LIQUID SOLIDS CONTROL

INSTRUCTION MANUAL

MODEL 326 X1 & X2
PROCESS REFRACTOMETER

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LSC Model 326

PROCESS REFRACTOMETER

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INSTRUCTION MANUAL

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1. INTRODUCTION

This Manual is designed to give operations and maintenance personnel a complete understanding of the LSC "Model 326 X1" and the "Model 326 X2". The 326 X1 provides a single measurement, where the X2 has the ability for two independent measurements. The Model 326 is a Multi Range Micro Processor based Refractometer that measures the concentration of dissolved solids calculated from the Refractive Index. Using "Critical Angle of Refraction" as the measurement principle. Refractive Index of the product is converted to the appropriate engineering units and displayed. The display is a continuous real time measurement. The LSC Model 326 also provides an Ethernet based web browser interface, along with a standard 0 - 10 VDC output, an isolated 4 - 20 mA output and a 0 - 10 VDC temperature output. The LSC Model 326 Refractometer consists of a Processor, Sensing Head, and an optional Intrinsic Safety Barrier. This version of the unit will be available with or without a touchscreen.

1.1 PROCESSOR

Figure 1
Model 326

1.1.1a 326 X1 PROCESSOR

The Model 326 X1 consists of 11 major components without a display or 13 with one. The part numbers and descriptions of all the major components are listed below in table 1. All components are housed in a polyester Nema 4X enclosure, which allows you to locate the unit in damp and dusty environments. **Note: There are 2 versions of the USB cable.** Figure 2 below shows the physical layout of the component and demonstrates the cable for use with OUT a display; this cable would also be used in a dual unit.

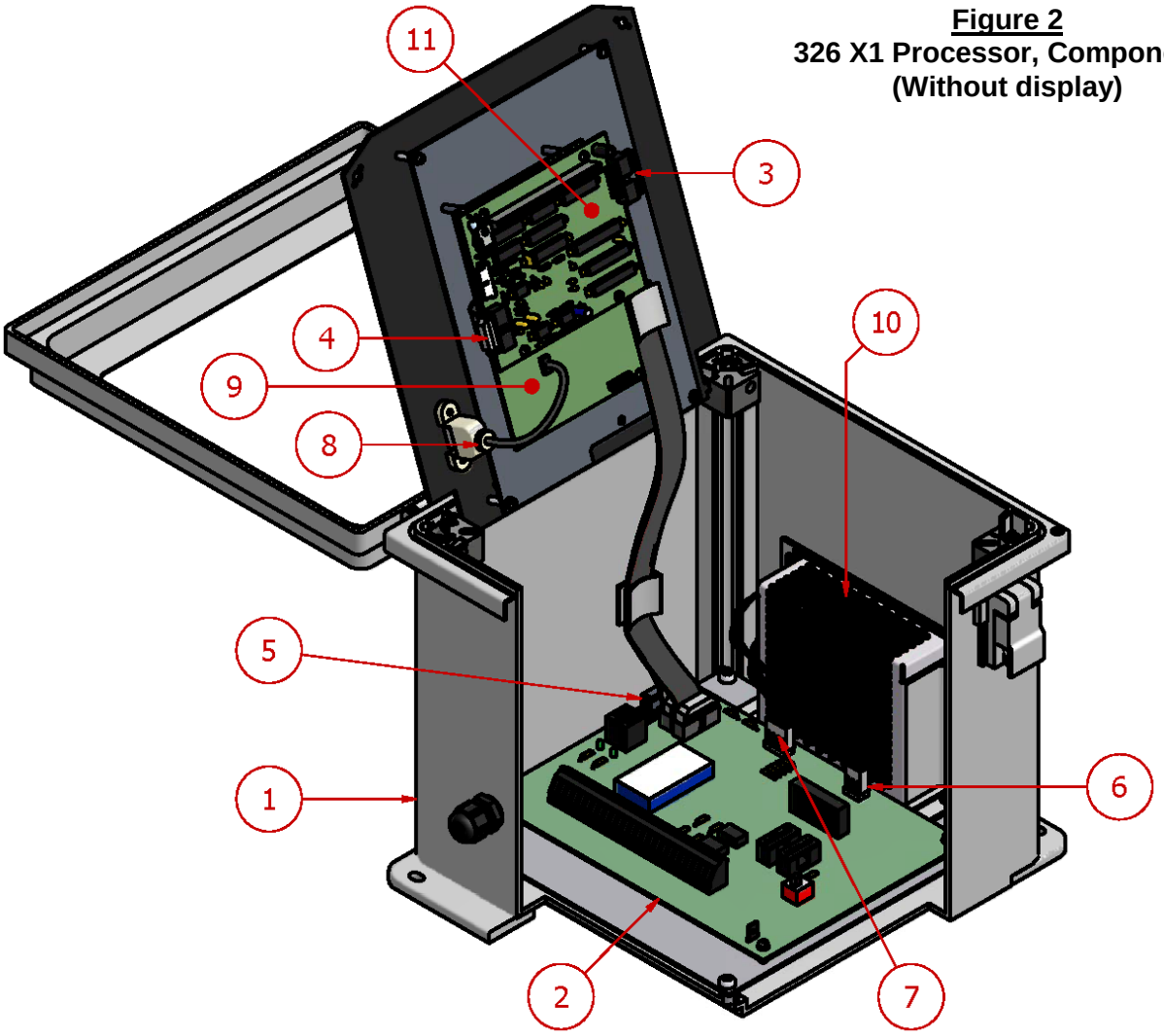


Figure 2
326 X1 Processor, Components (Without display)

Table 1
Components of the 326420-NET X1 Processor

1	326000	NEMA 4x ENCLOSURE	7	326469-PS	DC, POWER CABLE
2	326402	INTERCONNECTING BOARD, SINGLE UNIT	8	326475	CABLE, USB (NO DISPLAY)
3	326461	CABLE, 16 PIN, REFRAC 1	9	326805	326 CPU BOARD
4	326462	CABLE, 14 PIN, REFRAC 1	10	480500	POWER SUPPLY W/ T-STRIP
5	326463	CABLE, 10 PIN	11	614401	REFRACTOMETER BOARD
6	326465-PS	AC, POWER CABLE			

1.1.1b 326 X2 PROCESSOR

The Model 326 X2 consists of 15 major components. The part numbers and description of all the components are listed below in table 2. All components are housed in the same enclosure as the X1. **Note: There are 2 versions of the USB cable.** Figure 3 below shows the physical layout of the component and demonstrates the cable that is used WITH a display, the USB cable below could also be used in an X1 with a display.

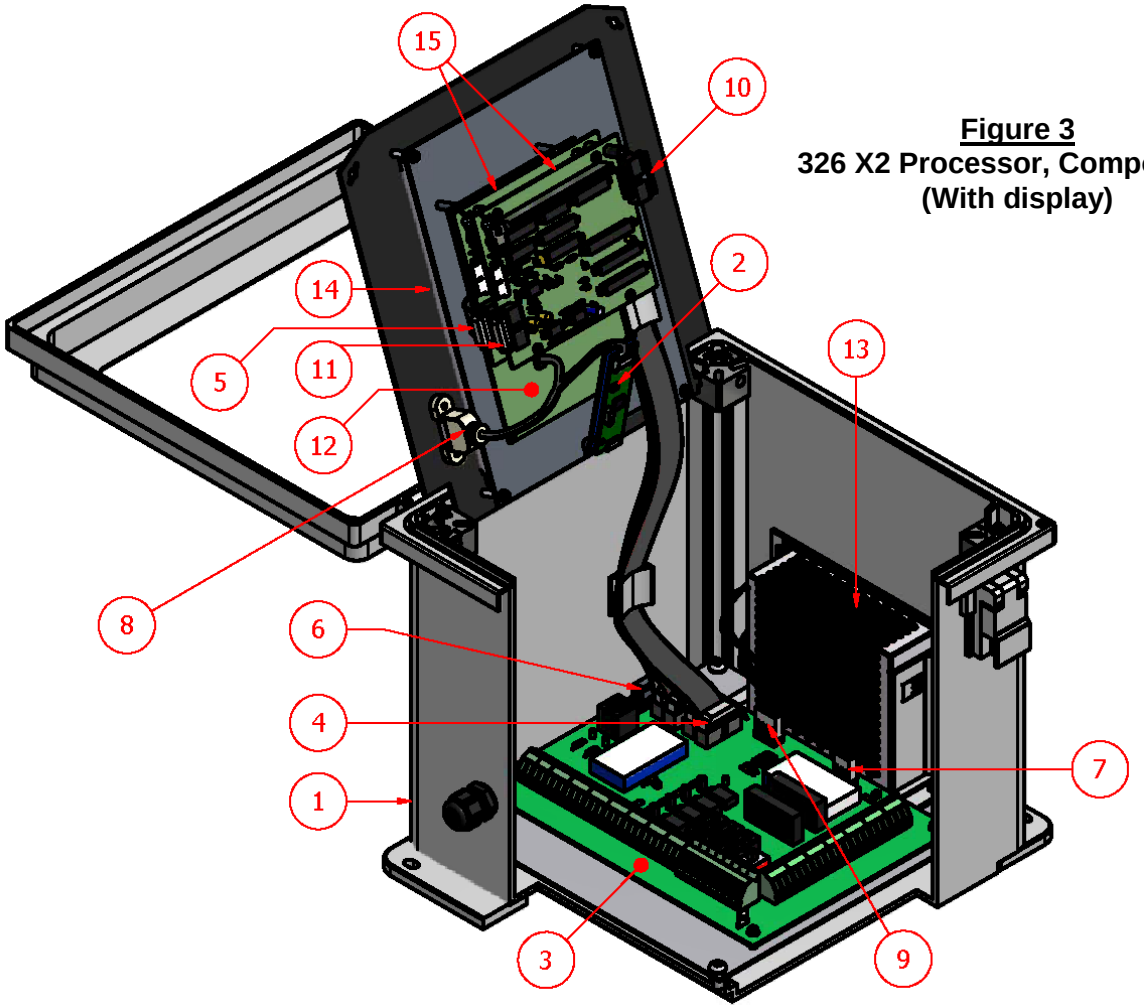


Figure 3
326 X2 Processor, Components (With display)

Table 2
Components of the 326425-TS X2 Processor

1	326000	NEMA 4x ENCLOSURE	9	326469-PS	DC, POWER CABLE
2	326111	TOUCH SCREEN CONTROLLER BOARD	10	326473	CABLE, 16 PIN, REFRAC 2
3	326403	INTERCONNECTING BOARD, DUAL	11	326474	CABLE, 14 PIN, REFRAC 2
4	326461	CABLE, 16 PIN, REFRAC 1	12	326805	326 CPU BOARD
5	326462	CABLE, 14 PIN, REFRAC 1	13	480500	POWER SUPPLY W/ T-STRIP
6	326463	CABLE, 10 PIN	14	480665	TOUCH SCREEN
7	326465-PS	AC, POWER CABLE	15	614401	REFRACTOMETER BOARDS
8	326467	CABLE, USB FOR DISPLAY			

1.1.2 INTERCONNECTION BOARD

Single (PN: 326402 PC-2) or **Dual** (PN: 326403 PC-3)
(Item # 2, Figure 2) (Item # 3, Figure 3)

All wiring from the Sensing Head and the input power are terminated to this card. All outputs are also terminated to this card, these outputs include; the 4 - 20 mA, RJ 45, "A" and "B" alarms, 0 - 10 VDC, 0 – 10 VDC Temperature Output and the Prism Wash signal. (See section 2.5 for the termination and a description of the inputs and outputs on the interconnection card. Figure 4 below shows the components of the interconnection card and Figure 19 shows the terminations. The LSC Model 326 X2 is designed to handle 2 independent sensing heads. See Figure 20 for the layout of the 326403 board and the wiring of the 2 terminal strips)

Figure 4 : Interconnection Card

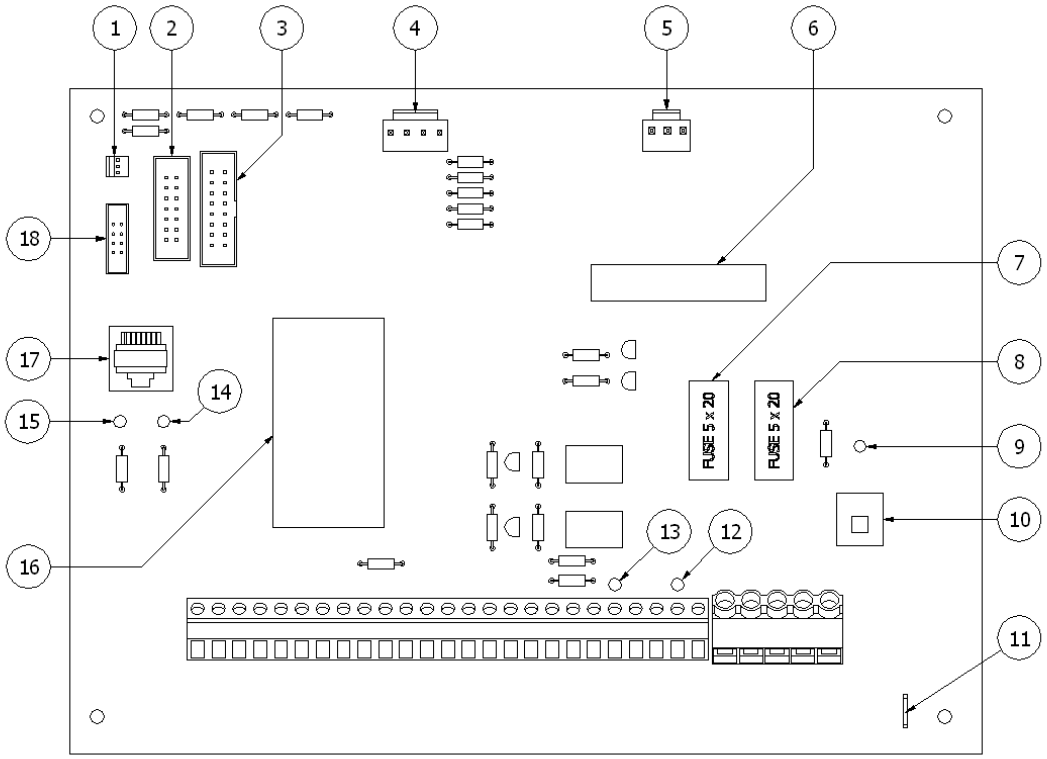


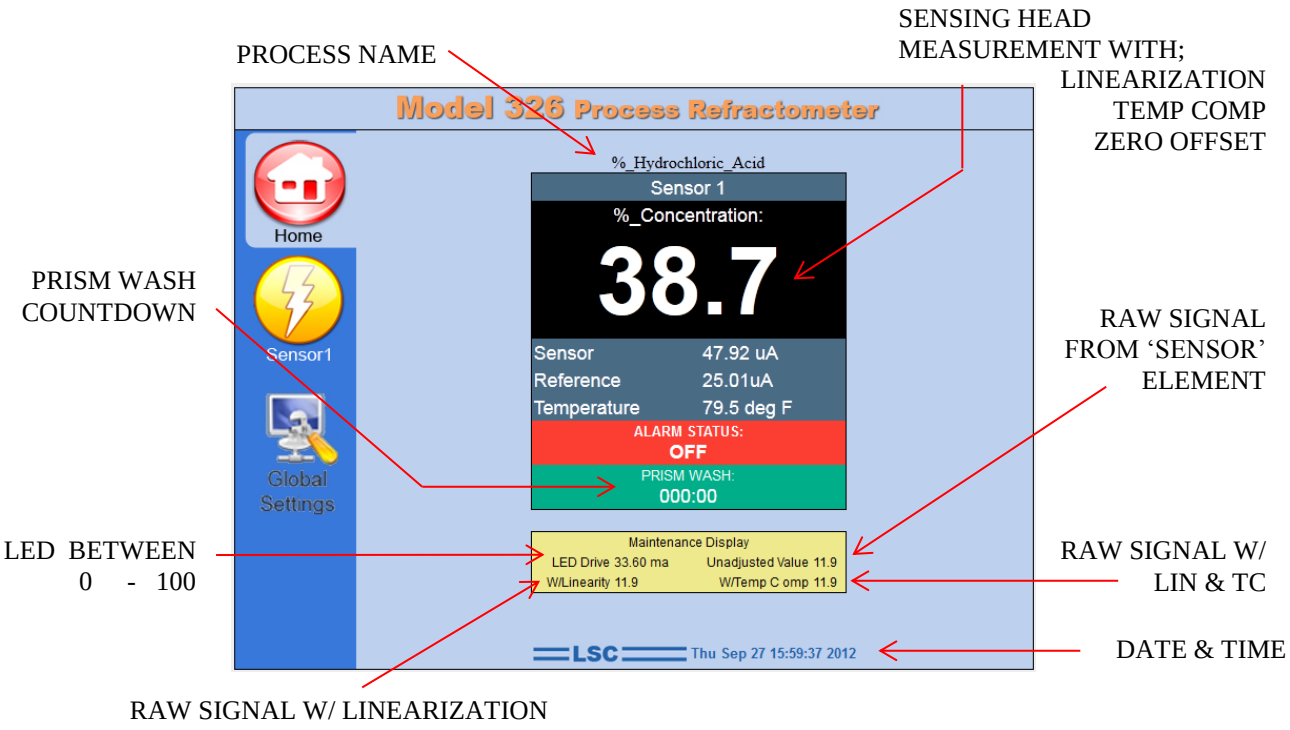
Table 3 : Interconnection card components & connections

1	326468 to Backlight of Touch Screen	10	Power, On/Off switch
2	14 Pin connection (J6 to PC1-J2)	11	Quick-Fit Ground Stud
3	16 Pin connection (J5 to PC1-J3)	12	LED 5, indicates 'B' Alarm on
4	Power, DC connection (J3 to PS-J2)	13	LED 4, indicates 'A' Alarm on
5	Power, AC connection (J2 to PS-J1)	14	LED 2, indicates E-net connectivity
6	Wash Relay	15	LED 1, indicates E-net Activity
7	2.5 Amp Wash Fuse (F2)	16	4-20 mA chip (isolated)
8	2.5 Amp Main Power Fuse (F1)	17	RJ-45 Ethernet connection
9	LED 3, indicates power.	18	10 pin connection (J4 to CPU-CN24)

1.1.3 TOUCH SCREEN 8.4" DISPLAY – LCD / LED BACKLIGHT (PN: 480665)

The touch screen is visible on the front of the Nema 4X enclosure. The display gives an immediate readout of the process at a 600x800 resolution. Using the Touch screen located on the front of the enclosure will allow the operator to view various screens, giving the technician easy access to the Model 326 X1 or 326 X2 and its functions. The default or Home screen is shown below in Figure 5 for the 326 X1. When powering the system up, the display will show the boot up sequence consisting of a minute of text and then a blank screen. This will take approximately 2 minutes before the LSC homepage is displayed.

Figure 5
Home Screen Display X1



1.1.4 CPU BOARD (PN: 326805)
(See item # 9, Figure 2 and # 12, Figure 3)

This board has a removable 4-GB, solid-state hard disk (compact flash). If for any reason the system is shut down or rebooted, there is a 2 minute time delay while the unit reboots. During this time, the 326 has no functioning capabilities. This board is powered by the +5 VDC signal from the power supply. There is also a battery mounted on the CPU to insure that the time and date functions are maintained during a power loss.

