that the circuit board has collected.



To reset the maximum wear percentage history data

WARNING: Do not move any dip switch except #1. Doing so could make the SureView Monitor function improperly.

1. At the rear of the circuit board, just in front of the 16-port green terminal strip, locate the small black strip that has 8 white switches. Each switch is numbered, 1 through 8. Each switch can be either on or off. One side of the bank of switches is labeled "on," the other side is labeled "off."
2. Using a small screw driver, move dip switch #1 to its opposite position (move the switch to 'off' if it's presently 'on', or vice versa).

The next time the circuit board is energized, maximum wear percentages will be reset to 0%.

6.0 Collecting rotor position data with standard portable data collection devices

WARNING: High voltage is present in the left compartment of the junction box when the pump is powered (note: there is a metal "safety cover" that covers the high voltage compartment if the junction box lid must be removed while the unit is operating.)

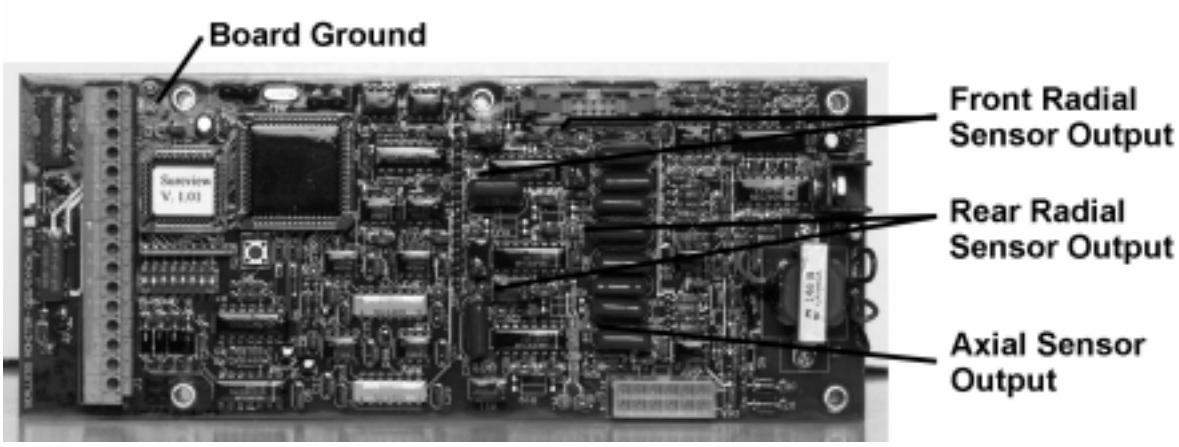
There is a port on the circuit board side of the junction box that can be used to connect to SureView output connections. Care must be taken to keep the inside of the junction box sealed from the outside environment. The port has a standard 1" NPT thread.

Vibration and orbit data can be collected using any standard portable data collector that can read 0-5 volts. The voltage data is taken straight off the circuit board from the following labeled testpoints on the top of the circuit board:

front (pump case end) horizontal sensor:	testpoint XA1
front (pump case end) vertical sensor:	testpoint YA1
rear (opp. pump case end) horizontal sensor:	testpoint XA2
front (opp. pump case end) vertical sensor:	testpoint YA2

axial	testpoint ZA
circuit board ground	testpoint GRN

TOP VIEW OF CIRCUIT BOARD



The radial sensor sensitivity is 50 millivolts per thousandth of an inch (mil).
The axial sensor sensitivity is 12.5 millivolts per thousandth of an inch (mil).

Special notes concerning the raw voltage data:
Take note that the raw RADIAL voltage data has some unusual characteristics due to the nature of the sensors. Every 1.5 seconds the probe's voltage signal will jump up or down to a default voltage level for approximately 120 milliseconds while the circuit board checks whether the pump is running wet or dry. This temporary DC shift should be ignored. It will show up as low frequency noise on a frequency analysis. Also, there will be a relatively small 120 Hz waveform superimposed on top of the probe's orbit waveform. This is caused by stray motor flux fields, and does not effect the sensor's performance because the circuit board disregards this noise when analyzing the data and determining when to turn on the radial and axial lights.

For creating orbit plots on some data collectors, since there is no available keyphasor, an artificial keyphasor might need to be set-up. Other data collectors will allow 2 channels of data to be plotted against each other on an X-Y graph without needing a keyphasor. If an artificial keyphasor is used, set it to 3550 rpm, or 59.2 Hz.

The sensor data can be analyzed using all the same vibration analysis techniques that are used with traditional proximity probes, such as:

- ✓Time Waveform Analysis
- ✓Orbital Analysis
- ✓Spectrum/Frequency Analysis

7.0 Parts Handling

All the electronic components for the SureView monitor have been designed to withstand tough industrial environments. However, they should still be handled with some additional care.

Do not pick SureView units up with a magnetic crane, as the magnetic fields may damage the circuit board's memory chips.

SureView units and spare circuit board should be stored away from equipment that emits heavy magnetic fields (such as magnetic-drive pumps).

Metal objects should not be laid on top of the circuit board, as the protective coating could be punctured, and allow the metal object to either create a short between two contacts or damage the electronic components.

The rear sensor housing has a rubber 4-pin female plug that must match up with a 4-pin male plug on the stator's rear endbell. When putting the rear sensor housing on, care should be taken to match these two plugs together. The rear sensor housing should be put on as straight as possible so that the male pins slide straight into the female connectors. This will prevent the pins from getting bent or buckled, and prevent the metal connectors from becoming dislodged from the rubber plug. If they do become dislodged, they can be reattached to the rubber plug with silicone-based RTV adhesive sealant. Be careful to keep the RTV off the metal part of the connector, which could prevent the male and female parts from making contact. Also, the rear housing contains the dry run sensor, and the sensor can be damaged if it is shocked by dropping the rear sensor housing onto a hard surface.

Warning: Do not life SureView units up by the neck of the junction box. And when lifting the larger T and L frame units, utilize the threaded eye bolt holes provided at each end of the unit.

8.0 Wiring of external connections (ports 1-16 at far end of the circuit board)

(includes relays, 4-20 mA output, serial communication, and auxiliary power)

There is a port on the circuit board side of the junction box that can be used to connect to the SureView output connections. The port has a standard 1" NPT thread. If this port is used, care must be taken to keep the inside of the junction box completely sealed from the environment. This will prevent water vapor, salt water, and other air-borne chemicals from either fogging up the sight glass or causing corrosion inside the junction box. There are several methods to accomplish this, including running the wires through sealed, air-tight conduit, or feeding the

wires through a rubber plug specifically designed for this sealing function, or using a ceramic feed-through that can be screwed directly into the 1” port.

At the far end of the circuit board (looking from the motor end of the pump), there is a 3” long green strip of 16 ports. The port on the far left is port #1, and the port on the far right is port #16. There is a small number 1 and a small number 16 printed on the flat, green part of the circuit board next to port 1 and 16 respectively. The function and wiring requirements of each port is described below.

TOP VIEW OF CIRCUIT BOARD

8.1 General Wiring Notes

Refer to the inside of the junction box, on the right side of the flap, for a list of how the 16 ports are connected.

Wiring for the relays, 4-20 mA output, and RS-485 serial communication link should be shielded with conduit in order to prevent any electrical noise from interfering with the signal. The wires should also be either in twisted-pair or braided format to prevent any cross-talk between the wires.

WARNING: High voltage is present in the left compartment of the junction box when the pump is powered (note: there is a metal “safety cover” that covers the high voltage compartment if the junction box lid must be removed while the unit is operating.)

8.2 Ports 1 & 2 Auxiliary Power

For auxiliary power, use <u>one</u> of the following:

- 12 volts DC
- 24 volts DC
- 12 volts AC (straight or RMS)

WARNING: exceeding 26 volts can damage or destroy the circuit board.

(note: voltage tolerance is +2 volts / - 1 volt)
(note: power source must supply at least 1 amp of current)
(note: a 12 or 24 volt lantern battery works well as a DC power source)
(a 12 volt power supply can be ordered from Sundstrand that plugs into a standard 120 volt outlet, Sundstrand part #: 77-077)

<u>Hooking up the auxiliary power</u>:

Looking at the circuit board inside the junction box, there is a 3" long green strip with 16 ports and 16 yellow push-down tabs at one end of the circuit board. Port #1 is closest to the junction box's divider wall, and port #16 is farthest away from the divider wall (there is a small number 1 and a small number 16 printed on the flat, green part of the circuit board next to port 1 and 16). If using DC power, insert the positive lead of the DC power supply into port #1, and the negative lead to port #2. If using AC power, either lead can be inserted into either slot.

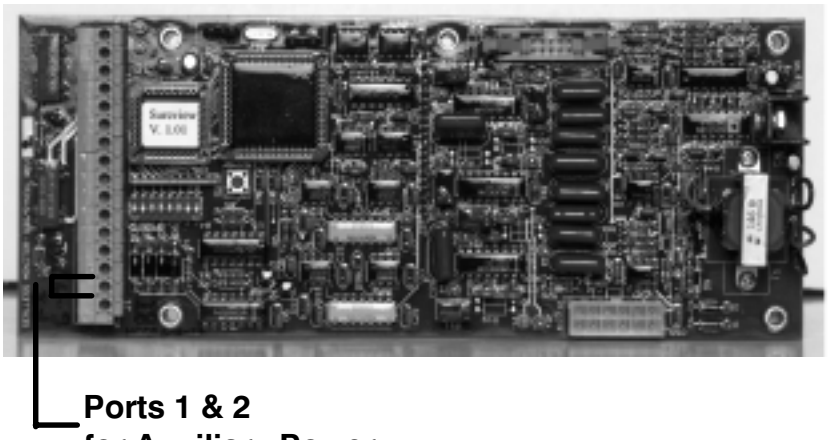
To connect the leads into the ports:

- at least 1/2 inch of insulation must be stripped off the lead wires
- before inserting the wires, <u>always</u> be sure the auxiliary power supply is off (this avoids shorts)
- push and hold down the yellow push-down tab in front of the port with a small screw-driver
- insert the wire approximately 1/2" into the port (be sure the wire going into port #1 does not touch the wire going into port #2, as this will short out the power supply if it's on).
- release the yellow clip so that the wire is securely held in the port. Lightly pull on the wire to make sure it is being securely held in the port

When both leads are connected and the power source is supplying power, some of the lights on the display board will light up. If no lights come on, the correct power is not being supplied to the circuit board. Recheck the connections, or make sure the power source is supplying sufficient voltage and current.