Note: For precaution LSC recommends using the shutdown button under the 'global settings' menu before powering the system off.

1.1.5 REFRACTOMETER BOARD (PN: 614401-PC1)
(See item # 11, Figure 2 and # 15, Figure 3)

LSC refractometer board analyzes all of the signals coming from the sensing head mounted on the process line. This would include the LED, Detector, and temperature sensor. This board is powered by the ±15 VDC signal coming from the power supply.

1.1.6 CAGED POWER SUPPLY

(Item # 10, Figure 2)
(Item # 13, Figure 3)

(PN: 480500)

MODEL		RT-65C		
OUTPUT	OUTPUT NUMBER	CH1	CH2	CH3
	DC VOLTAGE	5V	15V	-15V
	RATED CURRENT	5A	2.2A	0.5A
	CURRENT RANGE Note.6	0.5 ~ 8A	0.2 ~ 3A	0 ~ 1A
	RATED POWER Note.6	65.5W		
	RIPPLE & NOISE (max.) Note.2	80mVp-p	120mVp-p	80mVp-p
	VOLTAGE ADJ. RANGE	CH1: 4.75 ~ 5.5V		
	VOLTAGE TOLERANCE Note.3	±2.0%	+8,-4%	±5.0%
	LINE REGULATION Note.4	±0.5%	±1.5%	±0.5%
	LOAD REGULATION Note.5	±1.0%	±3.0%	±1.0%
INPUT	VOLTAGE RANGE	88 ~ 264VAC 125 ~ 373VDC (Withstand 300VAC surge for 5sec. Without damage)		
	FREQUENCY RANGE	47 ~ 63Hz		
	EFFICIENCY(Typ.)	77%	77%	78%
	AC CURRENT (Typ.)	2A/115VAC 1.2A/230VAC		
	INRUSH CURRENT (Typ.)	COLD START 40A/230VAC		
	LEAKAGE CURRENT	<2mA / 240VAC		
PROTECTION	OVER LOAD	110 ~ 150% rated output power		
		Protection type : Hiccup mode, recovers automatically after fault condition is removed		
	OVER VOLTAGE	CH1: 5.75 ~ 6.75V		
		Protection type : Hiccup mode, recovers automatically after fault condition is removed		
ENVIRONMENT	WORKING TEMP.	-25 ~ +70℃ (Refer to output load derating curve)		
	WORKING HUMIDITY	20 ~ 90% RH non-condensing		
	STORAGE TEMP., HUMIDITY	-40 ~ +85℃, 10 ~ 95% RH		
	TEMP. COEFFICIENT	±0.03%/℃ (0 ~ 50℃)on +5V output		
	VIBRATION	10 ~ 500Hz, 5G 10min./1cycle, period for 60min. each along X, Y, Z axes		

1.1.7 USB PORT (P/N: 326475 WithOUT TouchScreen) (P/N: 326467 with TouchScreen)

The USB diagnostic port is located under the touch screen on the front panel. This port allows for easy loading and offloading of calibration/history/event files. These files can be sent to your local LSC factory for analysis and troubleshooting assistance. These files can also be used for various customer reasons including spreadsheets, plots, and long term storage. See section 4.6.2

1.2 THE SENSING HEAD

The Sensing Head is the portion of the Refractometer that is in direct contact with the process and performs the actual Critical Angle Measurement. The measurement is achieved by the refraction of light at the interface between the Sapphire Prism and the process. (See Figure 6, Principle of Operation on next page). There are two types of sensing heads: the in-line and the insertion probe style. These are explained in more detail in sections 1.2.2 and 1.2.3 respectively.

1.2.1 SENSING HEAD COMPONENTS

There are three types of Sensing Heads to choose from, the Standard In-line Head, the Insertion Probe and a Green Liquor Probe. These heads consist of four major components: Detector, Infra-red Light Source, Temperature Sensor and a Sapphire Prism. The operations of these components are listed below and the assemblies are shown in Figure 7 "Standard In-Line Sensing Head Assembly" and Figure 8 "Insertion Probe Assembly".

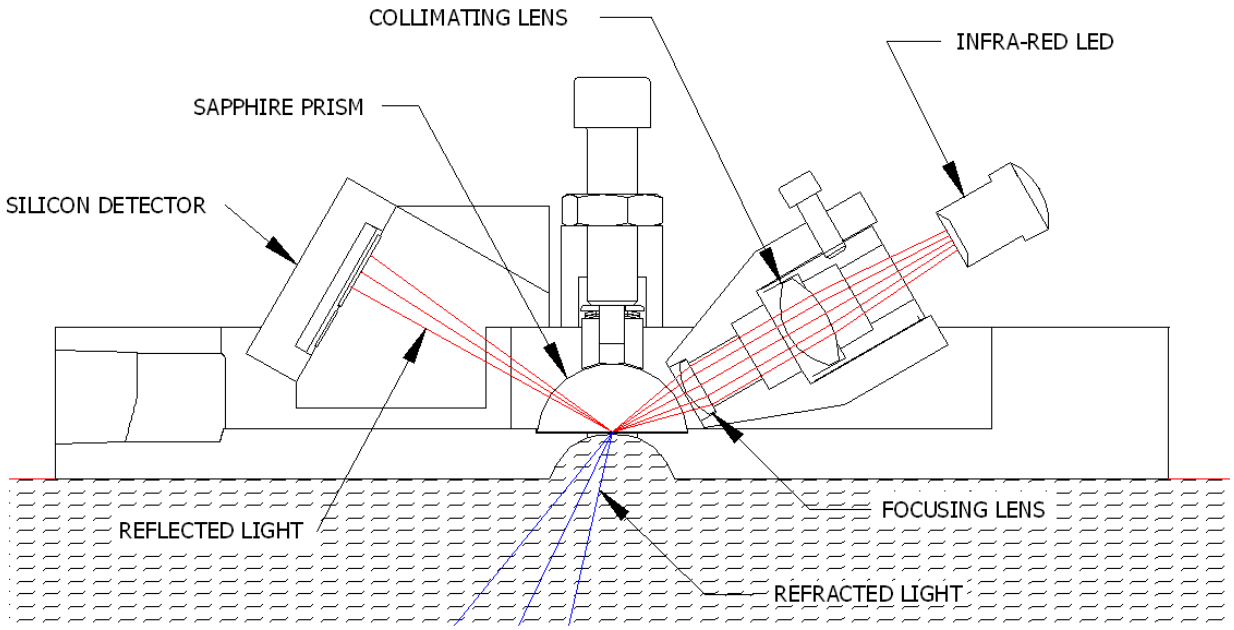
Detector: The Detector is made up of two modern silicon photocells, a measure cell and a reference cell. The reference cell measures the intensity of the light from the source and the 326 compensates for any fluctuations of intensity over time. The measure cell, measures the amount light reflected onto the cell.

Infra-red Light Source: The Infra-red Light Source "LED" emits a light beam through a collimating lens and a focusing lens, before it is reflected off the interface between the prism and the process. The light that is reflected is the light that hits the liquid interface at an angle below the "Critical Angle". The rest of the light is absorbed or refracted into the process. It is the reflected light that is measured by the detector.

Temperature Sensor: Monitors the change in temperature of the process. As temperatures increases or decreases, the voltage across the sensor increases or decreases, (0.01 VDC per °C).

Sapphire Prism: The Sapphire Prism is mounted in direct contact with the process. The wetting of the prism face provides the properties necessary for the "critical angle measurement". At the interface, light is reflected and refracted off the process at different angles depending on the dissolved solids level of the process.

Figure 6
Principle of Operations



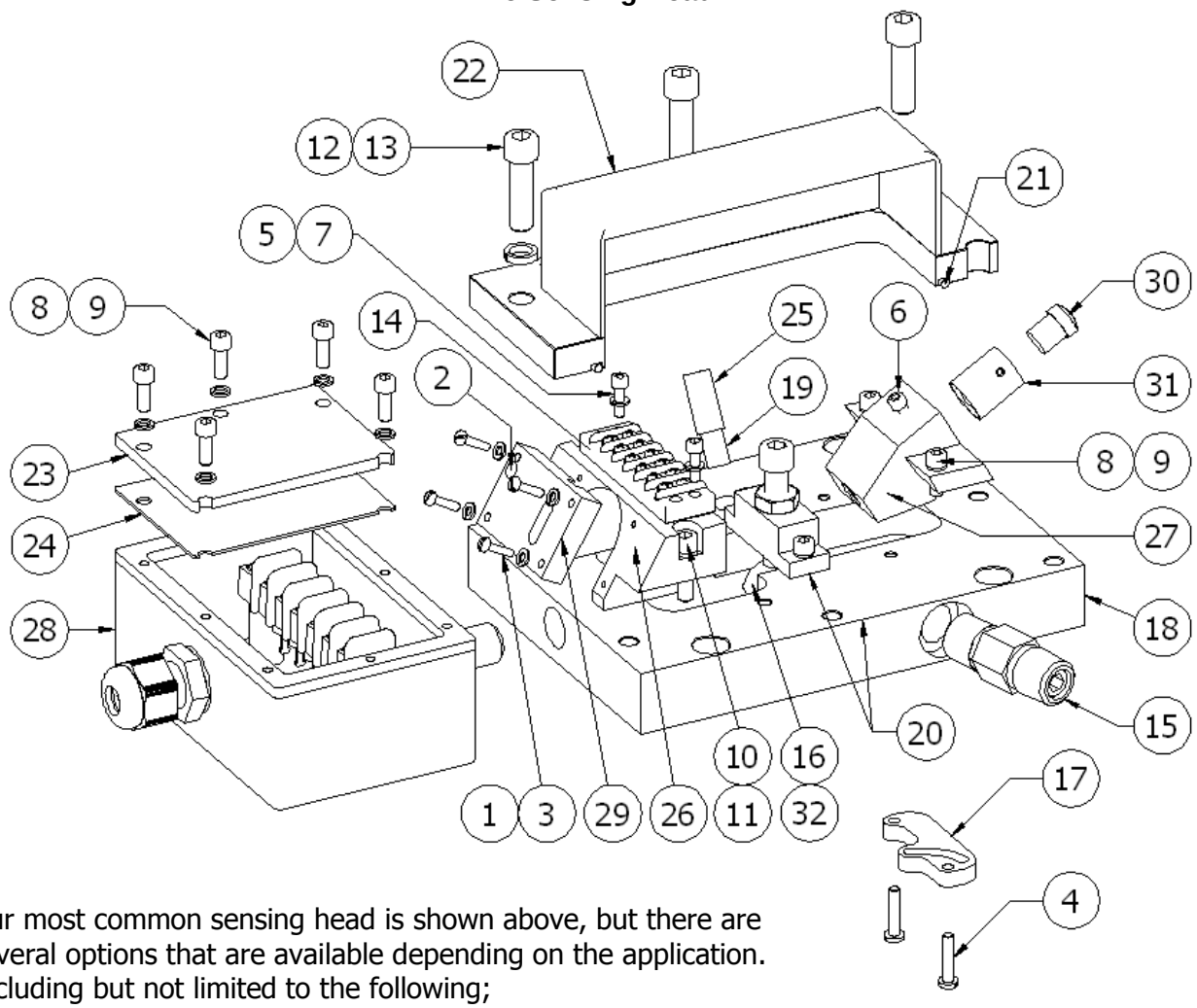
1.2.2 IN-LINE SENSING HEAD

The 326 In-Line Sensing Head is mounted on a process fluid line and can be installed on the following:

- Pipe Sections
- Flow Thru Blocks
- Valve Bodies

Each of these options will be discussed in more detail in Section 2.1.

Figure 7
In-line Sensing Head



Our most common sensing head is shown above, but there are several options that are available depending on the application. Including but not limited to the following;

Part #	Description	Applications
326312	Sanitary Head, W/O Prism Wash	Food & Chemical
326315	Standard Head W/ Prism Wash	Pulp/Paper & Chemical
326316	Thru-Probe Head	Rapid temperature fluctuations
326317	Probe Optics	Food & Chemical

The designation after the part number determines the material of the baseplate. For example; A Baseplate made of Duplex 2205 stainless = 326315-2205. Other materials include but are not limited to; 316 SS, Hastalloy-C, A-20, and Kynar

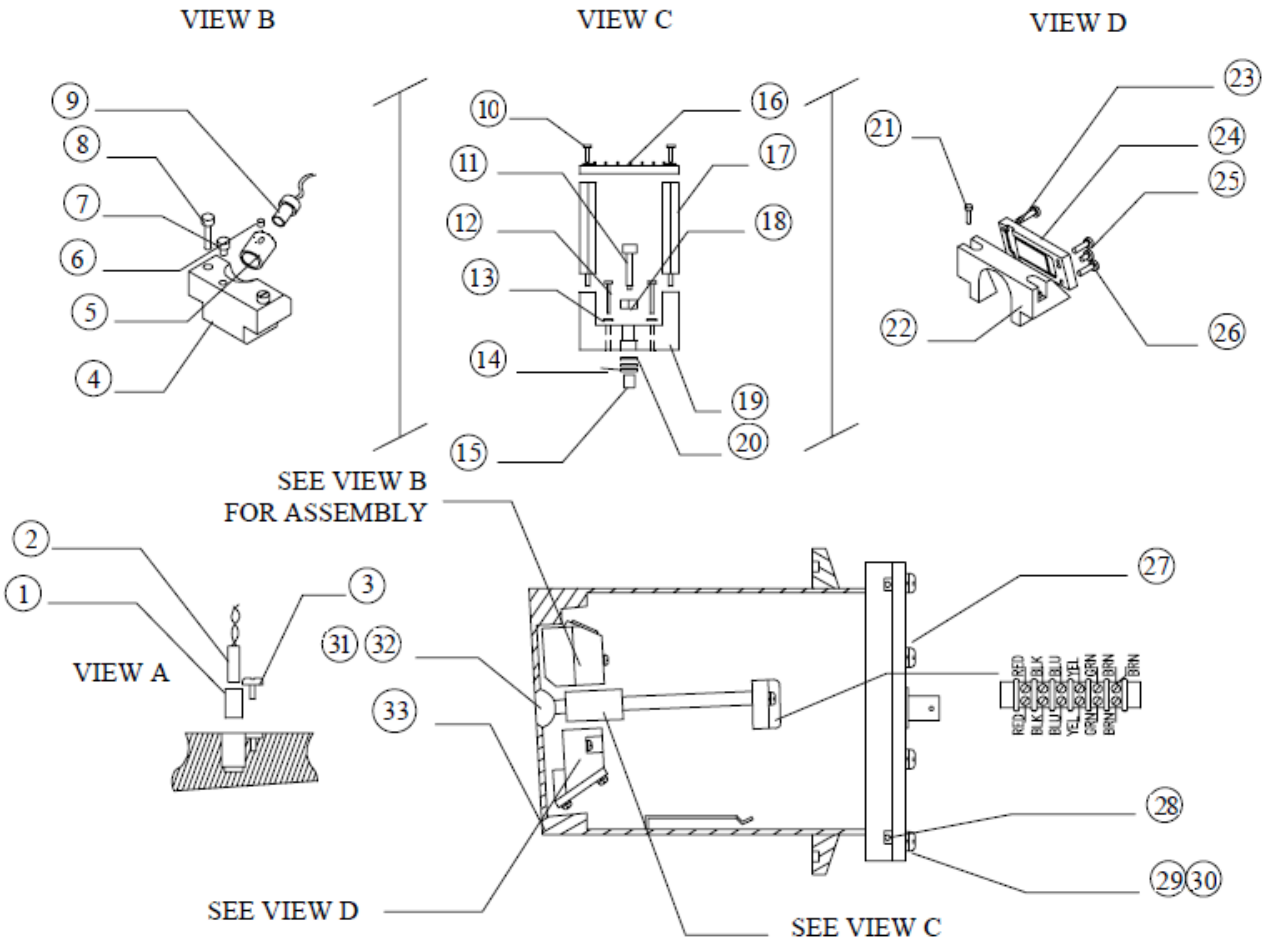
Table 4
In-line Sensing Head Parts List

ITEM	LSC PART #	DESCRIPTION	QTY
1	102006	SCREW, #2 – 56 x 3/8”	4
2	102202	SCREW, SH / CS #2 - 56 x 1/8”	1
3	102820	WASHER, LOCK #2	4
4	104007 104007-M	SCREW, PH #4 – 40 x 7/16” (STANDARD, 316SS) ‘’ ‘’ (MONEL, CORROSION RESISTANT, *EXPENSIVE)	2
5	104206	SCREW SH / CS # 4 - 40 x 3/8”	2
6	104210	SET SCREW, #4 - 40 x 1/4”	1
7	104820	WASHER, LOCK #4	2
8	106206	SCREW SH / CS # 6 - 32 x 3/8”	11
9	106830	WASHER, LOCK # 6 HC	10
10	108210	SCREW, SH / CS, #8 - 32 x 5/8”	2
11	108830	WASHER, LOCK #8 HC	2
12	125214	SCREW, SH / CS # 1/4” – 20 x 7/8”	7
13	125830	WASHER, LOCK 1/4” HC	7
14	170044	TERMINAL STRIP, INTERNAL	1
15	190116 190118 **190120** 190130	CHECK VALVE, (5 PSI) CHECK VALVE, (25 PSI) CHECK VALVE, **STANDARD** (40 PSI) CHECK VALVE, ADJUSTABLE	1
16	610100	PRISM (SAPPHIRE)	1
17	614009-2205	WASH NOZZLE, SIDE ENTRY, DUPLEX 2205	1
18	614010-2205	BASE PLATE, SIDE P/W, DUPLEX 2205	1
19	614300	TEMPERATURE SENSOR	1
20	614310-2205	BASEPLATE & PRISM BLOCK ASSEMBLY. (FIG 26)	1
21	640066	O – RING, COVER, SENSING HEAD	1
22	725000	COVER, SENSING HEAD	1
23	725009	COVER, T – BOX	1
24	725010	GASKET, T – BOX	1
25	725059	HOLDER, TEMPERATURE SENSOR	1
26	725094	DETECTOR HOLDER, BLUE	1
27	725302	FOCUSING LENS	1
28	725305	T - BOX ASSEMBLY	1
29	725307	DETECTOR	1
30	725308	LED (LIGHT SOURCE) INFRA-RED	1
31	725309	COLLIMATING LENS ASSEMBLY	1
32	829098	PRISM GASKET	1

1.2.3 INSERTION-PROBE SENSING HEAD

The Insertion Probe is used for installation in tanks or vessels where dissolved solids must be measured in the vessel rather than the pipeline. The probe style sensing head can also be mounted on a large pipeline.

Figure 8
Insertion Probe Sensing Head



The drawing demonstrates our probe with a 4" tri-clamp flange and no prism wash. Any Industrial flange is available if sanitary fittings are not required, including ANSI, JIS, DIN/PN. These are represented by a dash after the part number; contact an LSC sales representative for a part number specific to your application before ordering.