Always turn off the auxiliary power supply before removing the wires from the ports (this prevents shorts).

TOP VIEW OF CIRCUIT BOARD



8.3 Ports 3 through 6 RS-485 Serial Communication Link (for use with the SureView HOST software)

An RS-485 link is a 4-wire link when connected in full duplex mode. An RS-485 card has two transmit lines and two receive lines. One *transmit* line is labeled positive, the other negative. One *receive* line is labeled positive, the other negative. The SureView circuit board also has two transmit lines and two receive lines (one labeled positive and one negative). The four RS-485 card wires and the four SureView circuit board wires must be connected as follows:

RS-485 card's	*connected to:*	SureView circuit board's	
receive +		transmit +	(TX+) **port #3**
receive -		transmit -	(TX-) **port #4**
transmit +		receive +	(RX+) **port #5**
transmit -		receive -	(RX-) **port #6**

8.4 Ports 7 & 8 4-20 mA output

The 4-20 mA output displays the percent of boundary limits that have been used up. The circuit board looks at the following four conditions, and picks the worst case to display: front radial, rear radial, front axial, rear axial. 4 mA represents a 0% excursion towards the boundary limit, and 20 mA represents a 100% excursion towards the boundary limit. At 100% the rotor and stator are about to rub.

The 4-20 mA circuit must be externally powered (the SureView circuit board does not power the 4-20 mA loop). Standard 4-20 mA readouts are available that can power the loop. The 4-20 loop can be powered with between 12 and 48 volts. However, the minimum voltage the customer must supply depends on how far the data must be transmitted, and how many volts are absorbed by the resistance in the transmission wires. The unpowered resistance of the 4-20 loop on the circuit board can range from 500 to 12,000 ohms. For transmission lengths of a mile or less, 24 volts should be sufficient to power the loop. Consult the manufacturer of your 4-20 mA readout device for specific recommendations.

NOTE: the relays and 4-20 mA outputs are isolated circuits (ungrounded).

NOTE: the time delay from when power is supplied to the unit to when the relays and 4-20 mA outputs begin providing updated output signals is less than 3 seconds.

NOTE: When power to the unit is shut off, the 4-20 mA output will remain at the level it was at when the unit's power was shut off.

8.5 Ports 9 & 10 future use

8.6 Ports 11 through 13 bearing wear relay

The bearing wear relay will trip when any one of these 4 conditions occurs continuously for the duration of the wear relay nuisance timer (default timer length = 15 seconds):

- the front radial sensor turns on its 10th (red) and final light
- the rear radial sensor turns on its 10th (red) and final light
- the front axial sensor turns on its 5th (red) and final light
- the rear axial sensor turns on its 5th (red) and final light

The 10th radial light indicates that the shaft has entered the 90% to 100% wear limit zone. The 5th axial light indicates that the shaft has entered the 90% to 100% wear limit zone.

Note that the bearing wear relay has a nuisance timer, which requires that any of the unit's final (red) lights stay on for the length of the wear relay nuisance timer before the circuit board will trip the bearing wear relay. The default length of the wear relay nuisance timer is 15 seconds. In other words, a final red light must continuously stay on for 15 seconds before the relay trips. If the final light goes off for any length of time after the relay has tripped, the relay will reset itself automatically. The length of the wear relay nuisance timer is field adjustable via the SureView HOST software and the RS-485 serial communication link.

The wear relay can be wired 2 different ways: either "normally closed" or "normally open."

Normally closed means that if the wear condition is acceptable (the wear is below the 90% trip limit), the circuit's electrical path remains complete (a closed circuit). When the wear goes beyond 90% and the relay trips, the relay opens, thus breaking the circuit loop (an open circuit). Use the normally closed option to power a device when the conditions are OK, and unpower the device when the conditions become unacceptable.

Normally open means that if the wear condition is acceptable (the wear is below the 90% trip limit), the circuit's electrical path is broken (an open circuit). When the wear goes beyond 90% and the relay trips, the relay closes, thus closing the circuit loop (a closed circuit). Use the normally open option to keep a signaling device (such as a light) unpowered when the conditions are OK, and to power the device when conditions become unacceptable.

For *normally closed* operation: wire the leads to port 11 and port 12.

For *normally open* operation: wire the leads to port 11 and port 13.

NOTE: The relay connections are not polarity sensitive

NOTE: The relays and 4-20 mA outputs are isolated circuits (ungrounded).

NOTE: The time delay from when power is supplied to the unit to when the relays and 4-20 mA outputs begin providing updated output signals is less than 3 seconds.

NOTE: When power to the unit is shut off, the relays return to their "normal" positions.

8.7 Ports 14 through 16 dry run relay

The dry run relay will trip when the dry run light turns red, and stays red continuously for the length of the dry run nuisance timer. The default length of the dry run nuisance timer is 20 seconds. In other words, the dry run light must stay red continuously for 20 seconds before the relay trips. If the light turns green for any length of time after the relay has tripped, the relay will reset itself (untrip) automatically. The length of the dry run nuisance timer is field adjustable via the SureView HOST software and the RS-485 serial communication link.

The dry run relay can be wired 2 different ways: either "normally closed" or "normally open."

Normally closed means that if the dry run condition is, the circuit's electrical path remains complete (a closed circuit). When dry run occurs and the relay trips, the relay opens, thus breaking the circuit loop (an open circuit). Use the normally closed option to power a signaling device when the conditions are OK, and unpower the device when the conditions become unacceptable.

Normally open means that if the dry run condition is acceptable, the circuit's electrical path is broken (an open circuit). When dry run occurs and the relay trips, the relay closes, thus closing the circuit loop (a closed circuit). Use the normally open option to keep a signaling device (such as a light) unpowered when the conditions are OK, and to power the device when conditions become unacceptable.

For *normally closed* operation: wire the common lead to port 14 and the positive lead to port 15.

For *normally open* operation: wire the common lead to port 14 and the positive lead to port 16.

NOTE: The relay connections are not polarity sensitive

NOTE: The relays and 4-20 mA outputs are isolated circuits (ungrounded).

NOTE: The time delay from when power is supplied to the unit to when the relays and 4-20 mA outputs begin providing updated output signals is less than 3 seconds.

NOTE: When power to the unit is shut off, the relays will return to their "normal" position.

9.0 High voltage to 12 volt AC internal transformer inside the junction box

The internal transformer is located inside the junction box on the high power side of the divider wall, and is mounted on the junction box's divider wall. It is an *isolated* transformer (high voltage cannot short circuit into the low voltage side).

10.0 Axial Field Calibration Procedure

10.1 R, S & L frame units only (*see section 10.2 for T-frames*)

The axial calibration procedure DOES NOT need to be performed if only the following items are replaced:

1. bearings
2. thrust washers
3. shaft sleeves
4. rear tab washer
5. pump case
6. auxiliary impeller or other shaft spacers
7. impeller or inducer or impeller washer or impeller bolt
8. adapter plate
9. throttle bushing or throttle bushing housings
10. o-rings

The axial calibration procedure is REQUIRED if ANY of the following items are replaced:

1. rotor
2. stator
3. front or rear bearing housing
4. rotor endnut
5. rear sensor housing

Warning: ***the rear sensor housings are unique to each stator assembly*. If repairing 2 or more units at once, take precautions to keep the rear sensor housings with their respective stators. If a rear sensor housing is put on a different unit, the axial field calibration must be done before it will function accurately.**

All calibration steps must be done with the unit off (rotor static) and with auxiliary power supplied to the circuit board. The axial calibration procedure is described below.

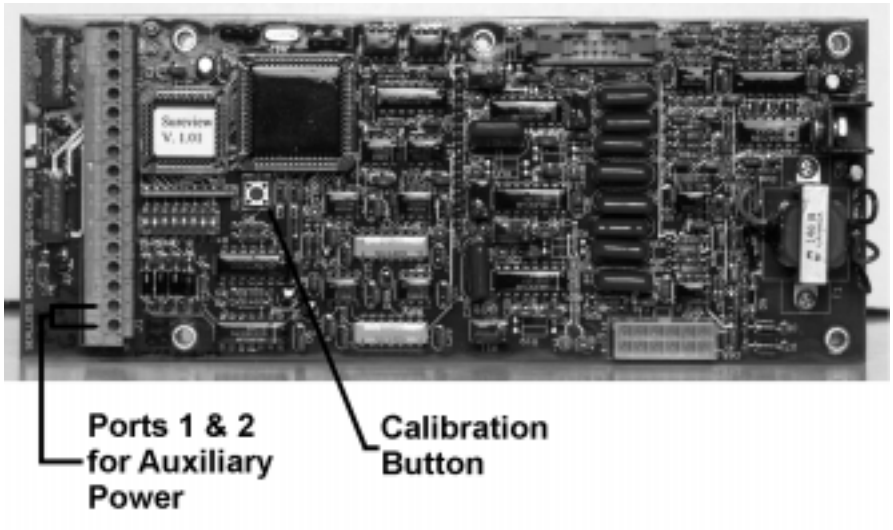
Warning: **These directions must be followed *exactly*, or the calibration will be inaccurate and invalid.**

Procedure for R, S & L frame units only

1. The unit should be completely assembled, EXCEPT **the pump case must be removed!**
2. The main power (usually 460V) to the unit must remain off during the calibration.
3. Hook up and turn on auxiliary power to the circuit board. (See Section 8.2, page 14).

Always turn off the auxiliary power supply before removing the wires from the ports (this prevents shorts).

TOP VIEW OF CIRCUIT BOARD



4. Push and hold down the brown calibration button on the circuit board. After approximately **3** seconds, release the button to put the circuit board into its axial calibration mode (*note: as soon as you push and hold the calibration button down, you will see all the lights on the display board illuminate. Don't release the calibration button until you see all the lights go out except the axial lights in the middle of the display board.*) When you release the button, the axial lights will strobe back and forth. SureView is now searching for the axial endplay (or dead zone). Aggressively push and pull the rotor across its full endplay 3 or 4 times. While pushing and pulling the rotor across its endplay, slowly rotate the shaft. Do this until the shaft has rotated 360 degrees.
5. Push and immediately release the calibration button to save the axial endplay calibration values. The axial lights should stop strobing, and only the 2 middle axial lights should be on.
6. Disconnect the power supply. THE AXIAL CALIBRATION PROCEDURE IS COMPLETE.