Part #	Description	Applications
326335	Sanitary 4" Tri-clamp Probe W/O Prism Wash	Food & Chemical
326345	Standard 4" Tri-clamp Probe W/ Prism Wash	Food & Chemical

Table 5
Insertion Probe Parts List

ITEM	PART #	DESCRIPTION	QTY
1	725059	TEMPERATURE SENSOR HOLDER	1
2	614300	TEMPERATURE SENSOR	1
3	106006	SCREW # 6 x 32 x 3/8” PH	1
4	725100	LIGHT SOURCE HOLDER	1
5	725309	COLLIMATING LENS HOLDER	1
6	104305	SCREW #4-40 x 3/32” SET	1
7	104210	SCREW #4-40 x ¼” SH/CS	1
8	106010	SCREW #6-32 x 5/8” PH	2
9	725308	INFRA-RED LED (LIGHT SOURCE)	1
10	104206	SCREW #4-40 x 3/8” SH/CS	2
11	829050	SCREW HOLD DOWN	1
12	106012	SCREW #6 - 32 x ¾” PH	2
13	106820	WASHER #6 LOCK6	6
14	106840	WASHER #6 BELLEVILLE	2
15	829051	PAD HOLD DOWN	1
16	170044	TERMINAL STRIP	1
17	139210	SPACER #4 - 40 x 2-5/8”	2
18	110852	NUT #10 x 32	1
19	725099	BRACKET, HOLD DOWN	1
20	104810	WASHER FLAT # 10	1
21	106010	SCREW #6 - 32 x 5/8” PH	4
22	725101	DETECTOR HOLD DOWN INSERTION PROBE	1
23	102820	WASHER LOCK # 2	4
24	725307	DETECTOR HOLDER ASSEMBLY	1
25	102006	SCREW #2 - 56 x 3/8” PH	4
26	102202	SCREW #2 - 56 x 1/8” SH/CS	1
27	725428	COVER ASSEMBLY INSERTION PROBE	1
28	640068	O - RING SENSING HEAD COVER, INSERTION PROBE	1
29	108008	SCREW # 8 - 32 x ½” PH	6
30	108820	WASHER LOCK # 8	6
31	610105	PRISM SAPPHIRE PROBE	1
32	725108	PRISM GASKET, INSERTION PROBE	1
33	725336	WELDMENT, INSERTION PROBE, PLAIN	1

1.3 SPECIFICATIONS

The technical specifications for the Model 326 are listed below in Table 6.

Table 6
LSC Model 326 Technical Specifications

Input Power Requirements	100 to 240 VAC, 47/63 Hz, < 25 Watts		
Refractive Index Range % Solids or BRIX Range	1.3000 – 1.6000 0 – 100		
Span (Calibration)		Minimum	Maximum
	RI	0.0015	0.2000
	BRIX	1.0	85.0
	SOLIDS*	1%	100%
	*May vary with some process materials or applications.		
Accuracy	± 0.5% of selected span range		
Repeatability and Sensitivity	0.1% by weight		
Speed and Response	500 milli-seconds		
Process Temperature Range	-25° to 150° C		
Temperature Compensation	Automatic (Can be calculated for any range)		
Process Line Pressure	Up to 1000 PSIG (68 bar)		
Interconnecting Cable Length	1,500 feet maximum (455 meters)		
Process Measurement Outputs	Standard and included Isolated 4 – 20mA DC, (15 V compliance) Isolated 0 – 10 VDC		
Optional Local Communication	8.4" Touch Screen (800x600 RES)		
Remote Communication	Web Browser via Ethernet		
Process Temperature Output	0 – 10 VDC		
Diagnostic Port	RS 232		
Alarm Set Points	HI / LO or OUT OF SPEC / SYSTEM Relays normally energized or normally not energized HI / LO set points are fully adjustable		
Prism Wash	Automatic " Settable "		
Wetted Material	Duplex 2205, 316SS, Alloy 20, Hast Alloy C, Teflons, Other materials available upon request		
Prism	Industrial Grade Sapphire		
Processor Enclosure	Nema 4X		
Electronic Enclosure Ambient Temp.	Up to 50° C		

Note: Due to the on going research and development and product improvement, all specifications are subject to change.

2. INSTALLATION

Before starting the installation, verify that all components ordered for the applications are available and the correct type such as:

Electronics / Enclosure	Sensing Head	Mounting Hardware
Prism wash components	Interconnecting Cable	Installation Drawings

2.1 IN-LINE INSTALLATION

There's a variety of different in-line installations depending on the application. Be sure that the pipe spool you ordered suits your application. Below are examples of different types of pipe spools and their applications. In - line installations can be mounted vertically or horizontally. In vertical pipeline applications, the recommended fluid flow direction is upward. In horizontal pipelines, the sensing head must be mounted on the side of the pipeline as shown in Figure 9.

2.1.1 PIPE SECTION MOUNTING

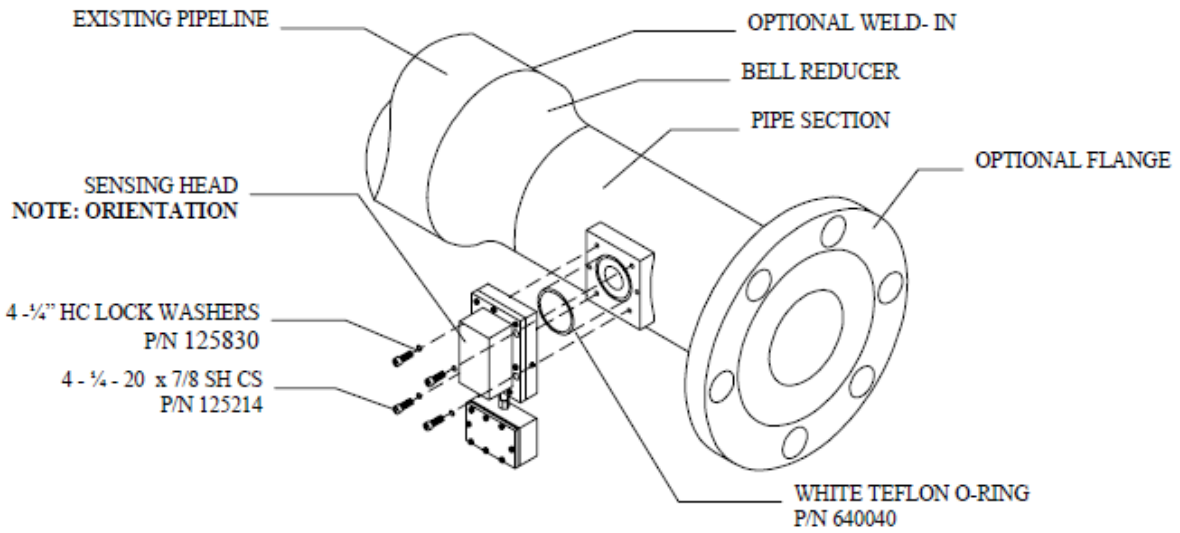
The In-Line Model 326 Sensing Head with pipe section mounting is illustrated in Figure 10. This type of mounting is used in most on line applications, generally in pipe lines 3" - 18" in diameter. Pipe sections can be ordered for specific applications. Our standard face to face dimension is 18" for single pipe sections and 28" for a dual pipe section as shown below. If the flow of the process is insufficient for good operation of the refractometer, a smaller pipe spool with bell reducers can be supplied. Mounting flanges are available in ANSI, JIS, and DIN standards if required.

Figure 9
Pipe Section

2.1.2 STANDARD SENSING HEAD MOUNTING

Standard in-line sensing heads are mounted to pipe sections, valve bodies and flow-thru-blocks sometimes called Flow cells. There are three types of standard sensing heads: with or without prism wash and a Thru Probe Sensing Head. Prism wash is only required if the process being measured has a tendency to coat the prism. Thru Probe Sensing Heads are required when temperature swings are fast and dramatic. The Sensing Head is mounted to the Pipe Section with Four 1/4 - 20 x 7/8" socket head cap screws, with 1/4" high collar lock washers. A white Teflon O-Ring is placed between the Sensing Head and the pipe spool.

Figure 10
Sensing Head Mounting



2.1.3 VALVE BODY MOUNTING

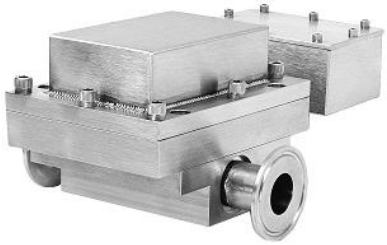
A valve body mounting is illustrated in Figure 11. This type of mounting hardware is well suited to pipelines from 2" - 4" diameter, in sanitary and non-sanitary applications. Valve bodies can be supplied with industrial flanges or tri - clamp connections depending on the application.

Figure 11
Valve Body

2.1.4 FLOW-THRU-BLOCK MOUNTING

The Flow-Thru-Block illustrated in Figure 12 is often used in by-pass loops and other small pipe-line applications, from 1/4" - 3" diameter. The Flow-Thru-Block mount is available with NPT threaded connections, Industrial Flanges, sanitary Tri - Clamp connections, and a variety of other connections to suit specialized applications. Typically the flow-thru blocks are 12" face to face but can be custom made to customer's requirements. Prism wash can be local to the sensing head or mounted to the Flow-Thru-Block depending on the application.

Figure 12
Flow-Thru-Block



2.2 INSERTION SENSORS

There are two different options for measuring a process where an in-line sensing head cannot.

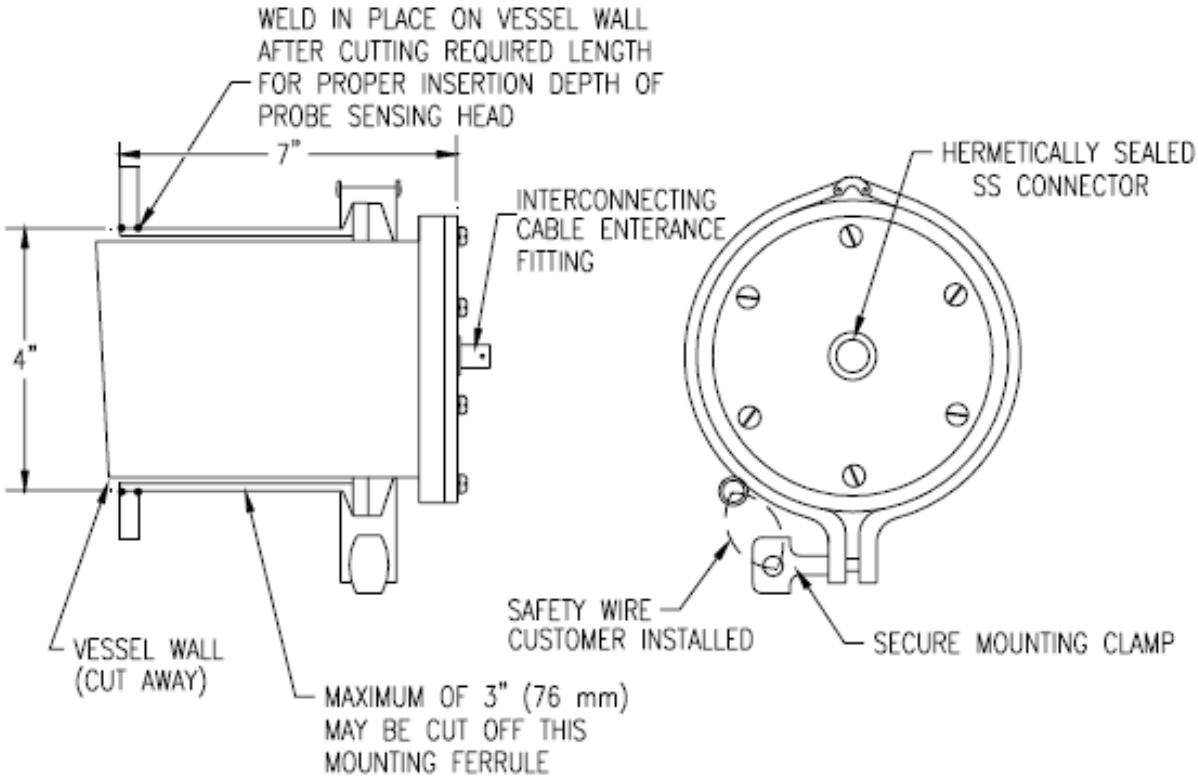
2.2.1 INSERTION PROBE

The Insertion Probe style sensing head, illustrated to the right, is installed by preparing a 4" diameter cut out in vessels, tanks, or large pipelines. Weld the mounting ferrule (supplied by LSC) in place, and mount the probe to the ferrule. The Insertion probe can be supplied with either sanitary prism wash.

Note: The end face of the Insertion Probe is manufactured at an angle. After installing the Insertion Probe, but before fully securing the mounting clamp, rotate the Insertion Probe to a position that maximizes the product impingement on the sensing window prism face.

Figure 13
Insertion Probe

Figure 14
Insertion Probe Installation

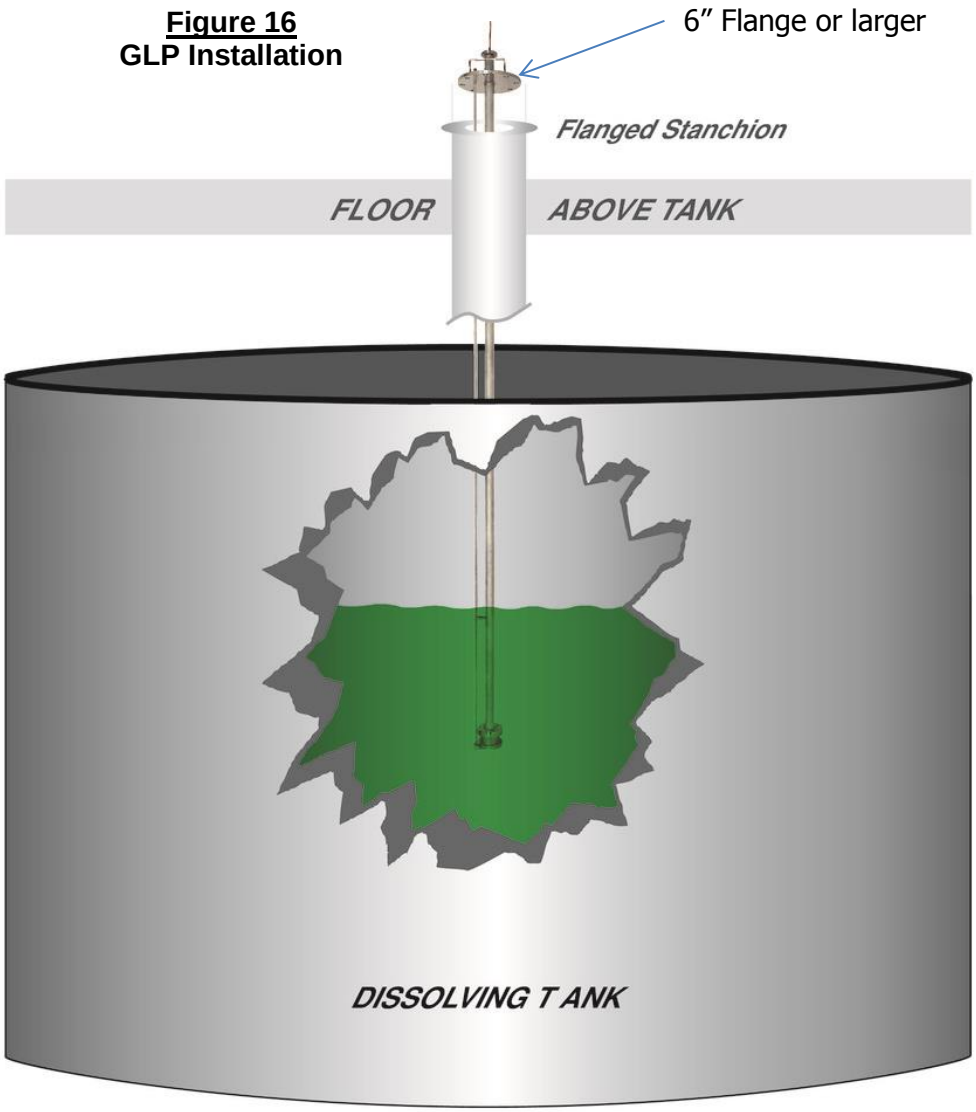


2.2.2. GREEN LIQUOR PROBE (GLP)

Figure 15
Green Liquor Probe

The Green liquor probe is the newest addition to LSC's inventory. The GLP provides the customer with the flexibility of determining the length of insertion. It is designed specifically for use in pulp and paper dissolving tanks. Due to the harsh environment of these tanks, these heads are more durable and utilize a special tri-port wash nozzle that prevents coating of the Prism. An example of a GLP installation is represented figure 16 below.

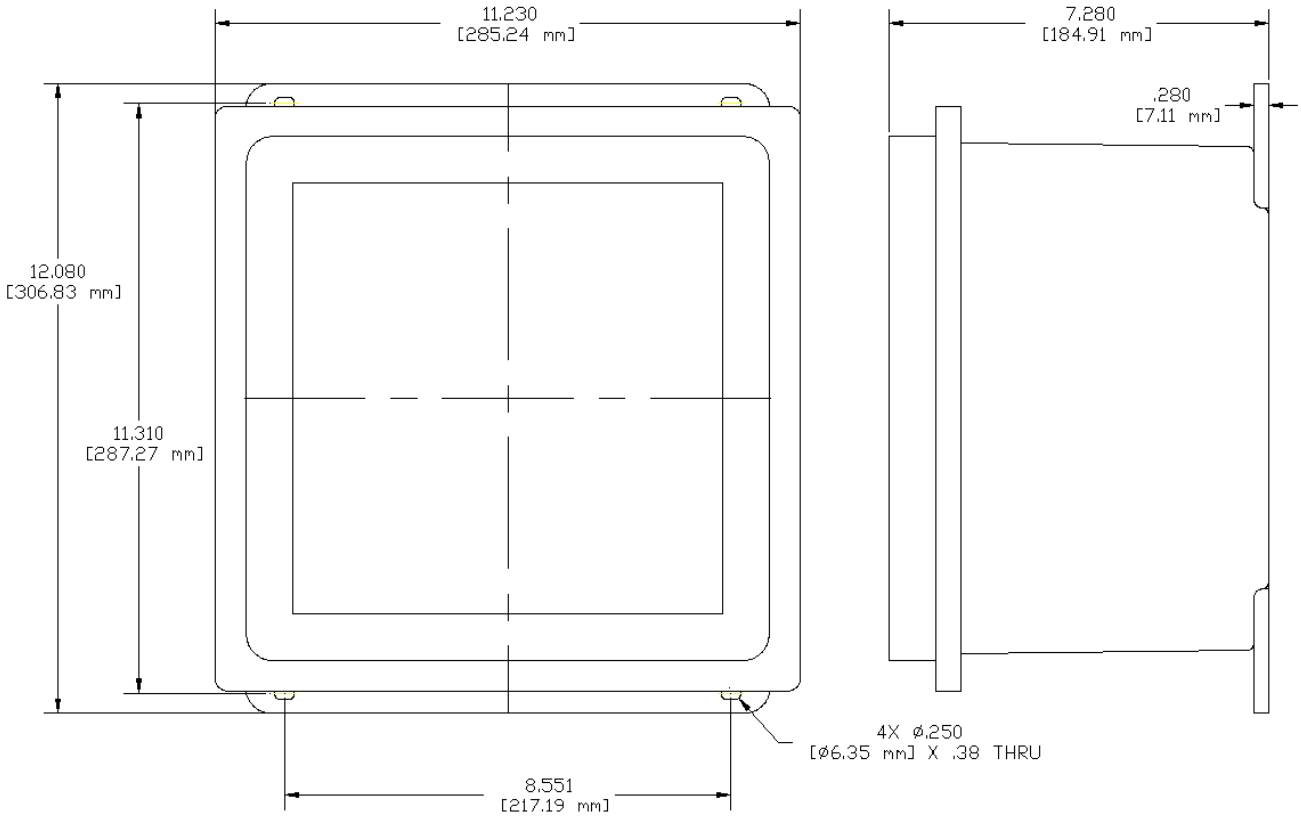
Figure 16
GLP Installation



2.3 INSTALLING ENCLOSURE

The enclosure is made of polyester and has a Nema 4X rating. This allows the processor to be mounted in damp and dusty environments. The processor can be located up to 1500 ft. (455 m) from the Sensing Head. Ideal locations would be in a control room or a rack room where environmental conditions are controlled, local temperature should not exceed 50° C. Both the LSC Model 326 X1 and X2 has been designed to give you a convenient mounting option. Mounting dimensions for are shown in Figure 17 below.