Important notes for correcting calibration mistakes:

- pushing in the calibration button accidentally, or even holding it in for less than 3 seconds, will not cause any problems.
- if the calibration button is accidentally pushed in for more than 6 seconds and then released, the circuit will be put in an incorrect calibration mode. If this happens, you can avoid accidentally saving invalid calibration information by immediately turning off the auxiliary power to the circuit board before you push the calibration button again (the values are not saved until the button is pushed in the second time). Therefore, if you meant to hold the calibration button down for 3 to 5 seconds, but accidentally held it in for more than 6 seconds, just turn the auxiliary power off before pushing the calibration button again, and no invalid information will be saved. Then turn the auxiliary power back on and repeat the axial calibration procedure.
- if the auxiliary power to the circuit board is turned off before the calibration button is pushed a second time to save the data, no new data will be saved, and the procedure must be repeated.

10.2 T frame & T-243 frame units only

The axial calibration procedure DOES NOT need to be performed if only the following items are replaced:

1. bearings
2. thrust washers
3. rear tab washer
4. inducer or impeller washer or impeller bolt
5. throttle bushing or throttle bushing housing
6. o-rings

The axial calibration procedure is REQUIRED if ANY of the following items are replaced:

1. rotor
2. stator
3. front or rear bearing housing
4. endnut
5. pump case
6. shaft sleeves (front or rear)
7. aux. impeller or the aux. impeller diffuser
8. any shaft spacers
9. impeller
10. rear sensor housing
11. adapter plate

Warning: ***rear sensor housings are unique to each stator assembly*. If repairing 2 or more units at once, take precautions to keep the rear sensor housings with their respective stators. If a rear sensor housing is put on a different unit, the axial calibration must be done before it will function**.

All calibration steps must be done with the unit off (rotor static) and with auxiliary power supplied to the circuit board. The axial calibration procedure is described below.

Warning: **These directions must be followed exactly, or the calibration will be inaccurate and invalid.**

Procedure for T frame & T-243 frame units only

1. The unit must be completely built, **including the pump case and liner disk.**
2. The main power (usually 460V) to the unit must remain off during the calibration.
3. Hook up and turn on auxiliary power to the circuit board. (*See Section 8.2, Page 14)*
4. Push and hold down the brown calibration button on the circuit board (see picture in above section). After approximately **3** seconds, release the button to put the circuit board into its axial calibration mode *(note: as soon as you push and hold the calibration button down, you will see all the lights on the display board illuminate. Don't release the calibration button until you see all the lights go out except the axial lights in the middle of the display board).* When you release the button, the axial lights will strobe back and forth. SureView is now searching for the axial endplay (or dead zone). Aggressively push and pull the rotor across its full endplay 3 or 4 times. While pushing and pulling the rotor across its endplay, slowly rotate the shaft. Continue to do this until the shaft has rotated 360 degrees. *(note: if the suction opening is too small to get a hand into the pump case to grab the impeller, and the pump is not equipped with an inducer to grab on to, a tool can be obtained from Sundstrand Fluid Handling to assist you (Sundstrand part #: TO01CN04). The tool is made by welding a 1 foot long rod to the end of an impeller bolt so that when this modified impeller bolt is used, the rod will extend out of the suction opening and give you something to push and pull the rotor across its endplay with.)*
5. Push and immediately release the calibration button to save the axial endplay calibration values.
6. Disconnect the power supply. THE AXIAL CALIBRATION PROCEDURE IS COMPLETE.

Important notes for correcting calibration mistakes:

See the end of the previous axial field calibration section **"R, S & L frame units only"**

11.0 Replacing Circuit Boards

Damaged circuit boards can be replaced. The unit does NOT have to be recalibrated. However, each unit has its own specific calibration values, and these calibration values must be loaded onto the new circuit board before it will function accurately. Each unit's calibration values are recorded at the main Sundstrand Fluid Handling office in Arvada, CO. Replacement circuit boards can either be programmed before they are shipped, or the calibration values can be programmed on site by a SureView field technician. For part #, see the section *SureView tools & replacement parts.*

12.0 T-frame rotor endnut and washer installation instructions

The rotor endnut functions as the target for the axial sensor, which determines the axial position of the rotor. Therefore, it is critical that the rear endnut be installed and tightened securely in the same way every time the unit is taken apart. The endnut has a shoulder upon which the tab washer must locate. It is critical that the washer be seated on this shoulder. If the washer slips off this shoulder as the endnut is tightened, it will not let the endnut go all the way on, and the axial sensor will not work properly. To ensure the endnut is installed properly, first hand-tighten the endnut. Then, before tightening the endnut the rest of the way, try to move the washer up and down and back and forth to feel whether the washer is locating on the endnut's shoulder. If it is, keep holding the washer there and hand-tighten the endnut the rest of the way. Then finish tightening it with a torque wrench to the recommended tightness of 50 ft/lbs (as stated in the Standard/non-SureView Instruction Manual). If the washer is not seated properly on the endnut, loosen the endnut and relocate the washer until the washer is located properly on the endnut's shoulder. Then finish tightening the endnut.

13.0 DCS setpoints for wear relay, dry run relay, and 4-20 mA wear % output

The following are the recommended alarm and shut-down points for SureView outputs:

Wear relay: When the wear relay trips, 90% of the allowable clearance has been used, so the unit should be shut down immediately. The 90% trip value is adjustable through the SureView HOST software or by a certified SureView field technician.

Dry run relay: When the dry run relay trips, the unit has a significant amount of vapor bubbles in the motor cavity and corrective action should be taken immediately. If the unit cannot be shut down, the root cause of the vapor bubbles should be determined immediately, and corrected so that the local display's dry run light turns green and the dry run relay resets.

WARNING: If the vapor formation proceeds faster than the internal vent system can handle, the bearing interface could quickly become dry and cause severe damage to the pump.

4-20 mA % wear output: The percent wear output should cause an alarm at 70%, and maintenance should be *scheduled*. The unit should be immediately shut down if it reaches 90%, which corresponds to when the last red light turns on at the local display.

14.0 Repairing Rotors and Stators (replacing the protective liners)

SureView rotors and stators can both be recanned at authorized SureView service centers.

15.0 Retrofitability Information and Instructions

New Parts (unique to SureView)

Longer stator and rotor
Longer base (but identical footprint to the standard design)
Rear sensor housing
Rear bearing housing (R&S frames only)
Longer pipe or tubing runs for heat exchangers
Rotor end nut

Interchangeable Parts

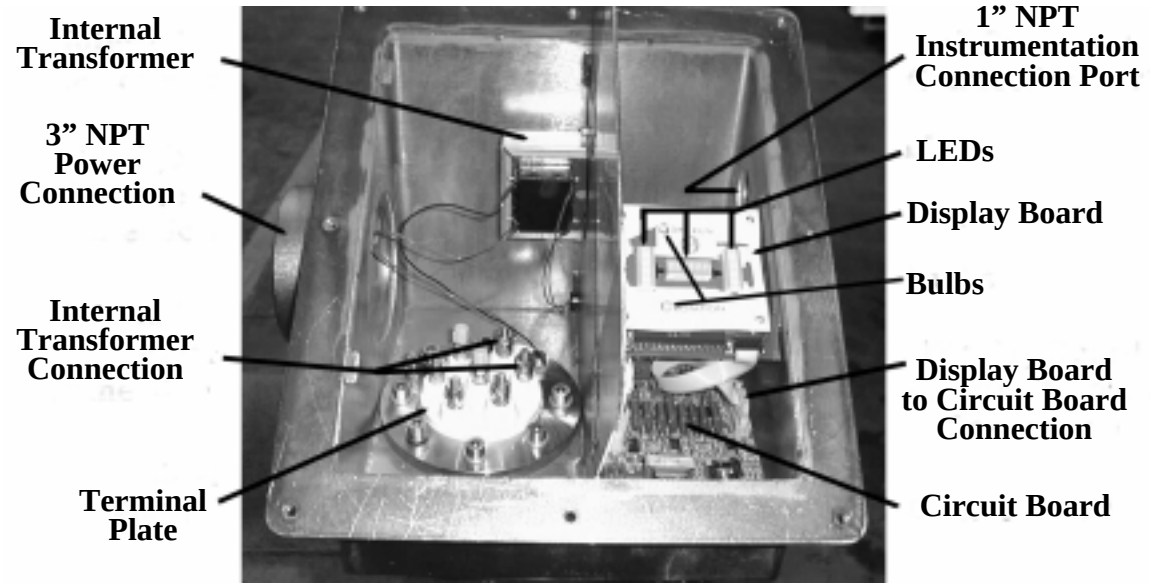
Wet ends (pump cases, impellers, inducers, liner discs, adapter plates)
Bearings, shaft sleeves, thrust washers
Miscellaneous hardware (nuts and bolts, o-rings)

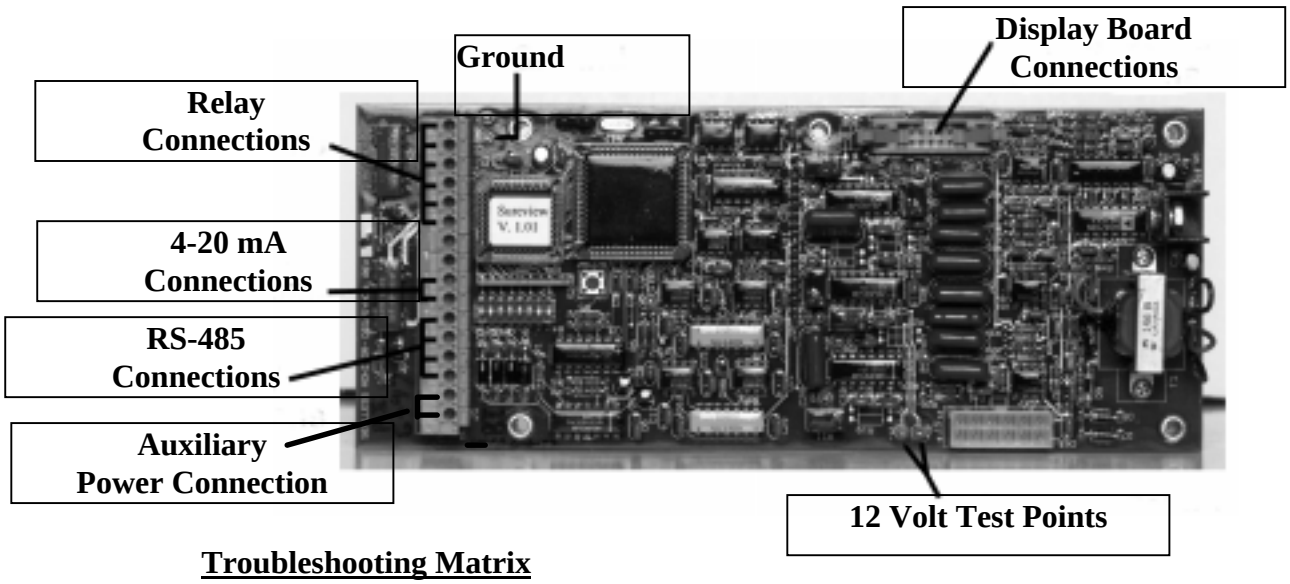
Rotors and stators remain repairable (the liners can be replaced at authorized SureView service centers).

Retrofitting Instructions

Standard part:	**Replaced with SureView part:**
for all frame sizes:	*for all frame sizes:*
stator	stator
rotor	rotor
rotor endnut	rotor endnut
baseplate	baseplate (same footprint as standard)
rear *bearing monitor* housing (T frame)	rear *sensor* housing
rear *bearing* housing (R & S Frame)	rear *bearing* housing plus rear sensor housing
R-frame o-ring for rear bearing housing (14-199)	R-frame o-ring for rear sensor housing (14-288)
S-frame o-ring for rear bearing housing (14-193)	S-frame o-ring for rear sensor housing (14-196)

16.0 Troubleshooting





Troubleshooting Matrix

R = radial sensor problems
A = axial sensor problems
O = special customer output problems (relays, 4-20 mA output, RS-485 serial link, addressability)
D = direction of rotation sensor problems
DR = dry run sensor problems
M = miscellaneous problems

Sundstrand Field Service phone #: 303-425-0800

type	description of problem	possible causes	recommended action (action # goes with cause #)
R, A, D, DR	all local display lights are off, and **unit is ON**	1. power lost to circuit board (verify this by having your *instrumentation specialist* check '12 volt testpoints' -- see *note #1* below for details)	1. ensure high-voltage to 12-volt internal transformer connections in junction box are connected to both the high voltage studs and the end of the circuit board
		2. display board connection to circuit board loose, broken, or corroded	2. ensure display board plugged into circuit board, then check for corrosion (if none, replace display board (part# PLO1CN22C00)
		3. damaged or corroded display board	3. replace display board (part# PLO1CN22C00)
		4. circuit board problem	4. contact Sundstrand field service
R,A	all local display lights are off, and **unit is OFF**	5. local display board is NOT lit up when the unit is off (this is normal)	5. there is NOT a problem, ensure the lights come on next time the unit is running
R,A	one entire bank of LED lights off (radial or axial), other banks on	6. burnt out LED lights	6. replace display board (part# PLO1CN22C00)
		7. loose, broken or corroded LED connections	7. replace display board (part# PL01CN22C00)
		8. loose, broken or corroded connection between display board and circuit board	8. check for corrosion or looseness and retry. If not fixed, replace display board (part# PL01CN22C00)
R,A	2 lights or more in either radial or axial direction upon startup w/ new bearings	9. tolerance stackup problem	9. continue to run until a yellow radial or axial light comes on, then shut down and inspect parts
		10. improper assembly	10. refer to the assembly section in this manual
		11. excessive rotor/shaft vibration	11. if unit is running off its design point, change flow to move closer to design point (vibration can also be caused by imbalance, bent shaft, cavitation, or damaged parts)
		12. inaccurate calibration	12. contact Sundstrand field service
		13. circuit board problem	13. contact Sundstrand field service
		14. real bearing wear (especially if started up in a dry condition)	14. continue to run until a yellow radial or axial light comes on, then shut down and replace bearings
R,A	out of sequence lights on (i.e. lights #1,4 & 5 on)	15. loose, broken or corroded LED connections	15. clean off corrosion and retry. If no corrosion, replace display board (part# PL01CN22C00)
		16. circuit board problem	16. contact Sundstrand field service
R,A	all 10 radial lights (front or rear), or all 5 axial lights (front or rear) blinking	17. excessive shaft displacement has occurred in that location (usually due to bearing wear)	17. immediately shut down the unit and replace the bearings
A	excessive **front** axial lights upon startup w/ new bearings	18. axial field calibration needed to be done, but wasn't	18. see the *Axial Field Calibration* section to verify whether recalibration was needed. If it was, shut the unit down immediately and perform the calibra-tion. Axial sensor won't work properly until then
		19. circuit board problem (axial wear dip switch)	19. contact Sundstrand field service
		20. tab washer behind endnut left out of rear rotor assembly	20. shut down, remove rear sensor housing, and check whether there's a tab washer between the rotor endnut and the shaft

		21. unit not built w/ stator's original rear sensor housing	21. investigate whether a different sensor housing was accidentally installed. If so, and the original sensor housing cannot be located, the *Axial Field Calibration* procedure must be done (see that section for instructions)
		22. damage to 4-pin electrical connector between stator and rear sensor housing	22. shut down , remove the rear sensor housing and inspect the 4-pin connection. If damaged, contact Sundstrand Field service for repair
		23. internal axial sensor connection damaged	23. contact Sundstrand field service
A	excessive **rear** axial lights upon startup w/ new bearings	24. axial field calibration needed to be done, but wasn't	24. see the *Axial Field Calibration* section to verify whether recalibration was needed. If it was, shut the unit down immediately and perform the calibration. Axial sensor won't work properly until then
		25. circuit board problem (axial wear dip switch)	25. contact Sundstrand field service
		26. tab washer not seated properly on the rotor's endnut	26. shut down, remove rear sensor housing, and check whether the tab washer between the rotor endnut and the shaft is seated properly. If not, remove endnut and reseat a new tab washer.
		27. unit not built w/ stator's original rear sensor housing	27. investigate whether a different sensor housing was accidentally installed. If so, and the original sensor housing cannot be located, the *Axial Field Calibration* procedure must be done (see that section for instructions)
		28. damage to 4-pin electrical connector between stator and rear sensor housing	28. shut down , remove the rear sensor housing and inspect the 4-pin connection. If damaged, contact Sundstrand Field service for repair
		29. internal axial sensor connection damaged	29. contact Sundstrand field service
A	blinking axial light (which indicates the rotor's current axial position) stops blinking	30. display board is currently locked due to data being collected via the customer RS-485 serial connection and the HOST software	30. stop collecting data or close the HOST software, and verify the light starts blinking at a regular, even interval again. If not, contact Sundstrand field service.
		31. circuit board problem (high likelihood)	31. contact Sundstrand field service
D	direction of rotation light off, other lights on	32. damaged direction of rotation sensor	32. contact Sundstrand field service
		33. internal direction or rot. sensor connection damaged	33. contact Sundstrand field service
		34. burnt out bulb	34. replace display board (part# PL01CN22C00)
		35. loose, broken, or corroded bulb connection	35. replace display board (part# PL01CN22C00)
		36. damaged or corroded display board	36. replace display board (part# PL01CN22C00)
D	direction of rotation light blinking red	37. main (high voltage) power leads connected in wrong order	37. shut down, and switch 2 high voltage leads. Restart and verify light turns green
DR	dry run light blinking red	38. vapor in motor cavity due to cavitation of main or aux. impeller, flashing, or presence of vapor in suction piping	38. increase suction pressure, operate the unit closer to its design point, or eliminate vapor in the suction piping
DR	dry run light off, other lights on	39. circuit board problem (dry run dip switch off)	39. contact Sundstrand field service
		40. burnt out bulb	40. replace display board (part# PL01CN22C00)
		41. loose, broken, or corroded bulb connection	41. replace display board (part# PL01CN22C00)
		42. damaged or corroded display board	42. replace display board (part# PL01CN22C00)
DR	dry run sensor not responding (always blinking red)	43. have continuous presence of vapor bubbles in the motor cavity	43. increase suction pressure, operate the unit closer to its design point, or eliminate vapor in the suction piping
		44. damage to 4-pin electrical connector between stator and rear sensor housing	44. shut down , remove the rear sensor housing and inspect the 4-pin connection. If damaged, contact Sundstrand Field service for repair
		45. internal dry run sensor connection damaged	45. contact Sundstrand field service
		46. circuit board inadequately grounded	46. contact Sundstrand field service
		47. dry run sensor damaged	47. contact Sundstrand field service
O	RS-485 serial communication link not connecting	48. loose, broken or corroded connections to the circuit board or within the serial link	48. check the 4-wire RS-485 connections to the circuit board for corrosion or looseness; and check the RS-485 loop for continuity
		49. 4-wire RS-485 connection wired to circuit board in wrong order	49. rewire the RS-485 connection as described in the *Customer Connections* section of this manual
		50. customer computer problem	50. contact your computer systems specialist for assistance, or contact Sundstrand field service
		51. circuit board problem	51. contact Sundstrand field service
		52. power lost to circuit board (verify this by having your *instrumentation specialist* check '12 volt testpoints' -- see *note #1* below for details)wrong port inside HOST software selected	52. ensure high-voltage to 12-volt internal transformer connections in junction box are connected to both the high voltage studs and the end of the circuit board
		53. wrong port inside HOST software selected	53. inside the HOST software, select "port," then select a highlighted port, then choose OK
		54. type/size of wire used in serial link inadequate	54. consult *your instrumentation specialist* for recommendations