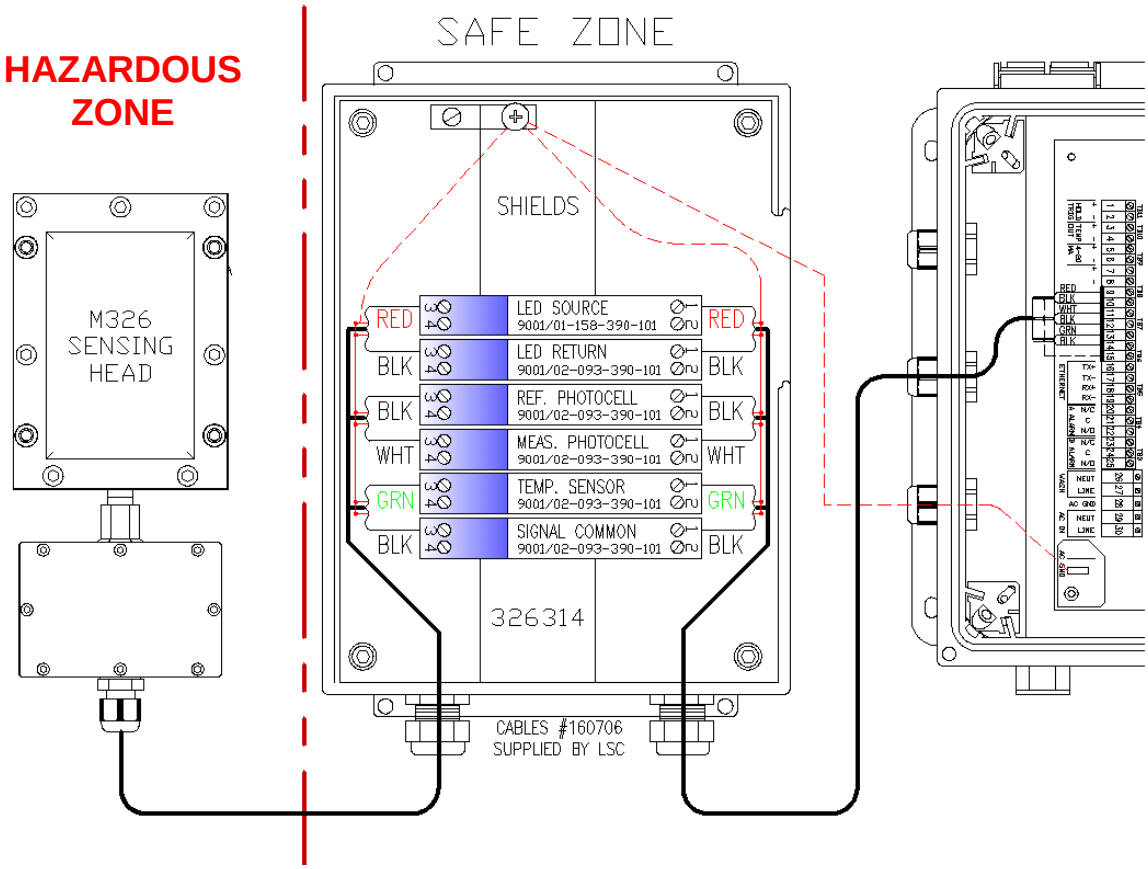
Figure 17
Enclosure Dimensions



2.4 MOUNTING IN A HAZARDOUS AREA

In applications where there is a potential for explosion caused by a spark, LSC offers an intrinsic safety barrier. The Intrinsic Safety Barriers and the 326 Processor are installed away from the process in a safe area. It limits both the current and the voltage to the sensing head, simple apparatus, such that it is impossible for it to generate a spark, thereby making it intrinsically safe.

Figure 18
Intrinsic Safety Barrier Wiring



2.5 PRISM WASH INSTALLATION

Prism wash is optional and only required if the process being measured has tendency to coat. A typical prism wash installation is demonstrated in Figure 19 on the next page. The appropriate wash medium with an adequate pressure is attached to the fitting provided. The frequency and the duration of the wash are set under the 'Sensor 1' Menu. See Sections 4.2.4 to set prism wash.

2.5.1 PRISM WASH REQUIREMENTS

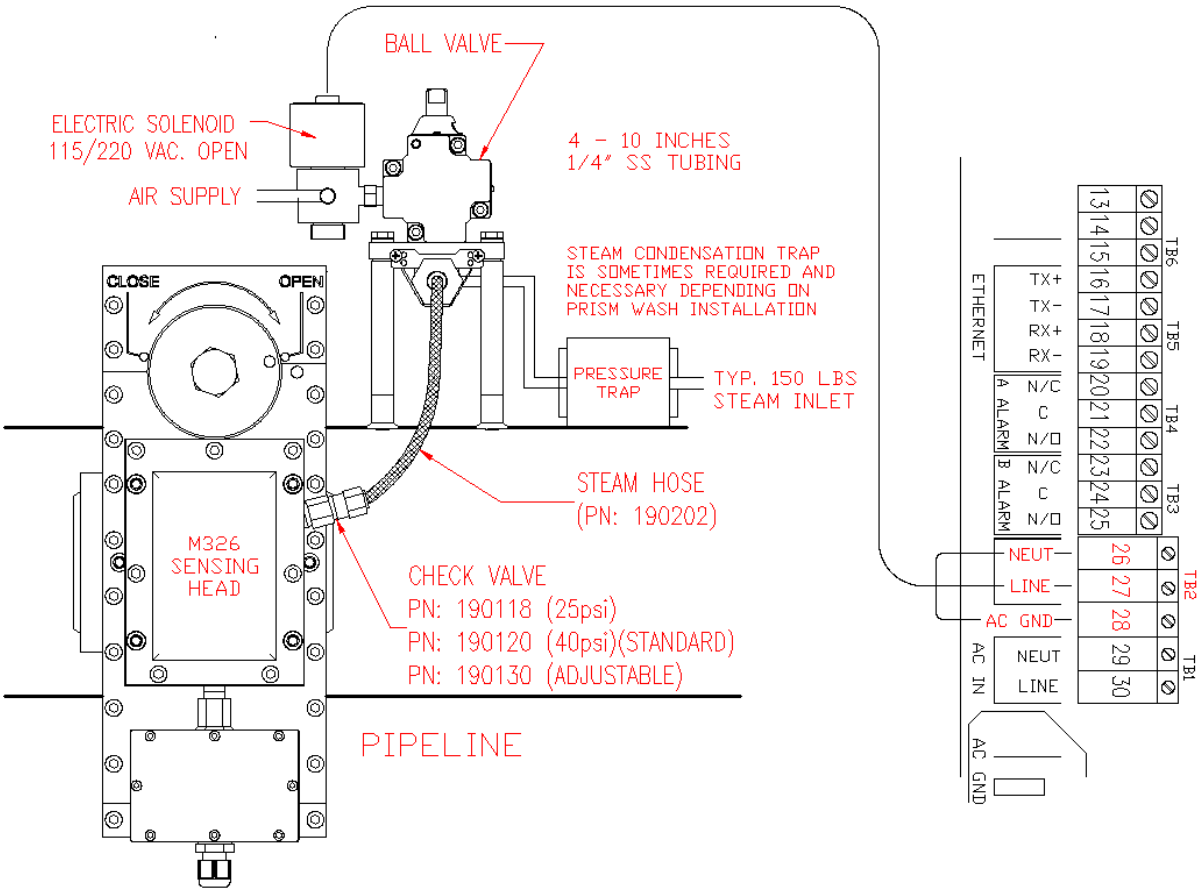
The wash medium pressure must be sufficient to overcome the process line pressure, the check valve cracking pressure and provide at least 30 to 45 psi actual washing pressure. This total required pressure is calculated using the formula below.

REQUIRED PRESSURE (PSI)	=	PROCESS LINE PRESSURE (PSI)	+	CHECK VALVE CRACKING PRESSURE (PSI)	+	30-45 (PSI)

LSC provides two types of actuators with systems that require prism wash, an air to open / air to close actuator and an air to open / spring to close actuator.

The air to open / spring to close actuator requires air pressure between 75 to 125 psi. P/N 190302
The air to open / air to close requires air pressure of 35 to 125 psi. P/N 190305
(See Figure 19 below for a Prism Wash System Schematic and Wiring Diagram).
Connections are shown in figures 20 & 21.

Figure 19
Prism Wash System Schematic and Wiring Diagram



2.6 CONNECTING THE ELECTRONICS

Each system has been factory tested and manufactured to accommodate each specific application. Check the data sheet for the unit at the beginning of this manual. If specifications are not to your requirements, contact LSC immediately. Wiring from the sensing head and all signal outputs are connected to the Terminal strip as shown below in Figure 20 and Table 7 below.

326 X1

Figure 20
326 X1 Termination

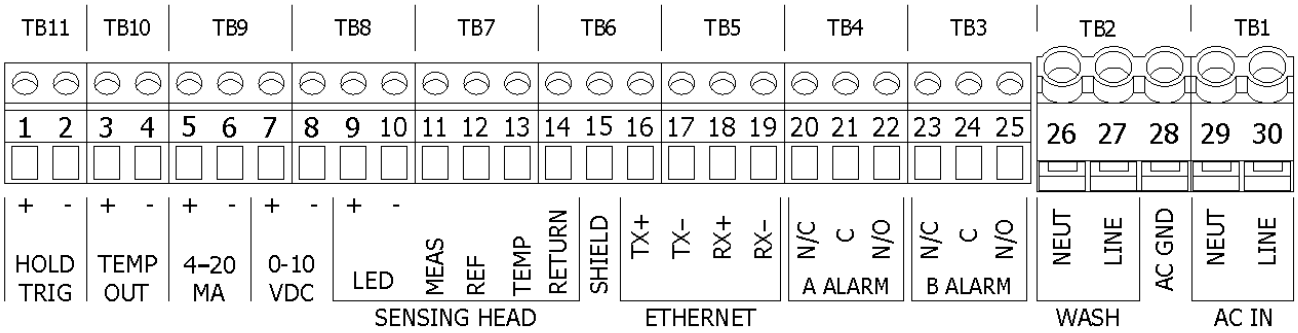


Table 7
Interconnection Card Wiring 326 X1

1	EXTERNAL HOLD TRIGGER	16	ETHERNET TX+ (WHITE/ORANGE)
2	GROUND FOR HOLD TRIGGER	17	ETHERNET TX- (ORANGE)
3	0-10 VDC TEMPERATURE OUTPUT	18	ETHERNET RX+ (WHITE/GREEN)
4	GROUND FOR TEMPERATURE OUTPUT	19	ETHERNET RX- (GREEN)
5	4 – 20 mA DC OUTPUT (ISOLATED)	20	“A” ALARM CLOSE CONTACT
6	GROUND FOR 4 – 20 mA OUTPUT	21	“A” ALARM COMMON
7	0 – 10 VDC OUTPUT	22	“A” ALARM OPEN CONTACT
8	GROUND FOR 0-10 VDC OUTPUT	23	“B” ALARM CLOSE CONTACT
9	LAMP VOLTAGE DC (RED)	24	“B” ALARM COMMON
10	LAMP GROUND (BLACK)	25	“B” ALARM OPEN CONTACT
11	MEASURE DETECTOR (WHITE)	26	PRISM WASH AC NEUTRAL
12	REFERENCE DETECTOR (BLACK)	27	PRISM WASH LINE
13	TEMPERATURE PROBE (GREEN)	28	AC POWER GROUND
14	SIGNAL RETURN (BLACK)	29	AC POWER NEUTRAL
15	SHIELD	30	AC POWER LINE

326 X2

The connections for the 326 X2 are similar to the X1 and are illustrated in (Figure 21, Table 8) below. The 326403 Board is required for a dual unit, the terminal strip for sensing head 1 is wired as shown in (Figure 20, Table 7) on the last page. The strip for sensing head 2 is located on the side of the 403 board.

Figure 21
326 X2 Terminations

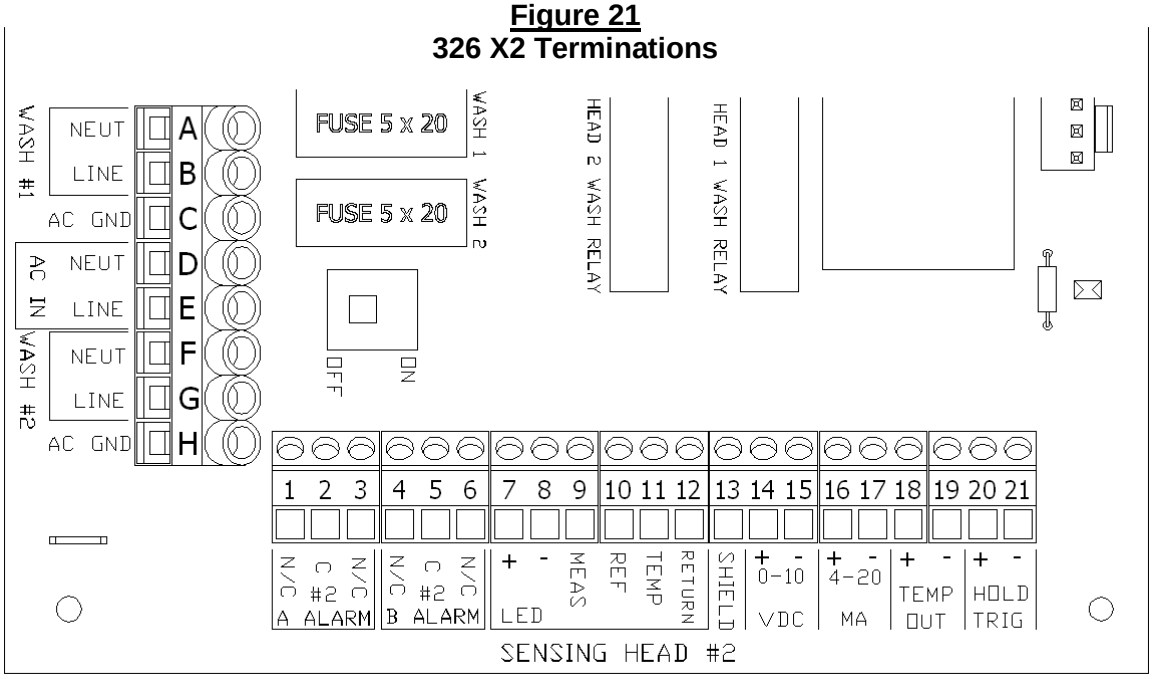


Table 8
Interconnection Card Wiring 326 X2

A	PRISM WASH #1 AC NEUTRAL	7	LAMP VOLTAGE DC (RED)
B	PRISM WASH #1 LINE	8	LAMP GROUND (BLACK)
C	AC POWER GROUND, WASH #1	9	MEASURE DETECTOR (WHITE)
D	AC POWER NEUTRAL	10	REFERENCE DETECTOR (BLACK)
E	AC POWER LINE	11	TEMPERATURE PROBE (GREEN)
F	PRISM WASH #2 AC NEUTRAL	12	SIGNAL RETURN (BLACK)
G	PRISM WASH #2 LINE	13	SHIELD
H	AC POWER GROUND, WASH #2	14	0 – 10 VDC OUTPUT
		15	GROUND FOR 0-10 VDC OUTPUT
1	“A” ALARM CLOSE CONTACT	16	4 – 20 mA DC OUTPUT (ISOLATED)
2	“A” ALARM COMMON	17	GROUND FOR 4 – 20 mA OUTPUT
3	“A” ALARM OPEN CONTACT	18	0-10 VDC TEMPERATURE OUTPUT
4	“B” ALARM CLOSE CONTACT	19	GROUND FOR TEMPERATURE OUTPUT
5	“B” ALARM COMMON	20	EXTERNAL HOLD TRIGGER
6	“B” ALARM OPEN CONTACT	21	GROUND FOR HOLD TRIGGER

2.6.1 CONNECTING MAIN POWER

Note: Please check with the local electrical codes before installation.
A circuit breaker on the power supply is necessary for all installations.

The Model 326 operates on an input power range from 100 to 240 VAC without adjustment. Three-cable strain reliefs have been provided to allow easy installation.

Before connecting the power supply, make sure that the power supply circuit breaker is OFF. Connect the main POWER "HOT" supply wire to terminal TB1 – 30 (AC LINE), POWER "NEUTRAL" to terminal TB1 – 29 (AC NEUT), on the Interconnecting Card PC – 2 (See Figure 20 and 21). Terminate the Ground to the male quick-fit terminal located in the lower right corner of the PC-2.

2.6.2 CONNECTING THE ALARMS

There are two alarm contacts "A" and "B" which are terminated to TB 4 & TB 3 respectively on the PC-2 Board. **The relays for these alarms can handle up to 24 VDC.** The alarms can be wired to either NO (Normally Open) or NC (Normally Closed) contacts. (See Figure 20) (Items 20 to 25) and 21 (Items 1 to 6)) the customer supplies the wiring for this connection.

2.6.3 CONNECTING THE TEMPERATURE OUTPUT (0 - 10 VDC)

The (0 - 10) VDC output is terminated to terminals 3 and 4 (ground) on the PC-2 Interconnection Board. The voltage output is a linear function, where "0 VDC" represents the low end temperature range set point and "10 VDC" represents the high end temperature range set point. See section 4.2.1 for setting these Temperature Ranges. The customer supplies the wiring for this connection.

2.6.4 CONNECTING THE (4 - 20 mA)

The 4 - 20 mA output is an isolated signal. 4 mA represent the low-end calibration and 20 Ma representing the high-end calibration set point. See section 4.2.1 to adjust unit's min and max. Connect the mA output to TB9 on the Interconnection Board at positions 5 and 6 (terminal 6 being the ground. The maximum load for this current signal is 750K Ω. See Figure 20 and 21 for the location of the wiring connection for the 4 - 20 mA. The customer supplies the wiring for this connection.

2.6.5 CONNECTING THE PROCESS OUTPUT (0 - 10 VDC)

The 0 - 10 VDC output is connected to the Interconnection Board at terminals 7 and 8 (8 is the ground). For locating the 0 - 10 VDC outputs see Figure 20 and 21. 0 VDC represents the low end calibration and 10 VDC represent the high end calibration set point. The customer supplies the wiring for this connection.