		55. inadequately shielded wire used in serial link (have noise in RS-485 signal)	55. consult *your instrumentation specialist* for recommendations
O	relays fail to actuate, or actuates incorrectly (backwards)	56. loose, broken or corroded relay connections to the circuit board or within the external relay loop	56. check the relay connections to the circuit board for corrosion or looseness; and check the relay loop for continuity
		57. damaged connection within external relay loop	57. consult *your instrumentation specialist* for recommendations
		58. circuit board problem (failed relay)	58. contact Sundstrand field service
		59. relay not wired to ground on circuit board's connection strip	59. rewire the relay connection as described in the *Customer Connections* section of this manual
		60. power lost to circuit board (verify this by having your *instrumentation specialist* check '12 volt testpoints' -- see *note #1* below for details)type/size of wire used in loop inadequate	60. check whether high-voltage to 12-volt internal transformer (inside junction box) is connected to high voltage studs
		61. type/size of wire used in loop inadequate	61. consult *your instrumentation specialist* for recommendations
		62. relay 'open' when it should be 'closed,' or vice-versa	62. relay wired incorrectly, so rewire it as described in the *Customer Connections* section of this manual
O	4-20 mA analog output (wear %) not reading properly	63. loose, broken or corroded loop connections to the circuit board or within the external 4-20 mA loop	63. check the 4-20 mA connections to the circuit board for corrosion or looseness; and check the 4-20 mA loop for continuity
		64. 4-20 mA loop improperly wired	64. consult *your instrumentation specialist* for recommendations
		65. 4-20 mA loop inadequately powered (must be powered externally)	65. consult *your instrumentation specialist* for recommendations
		66. circuit board problem	66. contact Sundstrand field service
		67. poor 4-20 mA loop ground	67. consult *your instrumentation specialist* for recommendations
		68. type/size of wire used in loop inadequate	68. consult *your instrumentation specialist* for recommendations
		69. inadequately shielded wire used in loop (have noise in 4-20 signal)	69. consult *your instrumentation specialist* for recommendations
		70. power lost to circuit board (verify this by having your *instrumentation specialist* check '12 volt testpoints' -- see *note #1* below for details)	70. ensure high-voltage to 12-volt internal transformer connections in junction box are connected to both the high voltage studs and the end of the circuit board
M	sight glass fogged up	71. water vapor leaking into the junction box through the high voltage conduit	71. ensure conduit leading to junction box is sealed such that vapor cannot enter the junction box via conduit; **with the unit off and locked out**, wipe out water that has collected in the junction box
		72. water vapor leaking into the junction box through the 1" customer connection port on the junction box	72. ensure junction box's 1" customer connection port is plugged, or seal the conduit such that vapor cannot enter the junction box via the conduit; **with the unit off and locked out**, wipe out water that has collected in the junction box
		73. no leak paths into the junction box are present, but the water vapor that's in the junction box when it's sealed is condensing on the sight glass	73. nitrogen purge the junction box before sealing it, or apply anti-fogging agent to the inner side of the sight glass

troubleshooting notes:

note #1: Refer to the picture at the beginning of this section for the location of the circuit board's "12 volt testpoints." With the unit running, use a voltmeter to check if there is 12 volts between ground and the 12 volt testpoint. If yes, the circuit board is being powered properly. If not, power has been lost to the circuit board, or is not adequate.

17.0 Recommended Spare Parts

With the exception of the following, refer to the list of recommended spare parts in the Standard Instruction Manual:

- the rotor endnut is not a recommended spare part for SureView units

- *on R & S frame units*, the o-ring changed on the rear bearing housing (now called the rear sensor housing). On R-frames it changed from 14-199TA to 14-288 ('TA' = teflon). On S-frames it changed from 14-193TA to 14-196TA ('TA' = teflon).
- there are no <u>additional</u> spare parts recommended for SureView units

18.0 SureView tools & Replacement parts

T= tool R= replacement parts

type	part name	description	used for	Sundstrand Part #
T	12 volt power supply	12 volt DC power supply, plugs into standard 120 volt outlet	axial field calibration	77-077
T	GLPT insulating varnish	arc resisting varnish	protecting the remaining "feet" of resistors that must be removed from the circuit boards when linking (daisy-chaining) multiple units together	77-078
T	T-frame calibration tool (needed for pump cases with small inlet openings)	impeller bolt with an extension rod and tightening bolt welded to it	doing the axial calibration procedure on T-frames whose pump case inlet diameter is too small for a hand to fit into	TO01CN04
R	circuit board fuse	1.2 amp slo-blo fuse 250 volt	replacing a blown circuit board fuse	70-584
R	spare circuit board including new display board	circuit board including new display board (must be ordered <u>for a particular unit</u>)	replacing damaged circuit board	PLO1CN22000
R	display board only	local display board	replacing damaged display board	PLO1CN22C00
R	internal transformer (high voltage to 12 volt)	transformer located inside junction box used to power circuit board	replacing damaged transformer	67-992
R	sight glass	sight glass in front of display board	replacing broken or scratched sight glass	LE03CN01
R	sight glass housing	housing that holds sight glass	replacing damaged sight glass housing	HO11CN35AF
R	sight glass screws	flat, socket head screws	holds sight glass housing on (4 needed per housing)	03-215DJ
R	sight glass gasket	gasket for sealing lens	replacing damaged or worn out gasket	GK01CN06
R	R&S frame junction box gasket	gasket for sealing cover	replacing damaged or worn out gasket	GK01CN10
R	T&L frame junction box gasket	gasket for sealing cover	replacing damaged or worn out gasket	GK01CN11
R	high voltage terminal plate & o-ring (R&S frames only)	7-stud terminal plate and sealing o-ring	replacing terminal plate & o-ring on left side of junction box	PL01CU02 14-001UR
R	high voltage terminal plate & o-ring (T&L frames only)	7-stud terminal plate and sealing o-ring	replacing terminal plate & o-ring on left side of junction box	PL01CN21 14-065UR

19.0 Initial startup procedure

- Before starting a pump, someone should be positioned at the pump's display board to view the color of the **direction of rotation light** when the pump is turned on. The pump must be turned on for at least 3 seconds before SureView is able to display what direction the rotor is rotating. If the red light comes on, the pump should be immediately shut down, and any two of the three motor leads switched to provide proper direction of rotation. Restart the unit and verify that the direction or rotation light is green.
- Once direction of rotation is properly established, start the motor and check the "dry run" light. If the light is green, you can continue running the pump. If the light is red, run for 15-20 seconds, then shut off for one minute. This helps purge the pump and motor of vapors. You may have to repeat this procedure several times.
- **Expected Lights:** at initial startup or after replacing bearings, there should be one front radial and one rear radial light on; one front axial and one rear axial light on; the dry run light should be green; and the direction of rotation light should be green. If this is not the case, corrective action needs to be taken. See the *Troubleshooting* section for help.

- As the pump runs for the first minute, the **dry run light** might be red until all the trapped vapor bubbles are flushed out of the motor. Then it should turn green, and stay green. If it remains red, there are either vapor bubbles trapped inside the motor or there are vapor bubbles migrating into the motor. Corrective action must be taken to eliminate them.
- **For further startup notes, refer to the *standard* (non-SureView) Instruction Manual**

20.0 Replacing the high voltage terminal plate (electrical feedthrough)

<u>WARNING</u>: Not following these directions could cause the direction of rotation sensor to function improperly.

To replace the terminal plate, *carefully* follow these steps:

- **DANGER!!** Ensure the power is locked out, then remove the high voltage leads.

- Mark which 2 terminal studs have the internal transformer wires connected to them, then remove the 2 transformer leads (see the picture in the *Troubleshooting* section).
- Remove the bolts that hold down the terminal plate.
- Using "crow's feet" (small 90 degree pry bars), pry on the underneath side of the terminal plate's stainless steel flange to lift the terminal plate out of its hole.

WARNING: The direction of rotation circuit board is attached to the underneath side of the terminal plate. Before removing any nuts or leads, carefully mark:

A. which side of the direction of rotation circuit board is facing down, as well as which studs it is mounted on

B. which stator leads are going to which studs (*each of the 3 studs has a letter by it*).

On the *<u>new</u>* terminal plate, the direction of rotation circuit board must be installed in EXACTLY the same position it was on the original terminal plate, and the high voltage motor leads must be wired EXACTLY the same way (or the direction of rotation sensor will read the opposite of what it should).

- Remove the high voltage stator leads and the direction of rotation circuit board.

Be careful not to damage the direction of rotation sensor by scratching its surface with

sharp tools.

- Ensure the NEW terminal plate's o-ring is in place.
- Install the direction of rotation circuit board, and wire the high voltage motor leads onto the *new* terminal plate in EXACTLY the same position they were on the old terminal plate.
- Carefully stuff the excess wires down into the neck of the junction box..
- Grease the terminal plate's o-ring with petroleum jelly, and gently push the new terminal plate back into the hole. It may be necessary to tap on the stainless steel portion of the terminal plate with a rubber mallet to get it into the hole.

DO NOT tap on the studs, as they can break off.

- Bolt down the terminal plate.
- Reconnect the 2 internal transformer leads.

The procedure is complete. The stator can be returned to service.

21.0 Conduit requirements for junction box connections (high & low voltage)

The junction box is designed to protect the circuit board from the outside environment. However, if precautions are not taken, water vapor can get inside the junction box via the electrical conduit, or when the junction box cover is removed. When water vapor gets inside the junction box, it can cause several problems, including fogging of the sight glass or corrosion and shorting of the circuit board. Therefore, the following is recommended:

- There must be a seal on the inside of all conduit leading to the junction box such that water vapor cannot travel through the conduit and into the junction box.
- The 1" NPT port on the circuit board's side of the junction box should always be plugged if it is not being used for external connections to the circuit board. The plug should be coated with pipe dope or teflon tape to prevent any leak paths for water vapor.
- the junction box's cover should remain *bolted on* unless the pump is being serviced.

22.0 The use of VFDs (Variable Frequency Drives)

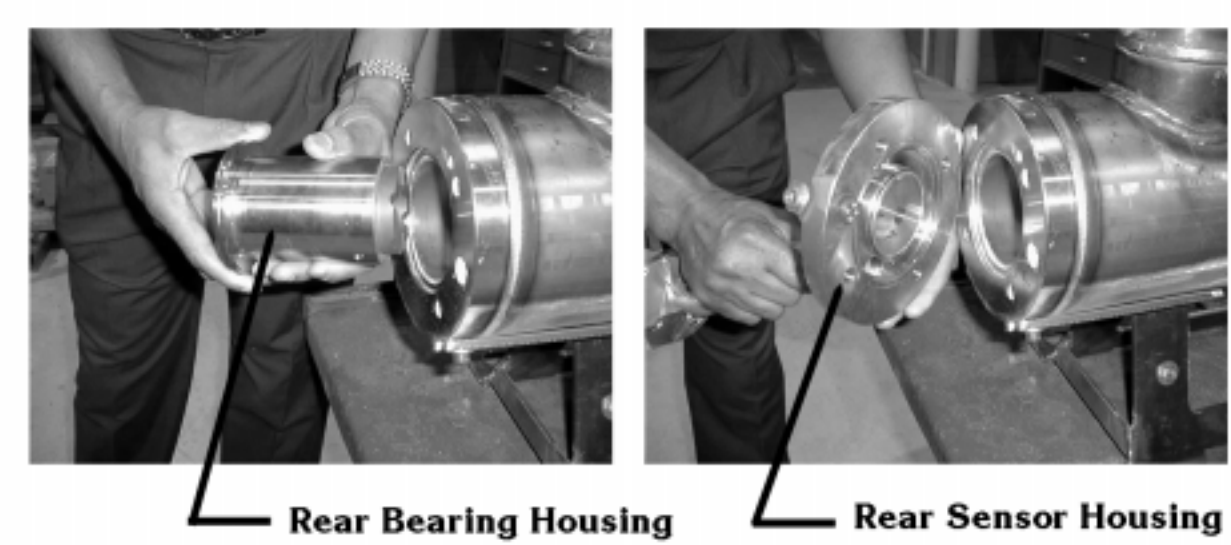
When VFDs transform line frequency to a higher or lower frequency, they create electrical noise. This noise has an adverse effect on SureView radial sensors, both in the front and in the rear. Therefore, SureView radial sensors **cannot** be used to sense radial wear if a VFD is being used to drive it. The VFD noise can also adversely effect the relay outputs, the 4-20 mA output, and the RS-485 serial communication link. The axial sensor, the dry run sensor, and the direction of rotation sensor are not adversely effected by the VFD noise, and can be used. However, **Sundstrand does not recommend using a VFD on any SureView unit since the ability to sense radial wear is critical to understanding the health of the unit.**

23.0 SureView Assembly Procedure

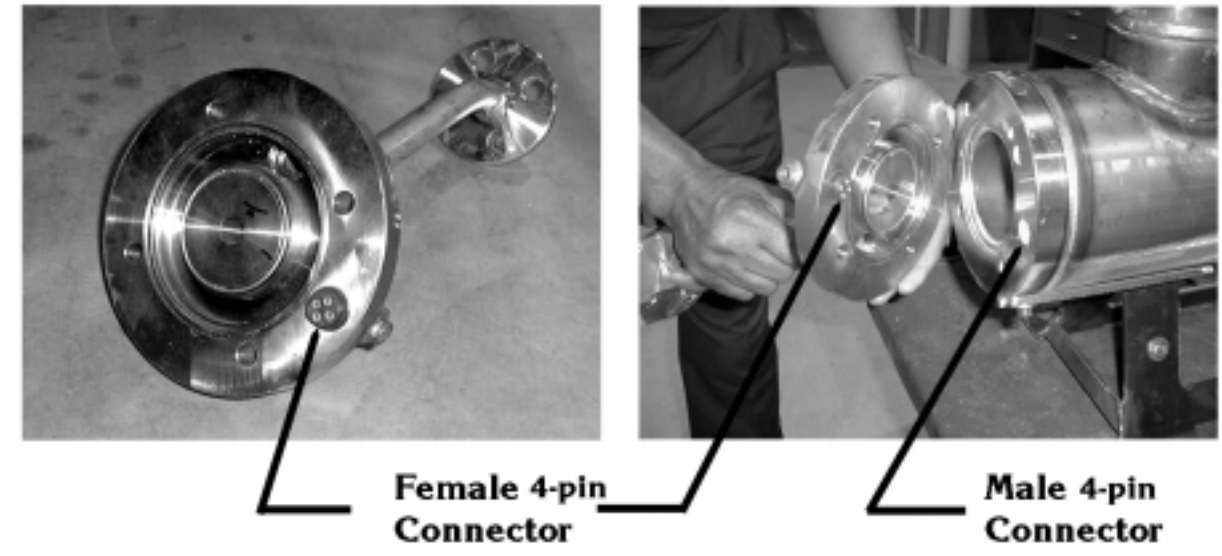
The assembly procedure for SureView units is the same as for standard (non-SureView) units with the following exceptions:

23.1 R, S, T & L frames

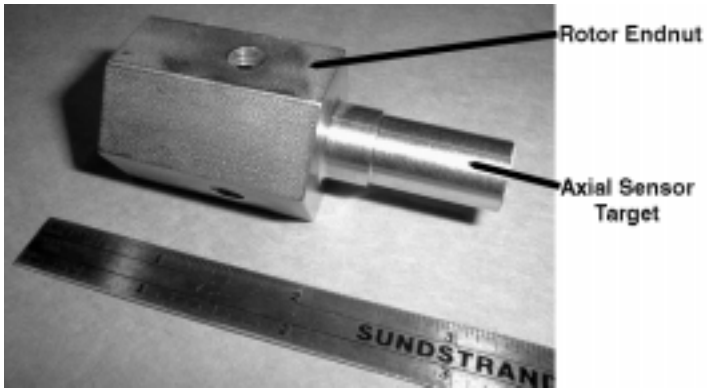
Except for the following changes, refer to the *Standard (non-SureView) Instruction Manual* for the complete assembly procedure.



SureView units have a 2-piece rear bearing housing and rear sensor housing assembly, as opposed to the 1-piece design on non-SureView units. First insert the rear bearing housing into the stator with the bearing clamping setscrew towards the top, then bolt on the rear sensor housing.



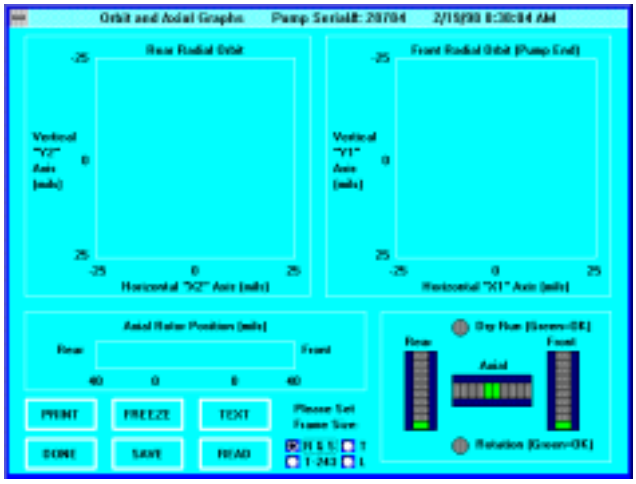
The rear sensor housing has a 4-pin female connector that mates with a 4-pin male connector on the rear of the stator. When installing the rear sensor housing, ensure that the connectors are lined up, and that the face of the rear sensor housing stays as parallel as possible to the stator so that the *male* pins don't get damaged when the connectors are pushed together and the rear sensor housing is tightened. (The studs should first be threaded into the stator. These studs will help align and guide the sensor housing during assembly.)



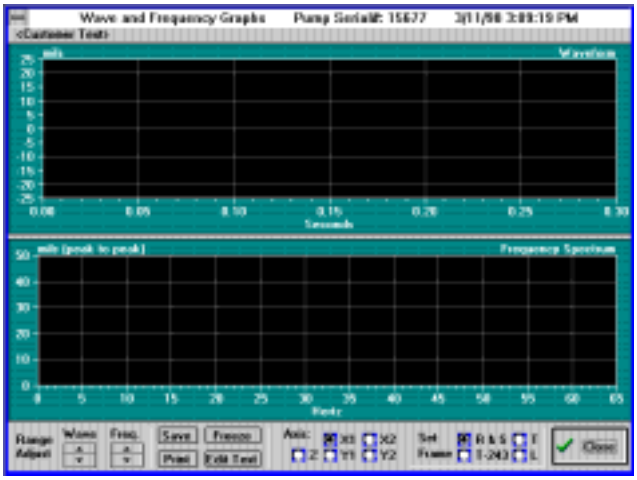
The SureView R & S frame rotor endnut (shown left) is different than the non-SureView endnut. The SureView endnut contains the axial sensor's target. However, the procedure for assembling both the SureView and the standard endnut is the same (refer to the *Standard Instruction Manual* for details)

24.0 Advanced graphical capability & analysis via the SureView HOST Software

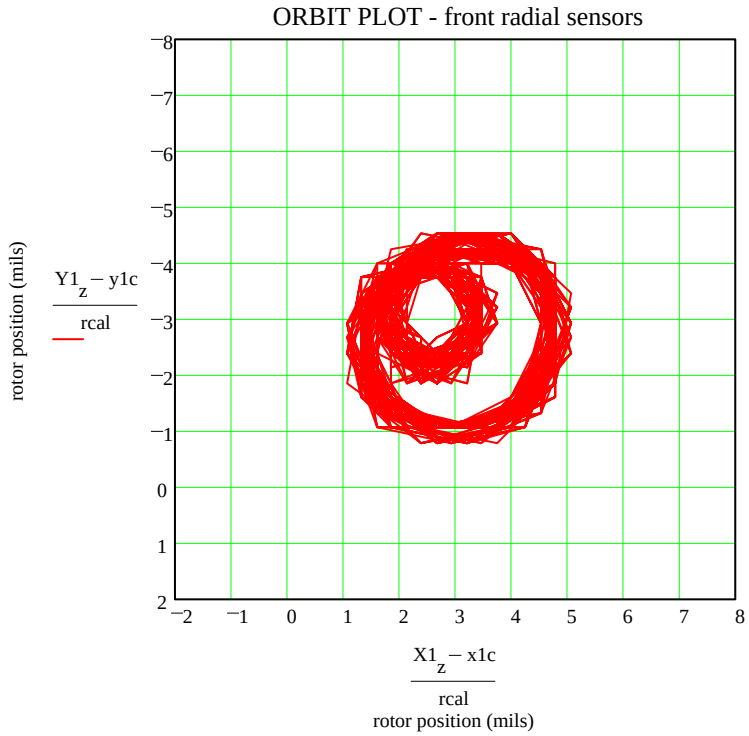
HOST software's *Real-time & Orbit* screen