2.6.6 CONNECTING THE PRISM WASH SIGNAL

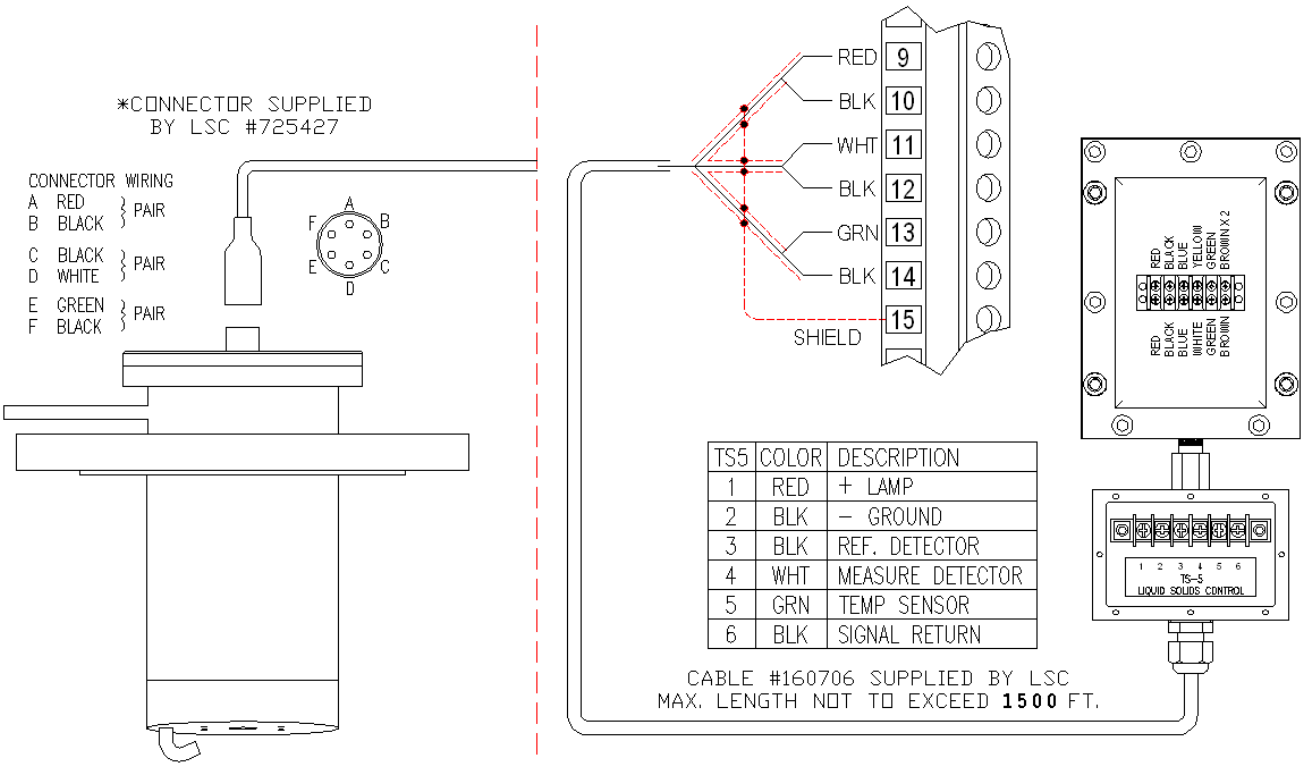
The AC signal to initiate the wash is connected to TB2 at terminals 26 and 27. (See Figure 20 and 21) This output matches the input power connected in section 2.6.1. Like all electrical installations, a qualified electrician should perform wiring to the prism wash solenoid. Refer to section 4.2.4 to set the wash parameters. The customer supplies the wiring for this connection.

2.6.7 CONNECTING THE SENSING HEADS

The cable used for connecting the sensor to the processor is supplied by LSC P/N 160706. The insertion Probe has a quick connector for positive connection to the probe. The In-Line Sensing Head is terminated with fork terminals inside the T-Box. When installing the cable, allow enough extra cable so the instrument technician can place the Sensing Head in a location accessible for calibration. See Figure 22 below for connecting the cable to the processor.

Note: The interconnection cable consists of three individually shielded pairs. Each pair has a color and a black wire. Each black wire carries a different signal and performs a different function, therefore pay particular attention to location of each black wire, which can be distinguished by the colored wire to which they are paired. Wiring required for the sensing head can be purchased from your local LSC representative. Length of cable cannot exceed 1,500 feet.

Figure 22
Wiring Installation of the Sensing Head

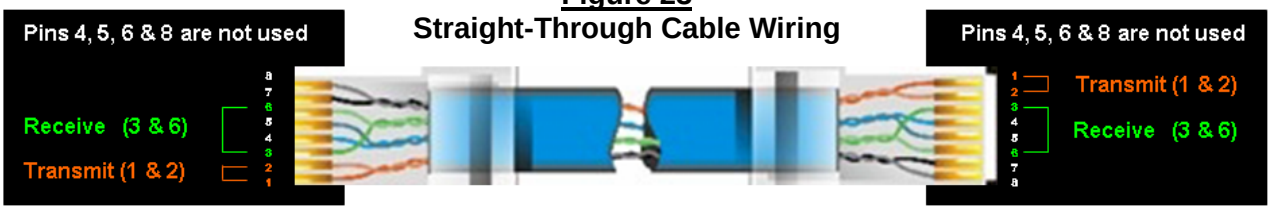


2.6.8 CONNECTING ETHERNET

Not only does the 326 provide the option to control it from a local display, but it also allows the customer to have remote access to the refractometer via a web browser (FireFox recommended). This can be done by plugging an Ethernet cable from (Item 17, Figure 4) to your Network using a straight-through Cat5 Ethernet cable or via a cross-over Cat5 cable directly to a computer.

When connecting it directly to a Local Area Network a 'Straight-Through' cable is required. This simply means the wires on either side of the cable go straight to the identical pins on the other side. (Wires 1, 2, 3 and 6 at one end are also wires 1, 2, 3 and 6 at the other end.) (Figure 23)

Figure 23
Straight-Through Cable Wiring



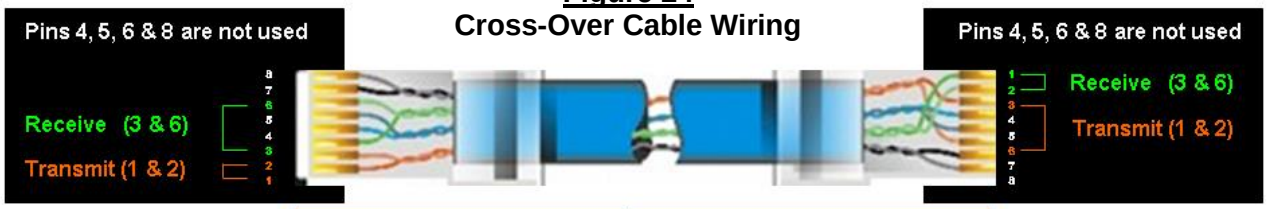
Pin #	Wire Color
Pin 1	Orange/White
Pin 2	Orange
Pin 3	Green/White
Pin 4	Blue
Pin 5	Blue/White
Pin 6	Green
Pin 7	Brown/White
Pin 8	Brown

Straight-Through

Wire	Becomes
1	1
2	2
3	3
6	6

When connecting directly to a laptop computer a 'Cross-Over' cable is used. This means the wires on one side of the cable go to opposite pins at the other. For example; Wire 1 becomes 3, Wire 2 becomes 6, Wire 3 becomes 1, and wire 6 becomes 2. (Figure 24)

Figure 24
Cross-Over Cable Wiring



Pin #	Wire Color
Pin 1	Orange/White
Pin 2	Orange
Pin 3	Green/White
Pin 4	Blue
Pin 5	Blue/White
Pin 6	Green
Pin 7	Brown/White
Pin 8	Brown

Crossed-Over

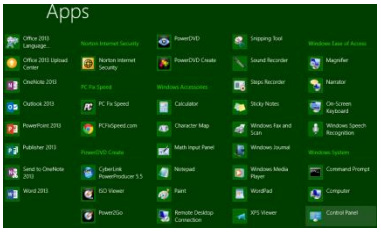
Wire	Becomes
1	3
2	6
3	1
6	2

2.7 SETTING UP THE LOCAL AREA CONNECTION

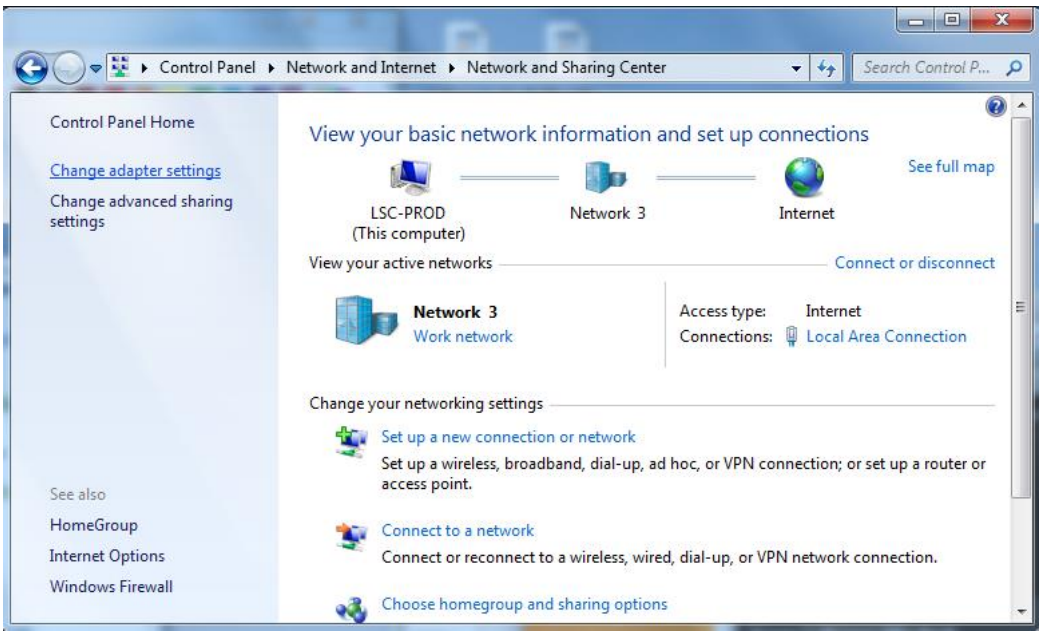
2.7.1 IP SET UP FOR WINDOWS 7 & 8* WITH FIXED IP

1. Go to the ‘Control Panel’ and click ‘View network status and tasks’

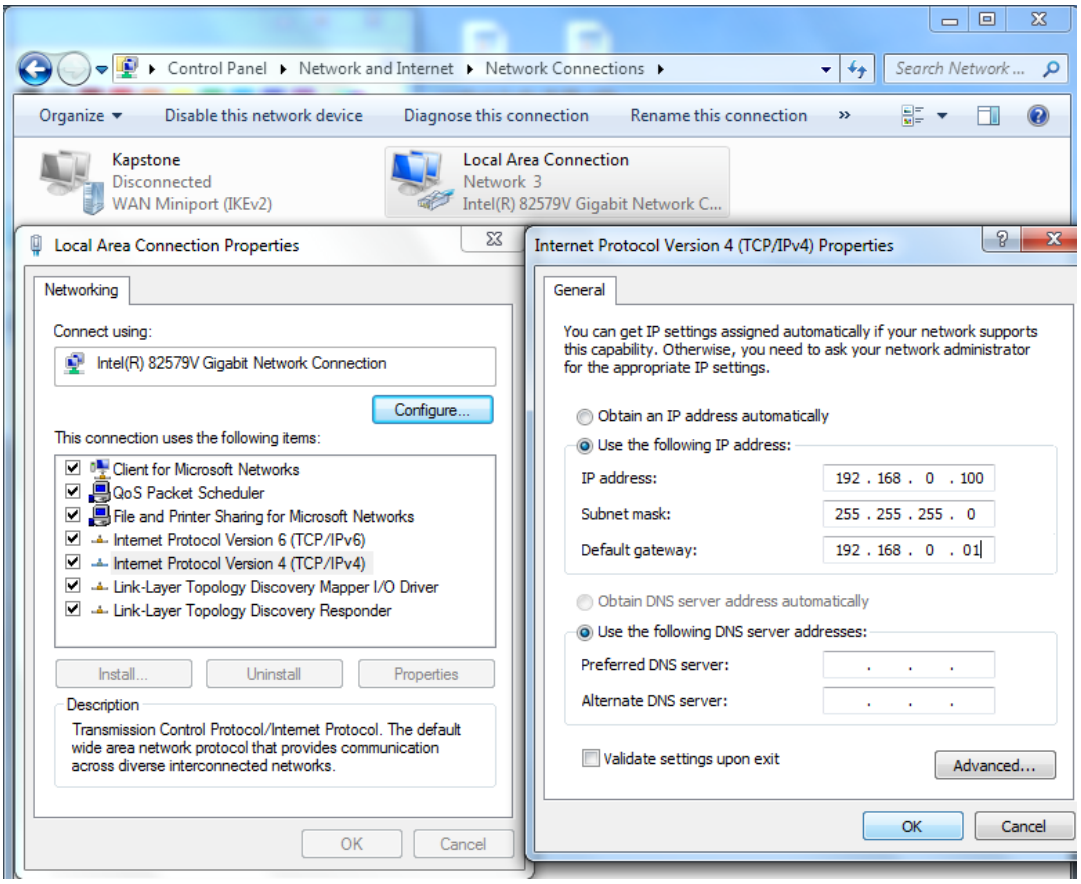
*When using Windows 8 the Control Panel can either be accessed via the ‘My Computer’ screen on the desktop OR under ‘All Apps’ under the ‘Start Up’ menu. Once into the control panel the setup procedure is almost identical to 7’s



2. From this page click ‘Change adaptor settings’



3. Right click ‘Local Area Connection’ or *Ethernet when using 8* choose ‘properties’ and then ‘Internet Protocol Version 4’ click properties for this as well.



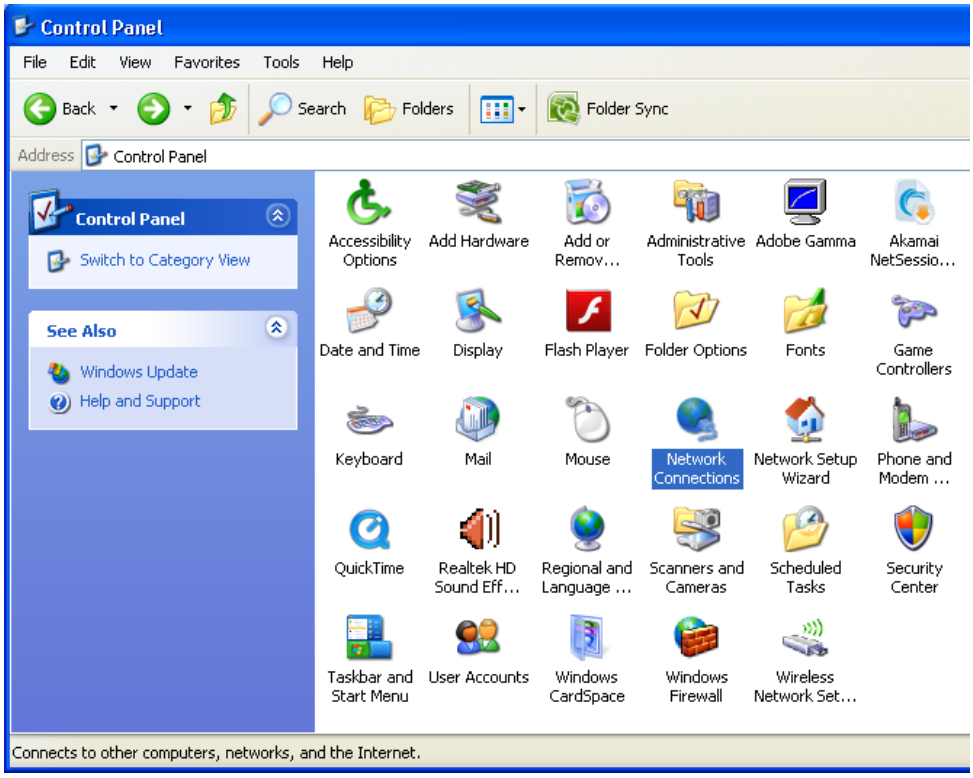
4. Finally check “Use the following IP address”

   - Enter 192.168.0. (Any number in the range of 2-255 that doesn’t conflict with another IP address in the same network, including any LSC units.)
   - Enter 255.255.255.0 for the ‘Subnet Mask’
   - Enter your default gateway. Typically 192.168.0.1

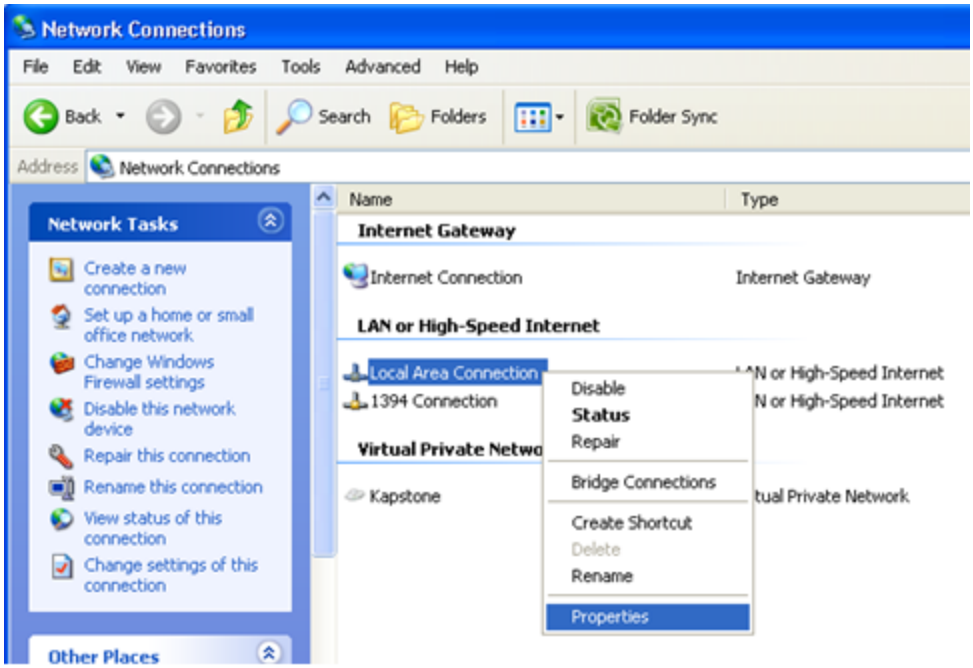
   Note: DNS servers are not needed for the connection.

2.7.2 IP SET UP FOR WINDOWS XP WITH FIXED IP

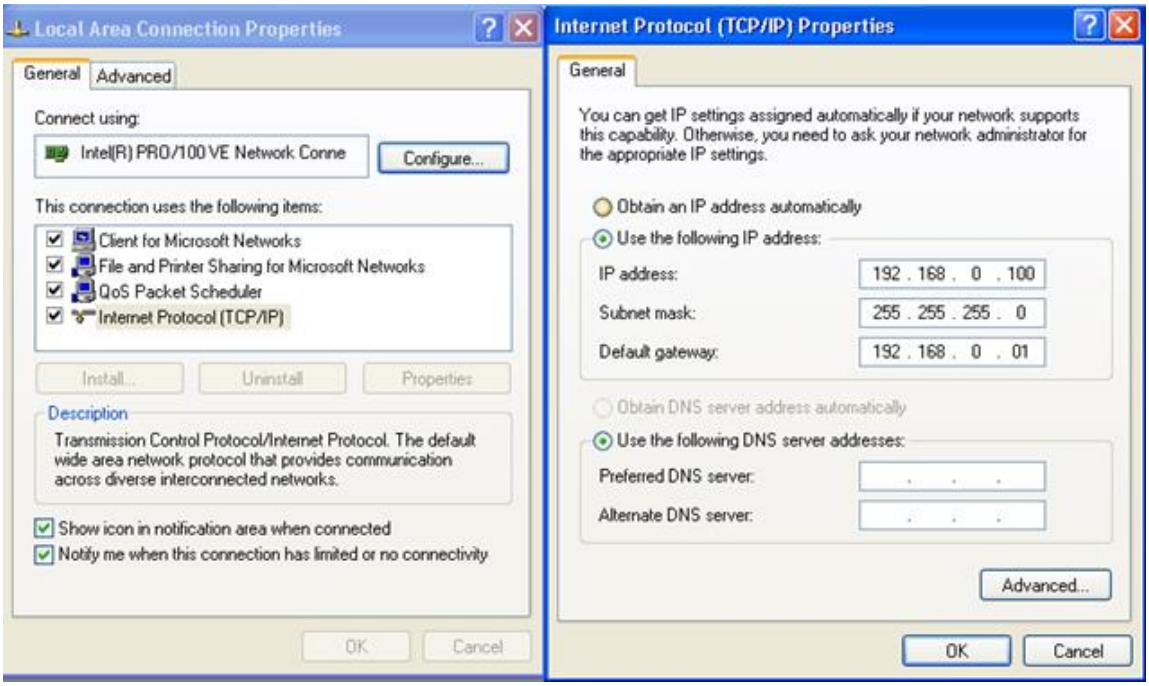
1. Go to the ‘Control Panel’ and double click ‘Network Connections’



2. Right Click ‘Local Area Connection’ and select ‘Properties’



3. Select ‘Internet Protocol [TCP/IP] and click ‘Properties’



4. Finally check “Use the following IP address”

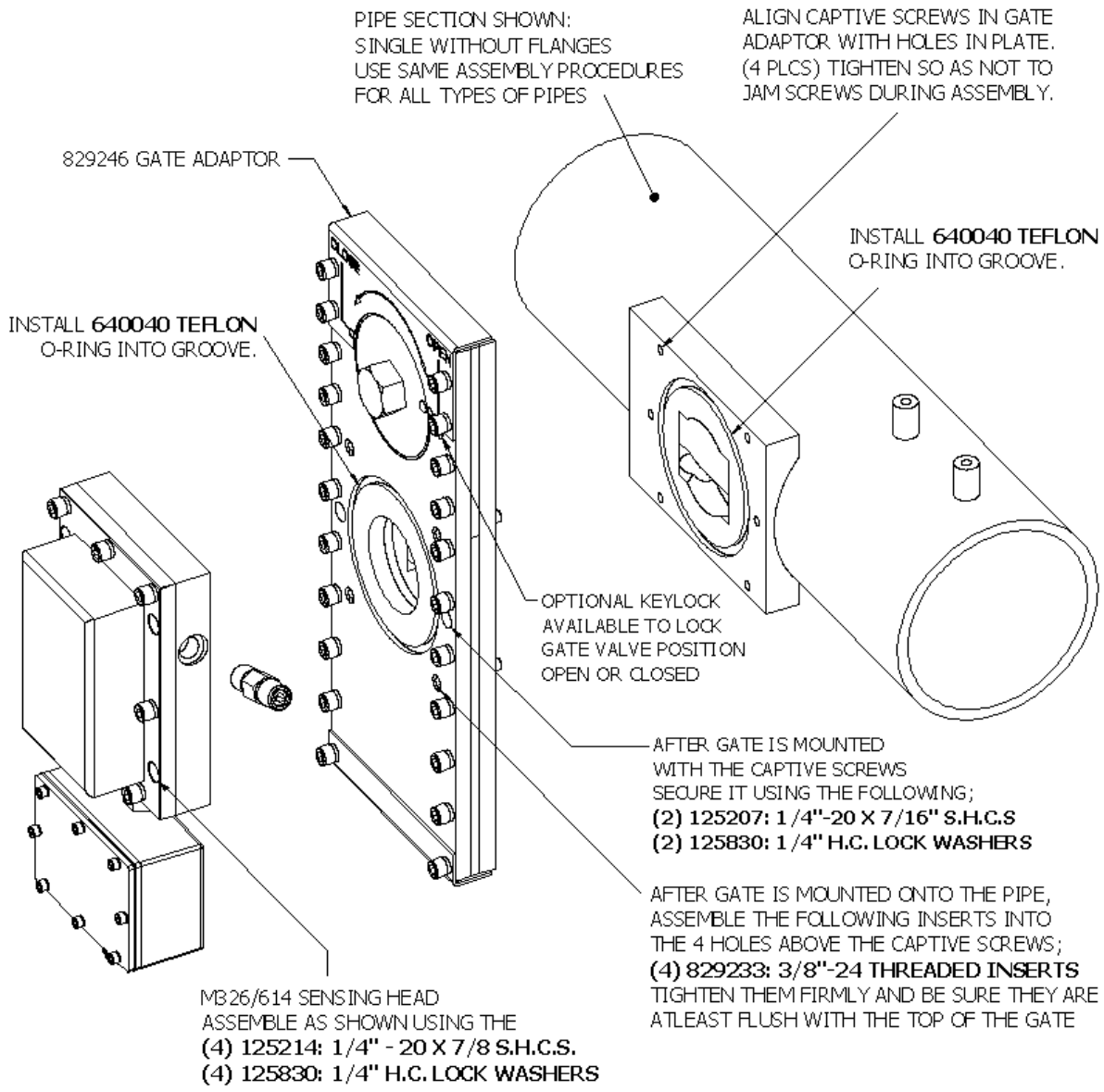
   - Enter 192.168.0. (Any number in the range of 2-255 that doesn’t conflict with another IP address in the same network, including any LSC units.)
   - Enter 255.255.255.0 for the ‘Subnet Mask’
   - Enter your default gateway. Typically 192.168.0.1

   Note: DNS servers are not needed for the connection.

2.8 GATE ADAPTOR "ISOLATION VALVE"

The Gate Adaptor is installed on a pipe section between the Sensing Head to allow isolation of the Sensing Head from an Active Process Line. The Gate Adaptor is mounted to the pipe section by six 1/4 - 20 bolts. A White Teflon O-Ring is placed between the pipe section and the Gate Adaptor before fastening down the Gate Adaptor. See section 6.2.3. for installation of the Gate Adaptor. The Gate Adaptor employs a complete slide gate that is moved by an eccentric cam. To open and close the gate, a 1" (25.4mm) hex nut is turned just under a half of a turn so that the indicating dot aligns with the "OPEN or "CLOSED" indicator. A 1/4" long shank lock should be used to verify that the gate is fully open or fully closed by sliding the lock though the alignment lockout hole. See Figure 32 in section 6.2 for part description and maintenance of the Gate Adaptor.

Figure 25
Gate & Sensing Head Assembly



3. GETTING STARTED

Before turning the power ON to the Model 326, re-check all the wiring per the prints provided with the system and the information given in the installation section of this manual. Be sure the On/Off Switch is set to the "OFF" position before plugging the power cable in. Most units are calibrated at the LSC factory according to parameters provided by the customer. When this is the case, it is possible to start right up and go.

3.1 START UP SEQUENCE

Turn the red & silver power switch (Item #10 in figure 4) ON in the Model 326. The display will show the boot up sequence consisting of 10 seconds of a flashing white screen, 1 minute of text, a blank screen for 30 seconds and finally a white screen with an x in the center until the home page is displayed. It takes approximately 2 minutes before the unit's homepage is displayed.

4. MENUS

The 326 software was designed to be extremely user friendly and straight forward. From the homepage there are either 3 or 4 available menus depending on whether the unit is an X1 or X2 respectively. After 5 minutes of inactivity under one of the menu screens, the unit is programmed to return back to the home screen.

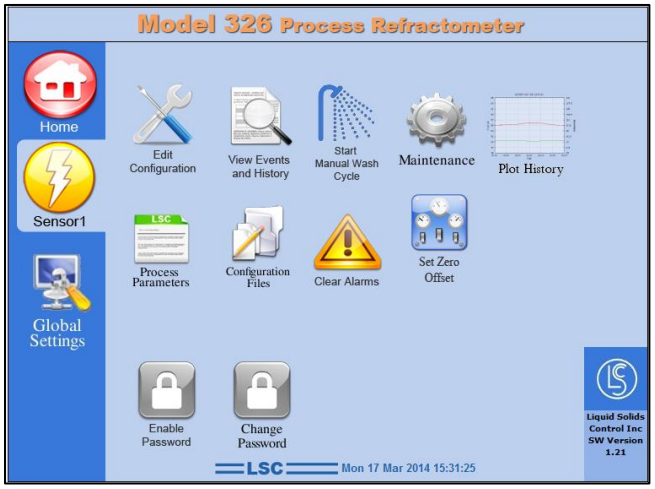
4.1 HOME / OPERATE SCREEN

This is the main screen in which the unit is designed to operate on. All information on the current conditions of the sensing head is displayed here. When selecting a menu from the home screen, a double click / touch of the icons is necessary. Once off the home screen the pages are static and a single click / touch is all that is needed.

4.2 SENSOR PARAMETERS MENUS

This is where the majority of the sensing head's settings are accessed and changed. The sub-menus available and the purpose of each are explained in detail on the next 2 pages.

Figure 26
Sensor Parameters Menu



4.2.1 EDIT CONFIGURATION 

This is one of the most important menus. In it you can set the following parameters;

Units Min/Max	Allows you to set the Min/Max span for the measurement. In this menu you can also name the units of measurement I.e. % Solids, % Concentrate, % by Weight, Brix, Etc.
Units Digits	Set the accuracy of the measurement. Up to 4 decimal places.
Alarm Set points	Can be set for either Lo/Hi or System Events. When "Lo/Hi" is selected the 'A' Alarm signifies a low reading while 'B' is High When "System Events" is selected the "A" alarm signifies Low AND High readings while the 'B' alarm contacts are utilized for any System events / maintenance alarms.
Temperature Settings	This section allows the user to choose the temperature scale they prefer. (Celsius or Fahrenheit), Set the minimum and maximum temperature (low & high) and the target operating temperature.
Temperature Compensation	Temperature compensation is entered here. See section 4.2.2
Wash Settings	All settings for an automatic prism wash are set here. See section 4.2.3 for more detail about setting an automatic prism wash
History Write Period	This determines how often, in seconds, the unit records information useful for troubleshooting. More details on the history files and correlation between period length and overall time can be found in section 4.2.4
Process Name	The name of the process is fully customizable using the keyboard.

TYPE THE DESIRED SETTINGS INTO THE APPROPRIATE FIELDS & PRESS SUBMIT WHEN DONE.

4.2.2 TEMPERATURE COMPENSATION

Before adjusting the TEMPERATURE COMPENSATION, you must set the TEMPERATURE RANGE and the OPERATING TEMPERATURE under TEMPERATURE SETTINGS first. As the temperature of the process changes, the refractive index, "RI" of that process also changes, while the **actual dissolved solids** remains constant. The amount that the RI changes, in reference to temperature, varies between processes and temperatures. This instrument has the ability to program multiple compensation values to compensate for these variations in RI during temperature swings. Note: the unit will only compensate within the TEMPERATURE RANGE set in Section 4.2.3 Extensive research has been done by LSC in determining the amount of compensation required for a process at different operating temperatures. This compensation is called the TEMPERATURE COMPENSATION VALUE ADJUSTMENT or "TCVA", and is a function of the change in Refractive Index and temperature. Below is a formula for calculating the TCVA, or call your local LSC representative. (See Section 8 for technical support).

$$TCVA = (\%\ CALIBRATION\ SPAN) \times (\delta\ RI/^{o}C) / (RI\ SPAN)\ (\delta = DELTA)$$

4.2.3 WASH SETTINGS

LSC's default prism wash is a smart wash every 20 minutes with a 40 second hold. However, optimal wash settings can vary greatly depending on the process being monitored.
Under the 'Wash Settings' the following parameters can be changed;

Wash Cycle (How long between each wash occurs in minutes)
Wash Length (How long a wash lasts in seconds)

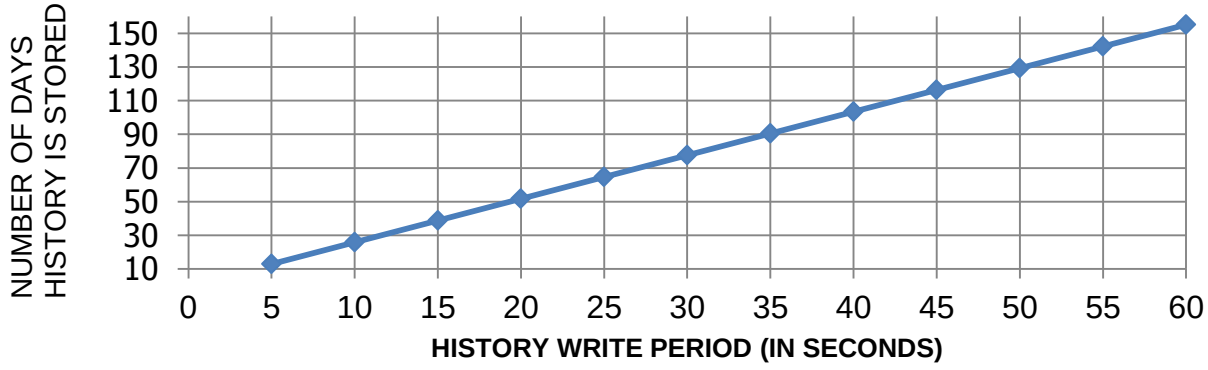
- A default SMART WASH is generally all that is necessary for most applications**. Smart Wash is turned on when the wash length is set to ZERO (0).** A Smart wash uses logic to determine when the prism has been sufficiently cleaned, it will wash until the micro-amp value is tripped or a maximum of 30 seconds. When it is successful the prism wash window will go straight into the holding cycle. If it is not successful a 'wash failed' alarm is triggered, the 326 will continue to try cleaning the prism by cutting the cycle time in half and trying again. If one of the following washes is successful the alarm is automatically cleared.

- Sometimes an application will require a more consistent wash length. A standard wash length is anywhere between 3 – 10 seconds. With the exception of applications which have a tendency to coat more, many Green Liquor applications can require extended washes up to and over 30 seconds.
  Note: Life of the head can be significantly shortened by long washes.

Hold Length (How long the unit holds the measurement it received before the wash began) this allows the concentration of the process to recover to regular operating conditions thus keeping the measurement stable. If a low solids alarm occurs after a wash, extend this setting. If problem persists, call an LSC representative.

4.2.4 HISTORY WRITE PERIOD

Every unit's default period is 15 seconds but it is common for customers to choose a range anywhere between 5 to 60 seconds depending on what suites their needs. For your reference the chart below shows the correlation between different write periods and the total amount of time the history is stored. This represents one history folder. The 326 stores up to 20 of these folders.



4.3 VIEW EVENTS AND HISTORY 

This menu allows you to view the event and history files as well as delete them.
Events consist of; "global events (big changes to the main settings of the unit) network changes, temperatures, acquire (watchdog status), prism washes & reference logs.
History shows diagnostics information from the sensor recorded according to the write period. Including; Date, Time, Value, Temperature, Sensor uA, Reference uA, and LED mA

4.4 MAINTENANCE SCREEN AND CALIBRATION 

The maintenance menu is where calibration of the sensor is performed. Calibration is the most important step of setting up a refractometer. Section 5 of this manual describes the calibration procedure in detail.

4.4.1 SETTING ACTUAL TEMPERATURE

This adjustment is rarely ever used, as the temperature sensor inside the sensing head, automatically measures the temperature accurately. However, in the case of intrinsically safe applications, the resistance of the ISB barriers will cause the temperature measurement to be slightly incorrect in which case this adjustment is required.

4.4.2 DELETE OR CLEAR LOCAL FILES

This button allows you to delete calibration files or clear the pub/incoming directories which hold files while loading/offloading diagnostic files to or from a remote computer via the remote web browser FireFox.

4.4.3 SETTING THE REFERENCE 

The 'Reference' is the micro-amp signal from the detector that is used to control the intensity of the LED inside the sensing head. The 326 provides 4 reference options. The default setting is 20 uA. The optimal current varies depending on the application. Generally when measuring a hot process a low setting of (15 uA) will extend the life of the LED, while a high setting is better suited for measuring within a narrow range.

4.5 PROCESS PARAMETERS 

This screen provides a summary of the current configuration file settings. The configuration file that is displayed under the 'Value' column (lscnet_1.cfg) is the default 'Run-time file.' The name of this file will NOT change when a new file is either saved or loaded. Essentially this creates 2 configuration files with the same settings (lscnet_1.cfg and the new file) this was done to create a fail-safe in case the master file gets corrupted there will always be another file that is ok.

4.6 CONFIGURATION FILES

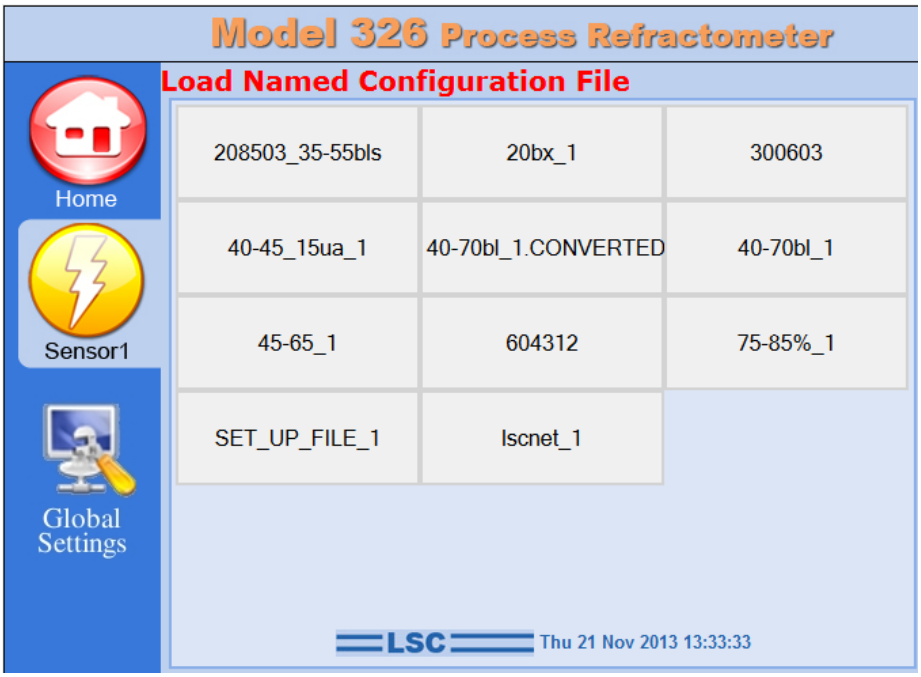
4.6.1 SAVING A NEW CONFIGURATION FILE

Sensor -> Configuration Files -> Save As New Configuration File

Name the file appropriately using the key board. The file is often named after the serial number, loop number, or significant calibration points of that particular file. Unfortunately some obscure characters such as slashes, question marks and quotes tend to have a problem saving and or being deleted after so should avoided.