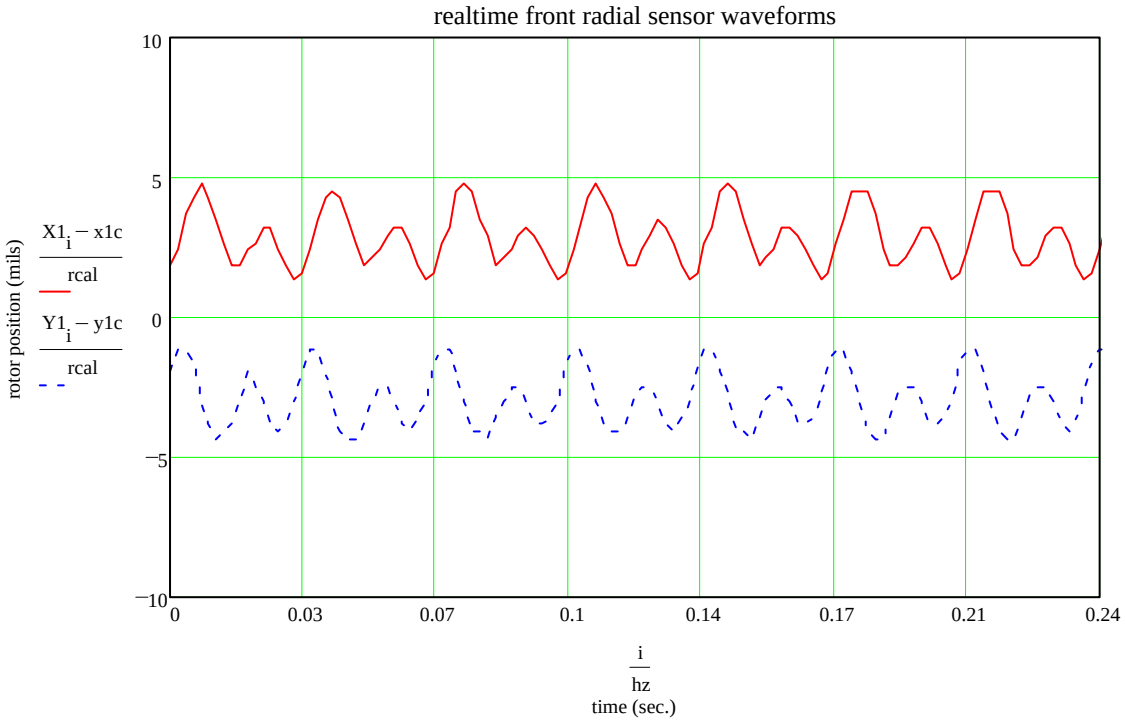
HOST software's *FFT/Waveform screen*



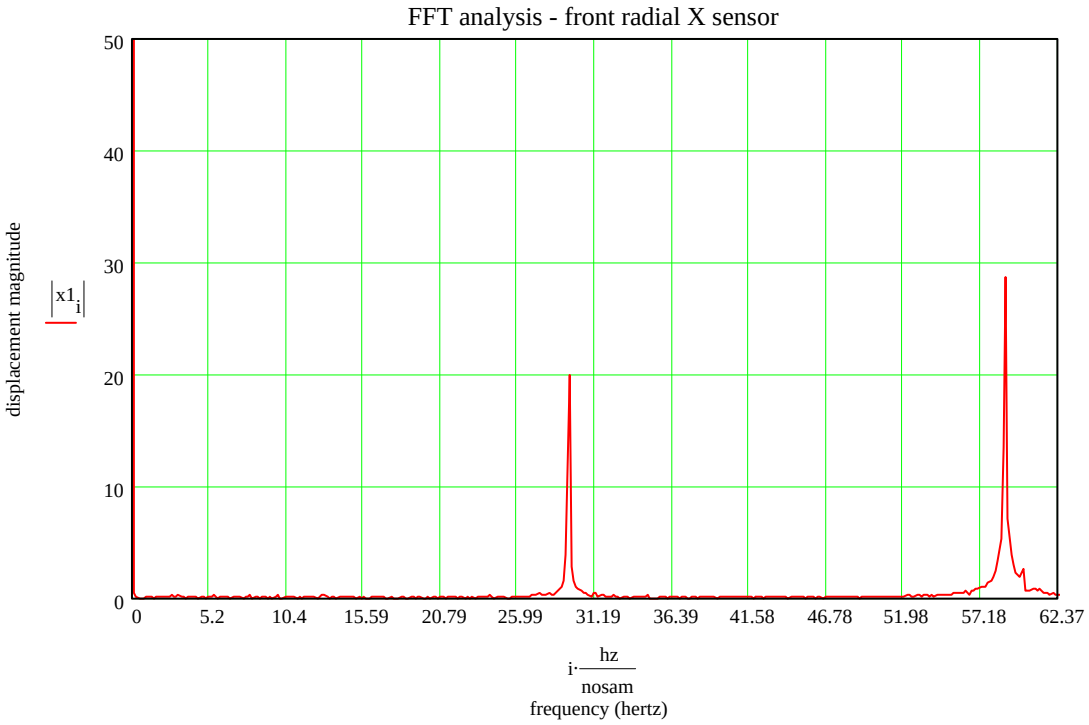
Shaft Orbits



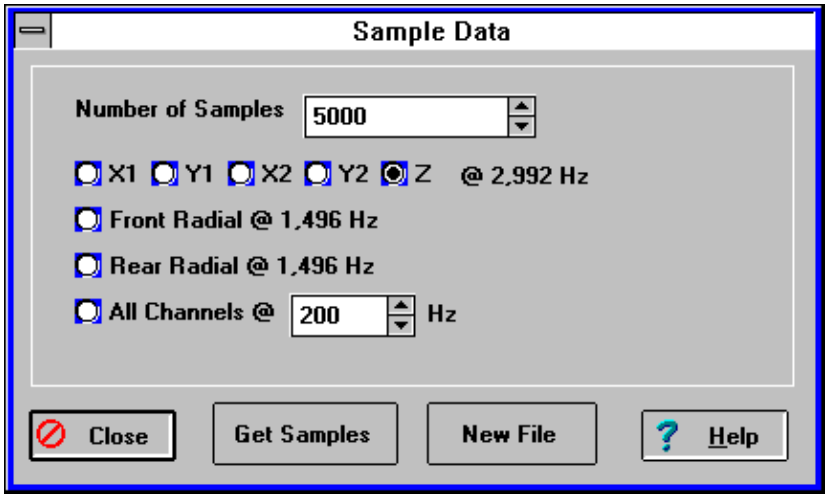
Waveform analysis



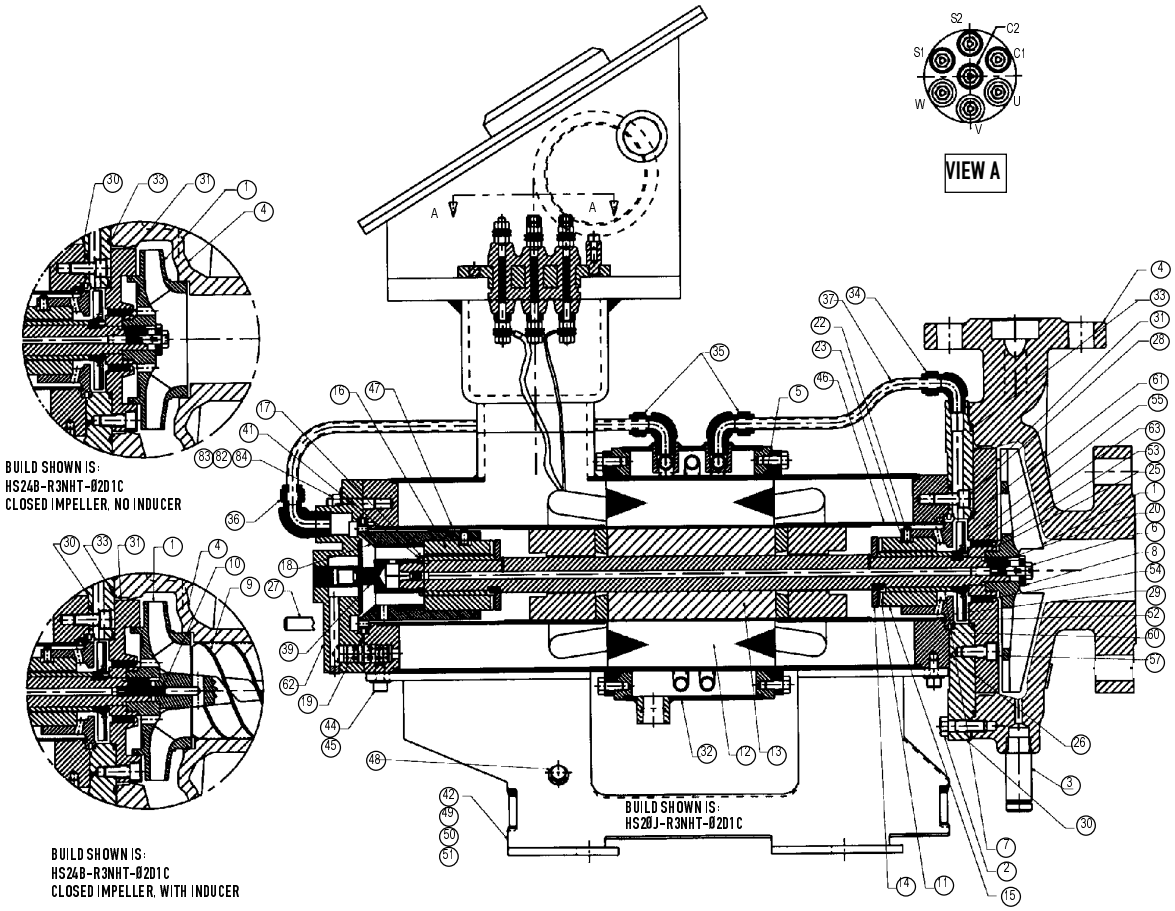
FFT analysis



Data sampling menu

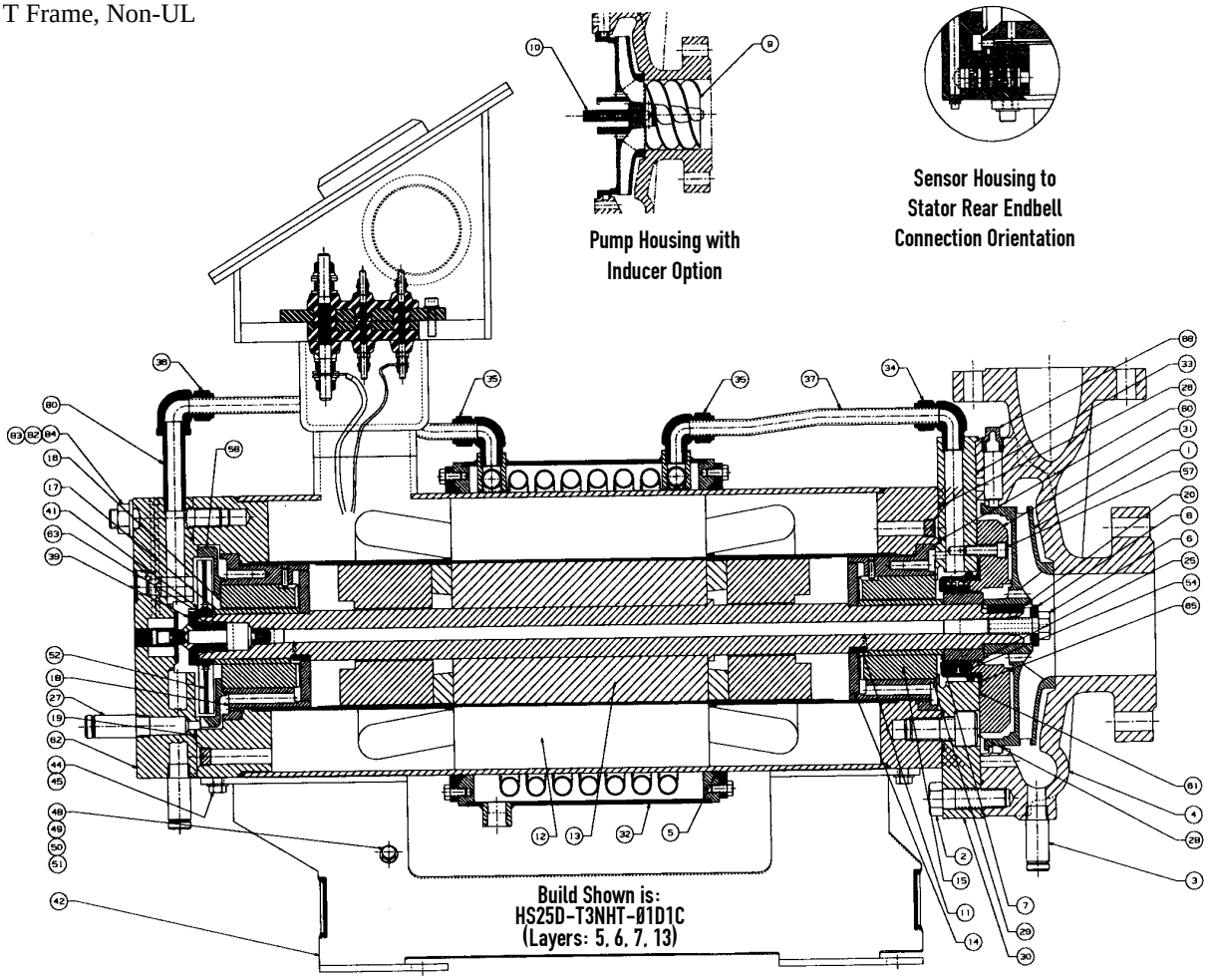


Layout, Pump, R & S Frame



ITEM	QTY.	DESCRIPTION	ITEM	QTY.	DESCRIPTION
1	1	IMPELLER	37	29"	TUBE, CIRCULATION
2	8/10	SCREW, PUMP CASE/ADAPTER	39	1	NUT, END ASSY., SUREVIEW
3	1	PLUG, PUMP CASE, DRAIN	41	1	WASHER, TAB ENDNUT
4	1	HOUSING, PUMP	42	1	BASEPLATE ASSY.
5	2	O-RING, HEAT EXCHANGER	44	4	SCREW, BASE/STATOR
6	1	BOLT, IMPELLER	45	4	WASHER, FLAT, BASE/STATOR
7	1	SLEEVE, SHAFT, FRONT	48	1	SCREW, GROUND, BASE
8	1	WASHER, IMPELLER	49	1	WASHER, LOCK, GROUND, BASE
9	1	INDUCER	50	1	WASHER, FLAT, GROUND, BASE
10	1	INDUCER STUD	51	1	NUT, GROUND BASE
11	2	KEY, SHAFT SLEEVE	52	1	AUX. IMPELLER
12	1	STATOR ASSEMBLY	53	1	PIN, BUSHING (HS/HP ONLY)
13	1	ROTOR ASSEMBLY	54	2	BUSHING, THROTTLE, (HS/HP ONLY)
14	2	WASHER, THRUST	55	1	RING, RETAINING
15	1	BEARING, FRONT	57	4	SCREW, ADAPTER/LINER DISK
16	1	BEARING REAR	60	1	O-RING, ADAPTER/STATOR ENDBELL
17	1	SLEEVE, SHAFT, REAR	61	1	O-RING, ADAPTER/LINER DISK
18	1	HOUSING, REAR BEARING	62	1	HOUSING, SENSOR
19	1	O-RING, SENSOR HOUSING	63	1	KEY, AUX. IMPELLER
20	1	KEY, IMPELLER	82	4	STUD, SENSOR HOUSING
22	2	SCREW, BEARING, SET	83	4	NUT, SENSOR HOUSING
23	2	PLATE, BEARING, SET	84	4	WASHER, SENSOR HOUSING
25	1	SLEEVE, BUSHING (SPACER HT)	90	8	STUD, NAMEPLATE
26	1	O-RING, ADAPTER/STATOR ENDBELL	91	8	NUT, NAMEPLATE
27	1	PLUG, SENSOR HSG. DRAIN	92	8	LOCK WASHER, NAMEPLATE
28	4	SCREW, ADAPTER/STATOR	100	1	NAMEPLATE, CUSTOMER
29	1	HOUSING, BEARING FRONT	101	1	NAMEPLATE, WARNING
30	1	ADAPTER	110	1	TAG, GROUNDING PORT
31	1	DISK LINER	111	1	TAG, FLUSH PORT (HS ONLY)
32	1	HEAT EXCHANGER ASSY.	112	1	TAG, WARNING (HQ ONLY)
33	1	O-RING, PUMP CASE/ADAPTER	114	1	TAG, JACKET
34	1	FITTING, TUBE, ADAPTER	116	1	TAG, DRY OPERATION
35	2	FITTING, TUBE, HEAT EXCH.	118	1	TAG, O-RINGS
36	1	FITTING, TUBE, SENSOR HSG.			

Layout, T Frame, Non-UL



ITEM	QTY.	DESCRIPTION	ITEM	QTY.	DESCRIPTION
1	1	IMPELLER	41	1	WASHER, TAB ENDNUT
2	10/12/16	SCREW, PUMP CASE/ADAPTER	42	1	BASEPLATE ASSEMBLY
3	1	PLUG, PUMP CASE, DRAIN	44	4	SCREW, BASE/STATOR
4	1	HOUSING, PUMP	45	4	WASHER, FLAT, BASE/STATOR
5	2	O-RING, HEAT EXCHANGER	48	1	SCREW, GROUND, BASE
6	1	BOLT, IMPELLER	49	1	WASHER, LOCK, GROUND, BASE
7	1	SLEEVE, SHAFT, FRONT	50	1	WASHER, FLAT, GROUND, BASE
8	1	WASHER, IMPELLER	51	1	NUT, GROUND BASE
9	1	INDUCER	52	1	AUX. IMPELLER
10	1	INDUCER STUD	54	1/2	BUSHING, THROTTLE
11	2	KEY, SHAFT SLEEVE	57	8	SCREW, ADAPTER/LINER DISK
12	1	STATOR ASSY.	58	1	RETAINER, REAR BRG.
13	1	ROTOR ASSY.	60	1	O-RING, ADAPTER/STATOR ENDBELL
14	2	WASHER, THRUST	61	1	O-RING, ADAPTER/LINER DISK
15	1	BEARING, FRONT	62	1	HOUSING, SENSOR
16	1	BEARING, REAR	63	1	KEY, AUX. IMPELLER
17	1	SLEEVE, SHAFT, REAR	65	1	HSG, THROTTLE BSHG.
18	1	HSG., REAR BRG.	74	-	SPACER, THROTTLE BUSHING (HT ONLY)
19	1	O-RING, REAR BRG. HSG.	80	-	PIPE, SENSOR HOUSING
20	1	KEY, IMPELLER	82	6	STUD, SENSOR HOUSING
25	1	SLEEVE, BUSHING	83	6	NUT, SENSOR HOUSING
26	1	O-RING, ADAPTER/STATOR ENDBELL	84	6	WASHER, SENSOR HOUSING
27	1	PLUG, SENSOR HSG. DRAIN	88	-	PIPE PLUG, PUMP HOUSING
28	8	SCREW, ADAPTER/STATOR	90	8	STUD, NAMEPLATE
29	1	HOUSING, BEARING FRONT	91	8	NUT, NAMEPLATE
30	1	ADAPTER	92	8	LOCK WASHER, NAMEPLATE
31	1	DISK LINER	100	1	NAMEPLATE, CUSTOMER
32	1	HEAT EXCHANGER ASSY.	101	1	NAMEPLATE, WARNING
33	1	O-RING, PUMP CASE/ADAPTER	110	1	TAG, GROUNDING PORT
34	1	FITTING, TUBE, ADAPTER	111	1	TAG, FLUSH PORT (HS ONLY)
35	2	FITTING, TUBE, HEAT EXCH.	112	-	TAG, WARNING (HQ ONLY)
36	1	FITTING, TUBE, R. BRG. HSG.	114	1	TAG, JACKET
37	33”	TUBE, CIRCULATION	116	1	TAG, DRY OPERATION
39	1	NUT, END ASSEMBLY, SUREVIEW	118	1	TAG, O-RINGS

SUNDSTRAND™ FLUID HANDLING

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