4.6.2 LOADING A SAVED CONFIGURATION FILE

Sensor -> Configuration Files -> Load Named Configuration File
Loading an older previously configured file is now as simple as 1 click of the desired file name.



The 'lscnet_1' config file is the default run file of any 326 unit. In other words when a configuration is saved, 2 files are actually created. 1 being the "named file" and the 2nd is a copy of that same file which overwrites the 'lscnet_1' This feature is built into the software in the rare case a file gets corrupted. The file with the actual name will always be able to be re-loaded

4.6.3 CONVERT CONFIGURATION FILE FORMAT

The file format changed with the release of software version 1.18 and all succeeding releases.
To load an older file created using versions prior to 1.18, first the file must be converted. To do so enter 'Convert Configuration File Format' and select whichever file that needs to be converted. At this point the file is automatically converted and loaded to work properly on ver. 1.20 or newer software. Now you should select the Sensor 1 icon and click on the Configurations icon. This will allow you to save the converted file to a name which can be retrieved later. If you forget to do this you can retrieve them in the 326.zip file when you offload the diagnostic files from FTP or Thumb Drive. The converted file will be labeled with 'its' NAME.cfg.converted. The original file will be 'its' NAME.original.version. You will not be able to see these from the Load Configuration Page.

4.7 GLOBAL SETTINGS

This menu is used to change the main settings of the 326 in general, rather than each individual head. In it you can change network settings, date / time settings, transfer files, change/set a password, and restart or shutdown the system and verify the software version.

Figure 27
Global Settings Menu

4.7.1 NETWORK SETTINGS 

This is where the I.P. Address, Netmask, or Gateway can be changed. The default I.P. Address from LSC is 192.168.0.10 unless otherwise specified. In applications where there are more than one unit on the same network each one will require a different address. Please refer to your network manager for the appropriate settings specific to your network. Simply retype the new settings into the spaces provided and press submit when done. A system reboot will be required.

4.7.2 DATE/TIME SETTINGS

This allows you to change the time and date to your local time zone. Please note that this can affect the prism wash clock. If you do make a time change please go to "Edit Configuration" on the "Sensor 1" page and reset your prism wash parameters.

One more note, if you change the time backwards from a remote web browser, the local touchscreen on the Model 326 Transmitter will not update until you select one of the icons (Sensor or Global) on the display. Once you do this, the 326 page is refreshed, which displays the time accurately. This is not needed when you change the time forward.

4.7.3 TRANSFER FILES

This can be used to transfer files TO or FROM the 326 or to update the software via a thumb drive. When transferring files TO the 326; select that option. Click browse, select the appropriate file, click 'open' then finally 'submit'. This option is used for installing configuration files from another computer or even another unit on the 326 refractometer.

When getting files FROM the 326; select that option, a new screen will appear. The only files that can be retrieved are the configuration files and the main zip file which contains all diagnostic information. Send the Zip file to LSC for factory troubleshooting assistance.

Certain software updates and patches can be installed via a thumb drive. Patches will not affect calibration files that are currently installed. When LSC sends these types of updates they can be sent via an Email attachment, offloaded on to a customer's thumb drive and installed using the 'Update Software from Thumb Drive' feature. However, when a completely new version of software is released LSC will send a new compact flash with the most current release installed. Configuration files can be transferred and global settings will have to be reset.

4.7.4 CHANGING AND ENABLING PASSWORD

Some customers like to prevent unauthorized people from accessing certain settings. By default the unit does NOT have any passwords set. There are 2 levels of password protection, one for 'Global Settings' and one for the 'Sensor' menu. To create one, go to the menu to be secured, click 'Change Password' and CAREFULLY type in a password of your choice using either numbers or letters. **Note: The password IS case sensitive.** The 2 passwords are independent of each other but can be the same if desired. It is important to enter the desired password accurately because there is currently no redundancy check. If for some reason a password was entered wrong or forgotten contact your LSC rep. to access the menu again.

4.7.5 SHUT DOWN AND REBOOTING

A soft shutdown is required before the power to the unit is turned off. This is done by pressing the red Shutdown button on the bottom of the screen. A command prompt will be displayed for about 30 seconds. Once the screen turns completely white it is safe to turn the power switch on the Interconnecting Board off and unwire the unit if necessary. For convenience a Reboot System and Reboot Programs feature has been added. These are only necessary for a network change or software patch to take effect. Rebooting the programs only takes a few seconds and may help correct any glitch in the system without interfering with the measurement.

5. CALIBRATION

NOTE: THE PRISM WASH NEEDS TO BE TURNED OFF ANYTIME YOU CALIBRATE THE REFRACTOMETER. TO DO THIS, GO TO THE PROPER "SENSOR" PAGE AND SET THE WASH CYCLE TO ZERO (0).

The following calibration procedure could be done annually (if required by customers preventative maintenance program or policy) to assure proper equipment operation and accuracy. Generally, calibration is only required when there is a discrepancy between the Model 326 reading and a reliable off line equivalent. It should also be performed if there is a detector or prism replacement, or a change in process liquid that does not already have a calibration in a process file. All LSC units are pre-calibrated at the factory to site specifications. These calibrated settings are saved as a configuration file, and are listed on the calibration data sheet at the beginning of the manuals received with the system. Loading this file will set the system back to the factory settings. It is not necessary to calibrate the system during initial startup, as the system has been factory calibrated.

Note: If calibrating to a different range, it will be necessary to use the appropriate upper and lower calibration samples. Call your local LSC representative for samples.

5.1 TOOLS REQUIRED

The following tools may be required to perform the calibration procedure:

- Wrench, 1" (Used for closing the Gate Adaptor "isolation valve" if installed)
- Wrench, Adjustable (Used to remove prism wash tubing if installed.)
- 3/16" Allen Wrench (Used to remove Sensing Head)
- Soft Paper Wipes (Used for cleaning the prism window)
- Opaque Cover (Used to cover sample when calibrating)
- Calibration samples: - one for the lower end (min), and one for the higher end (max). LSC supplied calibration samples are recommended but not necessary. If you use other samples be sure they represent the dissolved solids measurement of the process at operating temperature, not ambient temperature. These samples do not have to be the actual process liquid. When the actual process liquid is unstable or volatile, it is recommended that a stable, safe solution be used. Consult your LSC representative for suggestions on suitable calibration samples.

5.2 CHECKING SET POINTS

It is important to verify that the rest of the configuration settings are accurate for your application requirements before starting a calibration. When parameters are changed, the changes will be written to a file called LSCNET_1.cfg. If any changes have to be made to the file, be sure to save the file and record the number or name of the file. It is important to have a backup for your LASTNET_1.cfg file. If no changes are made, your original file name is still a valid backup file.

5.3 OFF-LINE CALIBRATION PROCEDURE

NOTE: THE PRISM WASH NEEDS TO BE TURNED OFF ANYTIME YOU CALIBRATE THE REFRACTOMETER. TO DO THIS, GO TO THE PROPER "SENSOR" PAGE AND SET THE WASH CYCLE TO ZERO (0).

When doing a calibration for the first time, read through the complete procedure before starting.

1.1) If Prism Wash is installed turn off the prism wash, air and steam supplies.

1.2) If a Gate Adaptor is installed, completely close the gate before removing the head. To verify the gate is fully closed check that the lock porthole is clear by sliding a lock, or pencil though the porthole. (See figure 30 for the location of the lock porthole.) ONLY once the gate is fully closed remove the Sensing Head. Otherwise, the process must be shut down and the liquid drained from the line before removal of the Sensing Head.

1.3) For prism wash applications, remove the nozzle by removing the two mounting screws.

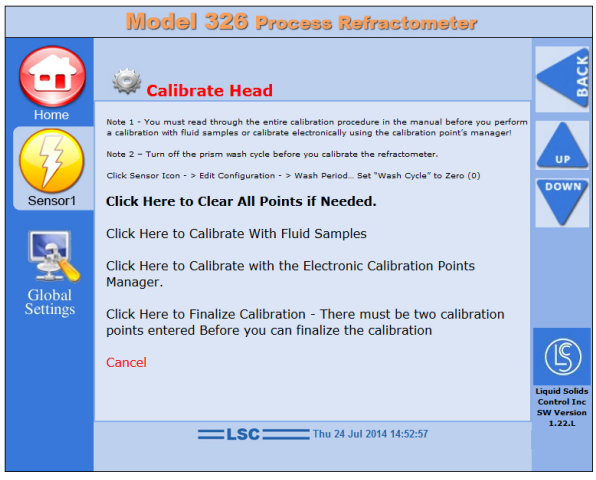
1.4) Clean the prism surface **well**. **Wait** for the sensing head to stabilize to ambient temperature. First washing the Sensing Head with warm water and then cool water may speed up cooling the Sensing Head down to ambient temperature. **DO NOT cool a hot sensing head with cold water!** A rapid temperature change can crack or damage the prism! It is important that the Sensing Head is at a stable ambient temperature before proceeding with the calibration.

2) Calibration Procedure; Select the sensor you wish to calibrate 'Sensor 1' or 'Sensor 2'
Enter the head's Maintenance menu and click 'Calibration'

Please remember that you should have already entered in the proper "min" and "max" set points under the edit configuration before performing this calibration.

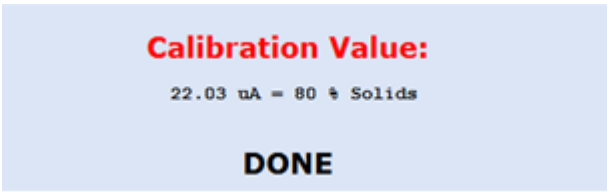
326 X2 USERS Note: It is critical that you select the appropriate sensing head before starting calibration. Only one sensing head can be calibrated at a time.

2.1) To create a new calibration the user must "Clear All Points" first. The current configuration file will still be able to be accessed using the "Load Configuration File" button and the parameters of it will transfer to the new one.



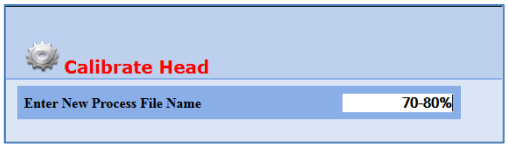
2.2) Apply 10 - 15 drops of low end or (zero) sample on the prism surface, cover with an opaque lid and press '**calibrate with fluid samples**' It is best to use a low-end sample provided by LSC which represents the low-end range point, but not necessary.

2.3) On the next screen press "**Take Sample**" After about 20 seconds it will show the below screen. **Enter the value of the sample used and press submit** when done. The micro amps and the corresponding sample value that was just entered will be displayed. **Press 'Done'** and it will go back to the main calibration screen.



2.4) Wipe off the previous sample completely. For best results use a drop of the next sample on the prism and wipe that off as well. Repeat the last 2 steps with another sample.

2.5) After the 2nd point is entered the system will now allow the user to **"Finalize Calibration"** In the Finalize Calibration screen, double check the "Lo & Hi" Calibration points then press **'Save As'** Finally using the keyboard enter a name for the new process file. The low and high cal. points can be a good way to keep track of the different config. Files.



3) Reinstalling the Sensing head;

3.1) Reinstall the prism wash nozzle (if installed) and mount the Sensing Head to the pipeline or vessel with using a new O-ring. Reconnect the Steam Supply (if removed).

3.2) Refill the pipe line or vessel with process fluid and / or Open the Gate Adaptor (if installed).

3.3) Turn the air and steam supplies on for the prism wash (if installed). **Go back to the "Sensor" page and turn the Wash Cycle back to the original setting.**

3.4) Wait for the head to stabilize to operating temperature.

3.5) Set the zero offset and or linearize if necessary. (See section 5.6 and or 5.4)

5.4 LINEARIZATION

If your process is a non-linear process, then it requires additional calibration points to be added to the configuration file. In prior systems this was performed separate from calibration. However the 326 (ver. 1.18 or newer) has incorporated linearization into the calibration procedure. A technician now has the ability to put more than 2 different samples (Up to 25) on during the calibration process and the software linearizes all the points together. When adding linearization points to an existing calibration file the procedure is the same as a new calibration except the "Clear All Points" button discussed in step 3.1 of the previous section is NOT pressed.

The points can also be entered manually using the 'Calibration Points Manager' in section 5.5

5.5 CALIBRATION POINTS MANAGER

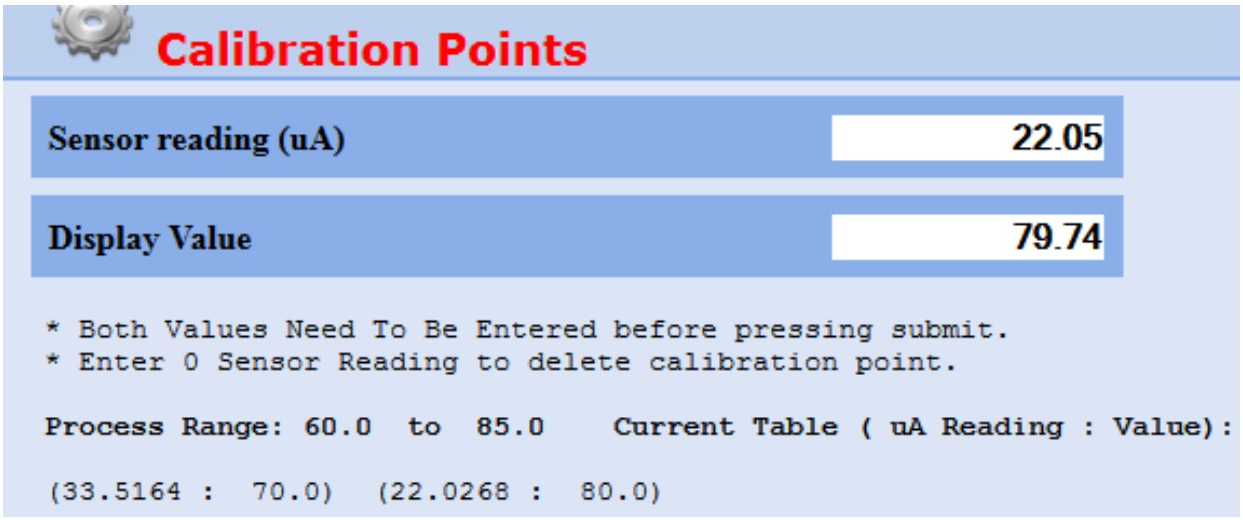
NOTE: THE PRISM WASH NEEDS TO BE TURNED OFF ANYTIME YOU CALIBRATE THE REFRACTOMETER. TO DO THIS, GO TO THE PROPER "SENSOR" PAGE AND SET THE WASH CYCLE TO ZERO (0).

This is an entirely new feature added to broaden LSC's capabilities. This gives the technician the ability to manually enter calibration points electronically.

1) Record micro-amp value (next to Sensor) from the 'Home' screen

2) As Soon As Possible take an offline sample as close as possible to the sensing head.

3) Enter both these values into their respective places. As shown



4) Please note that you must enter two or more calibration points before you may Finalize the calibration. To do so, click 'Finalize Calibration' and it will prompt the user to save the calibration file.

Note: Remember to go back to the "Sensor" page and turn the Wash Cycle back to the original setting.

5.6 ZERO OFFSET

If the reading displayed is different than a proven off-line measurement and the desire is to have the refractometer reflect the offline measurement then click the Zero Offset icon under the Sensor menu and enter the value to be offset to and press submit. This adjustment will change the 4-20 mA output, the 0-10 VDC output and the displayed value. It does NOT change the slope of the calibration it merely shifts the scale up or down.

6. MAINTAINING THE EQUIPMENT

This section is a recommended annual maintenance for the Sensing Heads and Gate Adaptor.

6.1 SENSING HEAD MAINTENANCE

Before removing the Sensing Head from the Process Line or Vessel make sure they are empty and open to atmospheric pressure. If prism wash is installed, turn off the Steam and Air Supply. If a Gate Adaptor is installed, completely close the gate. To verify the gate is fully closed check that the lock porthole is clear by sliding a lock, or pencil thought the porthole. (See figure 30 for the location of the lock porthole)

1) Cool the Sensing Head down to ambient temperature. DO NOT cool a hot sensing head with cold water as it may thermally shock / damage the prism.

2) Check to see if the Prism is etched, pitted, foggy, or damaged visually. Inspect the prism gasket to insure it is not leaking. If Prism is damaged or leaking replace it (See Section 6.1.1 on the next page.)

3) Remove T-Box and Head Cover & check all termination's in the T-Box & on the terminal strip inside the Sensing Head. Check for loose connections, frayed wires or corrosion. If wires are loose tighten the connection. If there is any corrosion or fraying apparent on the connectors, replace and re-crimp them.

4 **In-line Sensing Head: (Figure 7)** Remove the LED (Item 30) from the Collimating Lens Holder. (Item 31) Check the lens in the Collimating Lens Holder to be sure these lenses are clean. If they are not, a dry cotton swab will clean the lenses. If this does not clean the lenses, use very little glass cleaner on the lenses. If cleaner is used, be sure no residue is left on the lens, wait for the lenses to completely dry before reassembling.

Insertion Probe: (Figure 8) Remove the LED (Item 9) from the Collimating Lens Holder. (Item 5) Check the lenses in the Collimating Lens Holder and the Focusing Lens Holder (Item 4) be sure this lens is clean. If it is not, a dry cotton swab will clean the lens. If this does not clean it, use some glass cleaner on the lens. If cleaner is used, be sure no cleaner residue is left on the lens, wait for the piece to completely dry before reassembling.

5) Visually inspect the two photocells on the detector. Check that they are firmly secured to the detector holder. The photocells should be clean and reflective, If there is a problem with the detector, replace the detector and re-calibrate the system.

6) **In-line Sensing Head:** Check the Sensing Head Cover O-Ring (Item 21) to see if it has still retained its memory. If it is flat or brittle replace it. However we recommend replacing it every time just to be safe.

Insertion Probe: Check the Insertion Probe's Cover O-Ring (Item 28) to see if it has still retained its memory, if it is flat or brittle replace it. However we recommend replacing it every time just to be safe.

7) Firmly tighten all screws and Allen Bolts.

8) Replace the sensing head and t-box cover if they are damaged.

9) If prism wash is installed, check that the wash port is clean. If not, clean the port by flushing warm water through the port. Inspect the Check valve; the spring must have a solid, positive return for a good seal on the O-Ring. The sensing head cover O-ring should be replaced after every time it is opened just for precautionary measures. Check the Ball valve; be sure it does not leak. If there is a problem with the ball valve, replace the valve. Watch the actuator; check that it fully returns to the open and closed positions, if it does not, replace the actuator.

6.1.1 PRISM REPLACEMENT

Replacement of the Prism is required if the Prism becomes etched, pitted, foggy, or damaged. The following procedure must also be followed if the Prism Gasket needs to be replaced due to a leak. (See Figures 28 & 29 below for an exploded view of the prism assembly).

1) Remove Sensing Head Cover and the T-Box. Remove all internal components, and clean the internal surface of the base plate and the prism seat.
2) Use a new Prism Gasket! DO NOT reuse the old gasket. Also use new Belleville washers.
3) Assemble the parts as shown in figure 28 & 29, be sure the gasket is centered on the prism.
4) While the Sensing Head is still COLD, torque the Hold Down Screw to 25 inch-lbs.
5) Bake the assembly at 400ºF (200º C) for 4 hours.
6) After baking for 4 hours, and while the Sensing Head is still HOT, torque the hold down screw to 35 inch-lbs. With a sharp knife, remove any gasket material extruded over the prism surface on the underside of the base plate.
7) Tighten the Hold down Screw Lock Nut to prevent loosening of the Hold Down Screw.
8) Re-assemble the T-Box and all the Sensing Head components. Replace any components of the Sensing Head that may need changing. (Refer to figure 7 and 8 for detail drawings of the Sensing Heads) Finally, Re-Calibrate the Sensing Head to the system. See Section 5.

Figure 28
Inline Prism Assembly

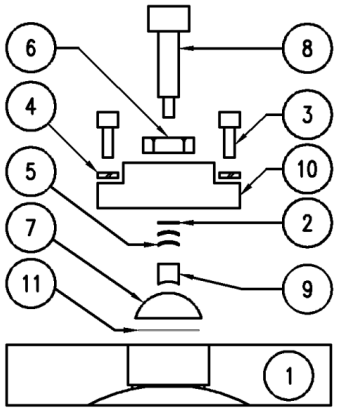


Figure 29
Insertion Probe
Prism Assembly

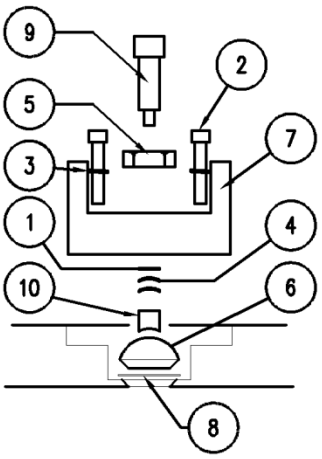


Table 9
Prism Assembly Parts

#	PART #	DESCRIPTION	QTY
1	X	BASE PLATE	1
2	104810	#4 FLAT WASHER (LARGE)	1
3	106207	S.H. CAP SCREW #6 - 32 x 7/16	2
4	106830	#6 HIGH COLLAR LOCK WASHER	2
5	106840	BELLEVILLE SPRING #6 WASHER	2
6	125860	1/4"- 28 THIN JAM HEX NUT	1
7	610100	SAPPHIRE PRISM	1
8	829050	HOLD DOWN SCREW	1
9	829051	HOLD DOWN PAD	1
10	829052	HOLD DOWN BLOCK	1
11	829098	TEFLON GASKET PRISM	1

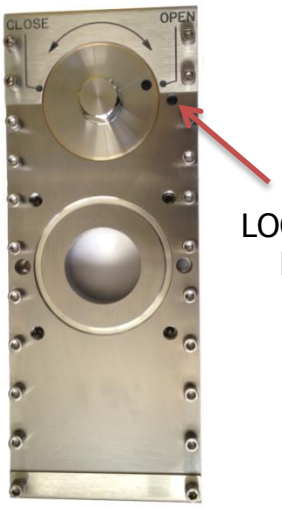
Table 10
Prism Assembly Parts

#	PART #	DESCRIPTION	QTY
1	104810	#4 FLAT WASHER (LARGE)	1
2	106208	#6-32 SHCS X 3/4" LG	2
3	106830	#6 HIGH COLLAR LOCK WASHER	2
4	106840	BELLEVILLE SPRING #6 WASHER	2
5	125860	1/4"- 28 THIN JAM HEX NUT	1
6	610105	PRISM, SAPPHIRE – PROBE	1
7	725099	BRACKET, HOLD DOWN, PROBE	1
8	725108	GASKET, PRISM – INS PROBE	1
9	829050	HOLD DOWN SCREW	1
10	829051	HOLD DOWN PAD	1

6.2 GATE ADAPTOR MAINTENANCE

The Gate Adaptor employs a completely captive slide gate that is moved by an eccentric Cam. To OPEN and CLOSE the Gate a 1 inch (25 mm) hex nut is turned just under a half a turn so that the indicating dot aligns with the OPEN or CLOSED indicator. When the Gate is fully OPEN or fully CLOSED, a ¼" Long Shank Lock will slide thru the Lock locator porthole, reassuring the fully open or fully closed position of the Gate.

Figure 30
Gate Adaptor



6.2.1 REMOVAL & ANNUAL REBUILD OF THE GATES

Before removing the Gate Adaptor from the Process Line, make sure the line is empty and that the line is open to atmospheric pressure.

1) Remove the Sensing Head from the Gate Adaptor by removing the four, 1/4" x 7/8" long Socket Head Cap Screws.

2) Remove the 4 threaded inserts from the sensing head mounting holes, allowing access to four of the six Gate Adaptor mounting bolts.

3) Unscrew the two 1/4"-20 x 7/16" center mounting bolts (P/N 125207) that hold the gate to the pipe section. Then remove the four corner bolts. Note that the four corner bolts are captive and must be unscrewed in successive increments to avoid jamming.

4) Dismantle the Gate Adaptor by removing the 22 socket head cap screws.

5) Remove O-rings and clean all parts. Also clean all foreign matter from the O-Ring grooves.

6) Inspect all parts for visual damage. Replace all O-Rings and repair or replace damaged parts.

7) File high spots around the Cam Oval on the Slide Plate and on the Bottom Plate with a fine metal file. Be sure to file the surfaces to re-attain their original dimensions so when re-assembly takes place; there is unrestricted movement of the Slide.

6.2.2 GATE RE-ASSEMBLY

1) For ease of assembly, place the bottom plate on a pair of riser blocks at least 1/2" thick.

2) Apply a thin layer of High-Temperature Teflon Grease (LSC P/N 829487) to the internal surfaces of the Top and Bottom Plates. Fill the O-Ring grooves, and the semi-circle pocket the Cam sits in. (See Figure 31). This lubricant protects the O-Rings and moving parts during operation. Use of other lubricants could lead to leaking or eventual seizing.

3) Press the O-Rings (LSC#'s 640065 & 640023) into the appropriate grooves of the top and bottom plates and smooth any excess grease.

4) Place the four 1/4"-20 x 3/4" (LSC P/N 125212) captive gate mounting bolts, with High Collar Lock Washers into the counter bored holes in the Bottom Plate.

5) Position the Slide on the Bottom Plate; aligning the Oval Hole over the C-shaped cutout in the Bottom Plate while ensuring the slide is also in the Gate Open Position.

6) Place the greased Cam Actuator assembly in the Slide with the Small Bearing in the Oval Hole.

7) Place the Side Rails on the Bottom Plate. Note: When placing the Small Side Rails on the Bottom Plate, the holes are offset to one side of the side rail. Place these small side rails with the offset holes closest to the Slide Plate.

8) Situate the Top Plate onto the arranged assembly, guiding the Cam Actuator into the opening of the Top Plate.

9) Position the End Cover Plates and install the 22 socket head cap screws (complete with lock washers and anti-seize compound). Note: The Bolts used with the end plates are 1" long and all others are 7/8" long. Tighten the bolts in succession starting with the center and alternate progressively to the ends.

10) Slowly cycle the actuator back and forth several times (using a 1" (25 mm) box end wrench) to evenly distribute the grease, removing any excess that squeezes out. NOTE: When cycling the gate, it must go all the way to the closed position before returning to the Open position. This will ensure that the O-Rings are seated properly in the O-Ring grooves.

6.2.3 INSTALLING THE GATE ADAPTOR

1) Before mounting the Gate Adaptor to the pipe, make sure the pipe mounting plate surface and O-Ring groove are clean.

2) Install a new O-Ring (LSC# 640040) into the pipe mounting plate O-Ring groove.

3) Position Gate Adaptor on the pipe and fasten with the four captive bolts. Note these bolts are captive and must be screwed successively to avoid jamming. (Be sure to use anti seize compound on the threads).

4) Install the two 7/16” bolts with their lock washers.

5) Screw the four threaded inserts into the four captive bolt holes. BE SURE EACH INSERT IS SCREWED BELOW THE SURFACE OF THE TOP PLATE, BOTTOMED AND TIGHT!

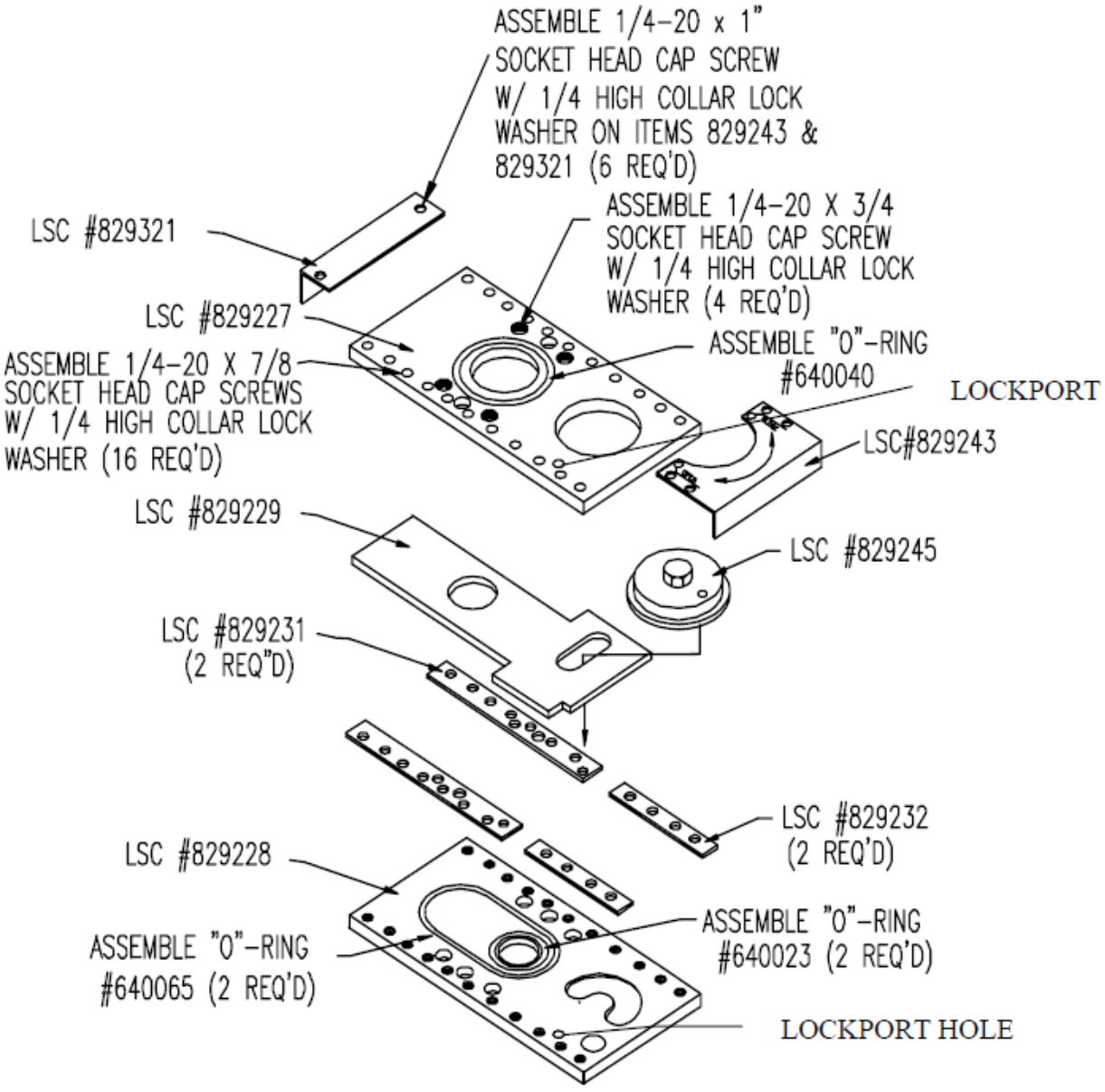
6) Seat a new Teflon O-Ring (P/N 640040) into the grove on the gate and install the Sensing Head, Steam Fittings and Gate Adaptor Limit Switch. (If removed)

7) Cycle the gate OPEN.

8) Turn on the steam and air supply to the prism wash system.

   NOTE: DUE TO THE CLOSE TOLERANCES IN ALL LOCATIONS WHERE SOCKET HEAD CAP SCREWS ARE USED, HIGH COLLAR LOCK WASHERS MUST BE USED.

Figure 31
Gate Assembly



326903 : IN-LINE SENSING HEAD SPARE PARTS KIT

QTY	DESCRIPTION	PART #
4	SCREW, PH #2-56 X 3/8 LONG	102006
4	LOCK WASHER, # 2	102820
3	SCREW, SH/CS #6-32 X 3/8 LONG	106206
2	LOCK WASHER, # 6 HC	106830
7	SCREW, SH/CS 1/4-20 X 7/8 LONG	125214
7	LOCK WASHER, 1/4 HC	125830
1	PRISM SAPPHIRE	610100
1	TEMPERATURE SENSOR ASSEMBLY	614300
1	O-RING, 3-5/8 OD X 3-3/8 ID	640040
1	O-RING, 4-7/16 OD X 4-1/4 ID	640066
1	GASKET T – BOX	725010
1	DETECTOR HOLDER ASSEMBLY	725307
1	LIGHT SOURCE ASSEMBLY	725308
1	GASKET PRISM SEAL	829098

326925 : GREEN LIQUOR PROBE SPARE PARTS KIT

QTY	DESCRIPTION	PART #
1	PRISM, SAPPHIRE PROBE	610105
1	TEMPERATURE SENSOR ASSEMBLY	614300
1	O-RING – EP 2” OD X 1 7/8” ID	640156
1	GLP O-RING – TEFLON, 4 1/4” OD X 4” ID	640167-T
1	GLP O-RING – TEFLON, 3” OD X 2 3/4“ ID	640168-T
1	GASKET, PRISM INSERTION PROBE	725108
1	DETECTOR HOLDER ASSEMBLY	725307
1	LIGHT SOURCE ASSEMBLY (LED)	725308
1	GREEN LIQUOR PROBE HARDWARE KIT	326911

326911 : GREEN LIQUOR PROBE HARDWARE KIT

QTY	DESCRIPTION	PART #
4	SCREW, PH #2-56 X 3/8 LG	102006
1	SCREW, PH #2-56 X 1/8 LG	102202
4	WASHER, LOCK # 2	102820
2	SCREW, SH/CS # 4-40 X 3/8 LG	104206
1	SCREW, SH/CS # 4-40 X 1/4 LG	104210
1	WASHER, FLAT # 4 LARGE PATTERN	104810
6	WASHER, FLAT # 4 SMALL PATTERN	104815
6	WASHER, LOCK # 4	104820
4	SCREW, PH # 6-32 X 5/8 LG	106010
2	SCREW, PH # 6-32 X 3/4 LG	106208
1	SCREW, PH # 6-32 X 3/8 LG	106206
6	WASHER, LOCK # 6	106820
2	WASHER, SPRING # 6, BELLEVILLE	106840
1	NUT, HEX THIN JAM 1/4-28 (18-8 SST)	125860
6	SCREW, M3 X 12 mm LG, PH (304 SST)	129552
10	WASHER, SPLIT LOCK M6(316 SST)	129553
2	SCREW, HEX HD CAP M6 X 25 mm (316L)	129566
8	SCREW, HEX HD CAP M6 X 22 mm (316L)	129568
6	TERM RING # 2	170430

829254 : GATE ADAPTOR SPARE PARTS KIT

QTY	DESCRIPTION	PART #
1	CAM ASSEMBLY	829245
4	THREADED INSERTS	829233
2	O-RING (SMALL) TEFLON ENCAPSULATED	640023
2	O-RING (LARGE) TEFLON ENCAPSULATED	640065
2	O-RING (WHITE)	640040
1	STICK FREE LUBE	829487

326915 : INSERTION PROBE SENSING HEAD SPARE PARTS KIT

QTY	DESCRIPTION	PART #
4	SCREW, PH #2-56 X 3/8 LONG	102006
4	LOCK WASHER, # 2	102820
1	SCREW, PH #6-32 x 3/8 LONG	106006
2	SCREW, PH #6-32 x 5/8 LONG	106010
2	WASHER LOCK #6	106820
6	SCREW, PH #8-32 x 1/2 LONG	108008
6	WASHER LOCK #8	108820
1	PRISM SAPPHIRE - PROBE	610105
1	TEMPERATURE SENSOR ASSEMBLY	614300
1	O-RING 3-11/16 OD x 3-1/2 ID	640068
1	GASKET TRI CLAMP 4”	640105
1	GASKET PRISM INSERTION PROBE	725108
1	DETECTOR HOLDER ASSEMBLY	725307
1	LIGHT SOURCE ASSEMBLY	725308

326930 : M326 X1 TO X2 CONVERSION

QTY	DESCRIPTION	PART #
4	SCREWS, #4 – 40 X 1/4 (SEM)	104004-SEM
4	STANDOFF – M/F 4-40 X .593 LG	139209
1	CABLE, 16 PIN (X2)	326473
1	CABLE, 14 PIN (X2)	326474
1	INTERCONNECTING BOARD, DUAL	326403
1	REFRACTOMETER BOARD	614401

326935 : M326 TOUCH SCREEN CONVERSION

QTY	DESCRIPTION	PART #
6	SCREWS, #4 – 40 X 1/4 (SEM)	104004-SEM
4	WASHER, #6 FLAT NYLON	106816
1	FRONT PANEL, M326 W/ CUT OUT FOR DISPLAY	326104-COD
1	BRACKET, MOUNTING, CONTROLLER BOARD	326108
1	TOUCH SCREEN CONTROLLER BOARD	326111
1	TOUCH SCREEN DISPLAY, 326	480465
1	CABLE, USB DISPLAY	326467

8. TECHNICAL SUPPORT

If your questions are not answered by the information contained in this manual, contact one of our LSC locations listed below.

(Head Office)
LIQUID SOLIDS CONTROL, INC.
Upton, MA 01568
P.O. Box 259

Phone: (508) 529-3377
Fax: (508) 529-6591
Email: usa@liquidsolidscontrol.com

(Canadian Office)
LIQUID SOLIDS CONTROL
DIVISION OF LIQUID SOLIDS CONTROL, INC.

5723 Old West Saanich Road
Victoria, BC V9E 2H2, Canada

Phone: (250) 474-2243
Fax: (250) 474-3339
Email: canada@liquidsolidscontrol.com

MANUAL REVISIONS

1.17 - CHANGED FIGURES 2 & 3 TO REPRESENT NEW POWER SUPPLY
- UPDATED POWER SUPPLY SPECIFICATIONS
- ADDED IP ADDRESS SET UP AND CONNECTING ETHERNET SECTION
- REVISED FIGURE PAGE NUMBERS

1.18 - REVISED SECTIONS 4.2.1 * 5.3 * 5.4 AND 5.5 TO BE CONSISTENT WITH THE NEW RELEASE OF SOFTWARE

1.20 - ADDED SECTION 4.6 ABOUT CONFIGURATION FILES
- ADDED SECTION 4.7.2 DATE AND TIME SETTINGS

1.21 - CHANGED CALIBRATION SCREEN BUT NOT PROCEDURE
- ADDED ADDITIONAL 'EVENT' LOGS

1.22 - CHANGED CALIBRATION SCREEN BUT NOT PROCEDURE