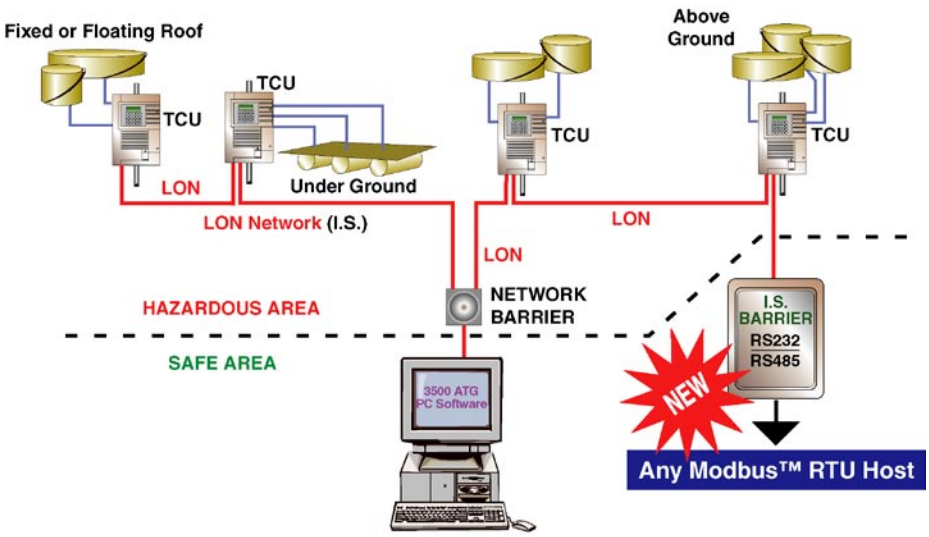
AUTOMATIC TANK GAUGING SYSTEM (ATG)

3500 ATG

Automatic Tank Gauging System for Inventory Management

PubID: 23100 5b (12/04)



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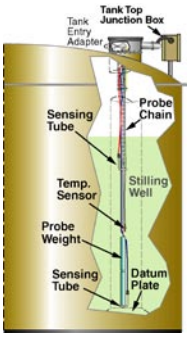
The 3500 Automatic Tank Gauging System (ATG) is a scalable inventory management solution for liquid inventory, custody transfer, tank farm, and reconciliation applications. A **unique hydrostatic measurement technique** provides continuous monitoring of volume, level, density, mass, temperature, and water bottoms at levels of reliability, accuracy and safety not possible using conventional hydrostatic measurement methods or other ATG measurement technologies. Plus, the 3500 also provides leak, overfill, and theft monitoring.



The 3500 system consists of highly accurate measurement/recording instrumentation, a flexible intrinsically-safe communications network, and a user friendly Windows™ based tank management software package.

The system determines (on demand) fluid level, volume, corrected volume, temperature, density, and water measurements. It does this by measuring hydrostatic pressures with a measurement probe inserted into the gauging well from the top of the tank. The hydrostatic pressures are measured by a solid state diffused silicon pressure sensor — no need for routine preventative maintenance.

Density measurements allow product quality to be monitored during tank transfers. Product mass is accessed directly for plant or tank farm inventory balancing. Optional water bottoms measurement allows quick disposal action. Periodic volumetric tank tightness testing can be done (without external devices) — avoiding potential remediation expenditures through early detection.

The 3500 can be installed on Above Ground (AST) or Underground (UST) storage tanks with Reid vapor pressures less than 15 PSI (100 kPa/ 1bar) and tank heights up to 60 ft (18.2 meters). TCU to tank base distance up to 400 ft. (120 m).

The LON network can interconnect up to 99 Tank Control Units (TCUs). Network barriers and repeaters are used to connect devices in hazardous areas to those in safe areas, or to extend the network length beyond 7,000 ft.

A Windows™ PC can be connected using the 3500 PC Connection Kit or the optional **Modbus**™ interface (RS232/485 protocol) can be used to connect PCs or host systems .

- **Level Accuracy to 0.04" (1 mm)**
- **Monitors Volume, Level, Density, Mass, Temperature, and Water Bottoms**
- **Easy Access to Inventory Data** for any tank on the network, using any Tank Control Unit (TCU) on the network
- **Drop-in Installation** through a 3" min. tank top opening during normal operation (no tank shutdown required)
- **Tank Farm Management Host Software -** User Friendly/Secure
- **Single DP Transducer Design** eliminates errors found in multiple transducer systems
- **Modbus™ Link** to Host systems
- **Datum Plate Reference Point** (same as manual gauging) eliminates errors due to vertical tank expansion.
- **Temperature measurement point(s)** used to correct volume back to base temperature (60°F), using API method
- **Leak Detection** (optional) EPA Approved for USTs up to 75,000 gallons

Applications: Airports, Refineries, Petrochemical/Chemical Plants, Tank Farms, Oil-fired Power Plants, Distilleries/Breweries, Shipboard Tanks, and Water Tanks

PRIME
Measurement Products
(Formerly known as Barton Instrument Systems)

TECHNOLOGY COMPARISON

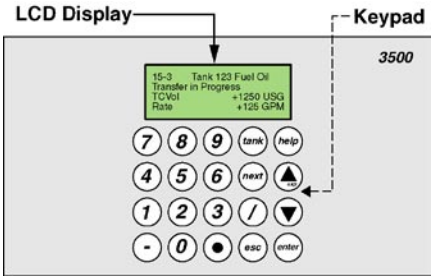
The 3500 ATG is a complete measurement solution — no additional sensors or processors required.

Inventory Data Available:	3500 ATG**	Traditional HTG	SERVO	RADAR	"CABLE"
Volume	**Yes**	Yes	External Processing*	External Processing*	External Processing*
Corrected Volume	**Yes**	Add Temperature	Add Temperature	Add Temperature	Add Temperature
Mass	**Yes**	Yes	Add Pressure	Add Pressure	Add Pressure
Density	**Yes**	Yes	Add Pressure	Add Pressure	Add Pressure
Temperature	**Yes**	Additional Entry (Add Temperature)	Additional Entry (Add Temperature)	Additional Entry (Add Temperature)	Additional Entry (Add Temperature)
Level	**Yes**	Yes	Yes	Yes	Yes
Water Bottoms	**Option**	N/A	Option	Option (Add Capacitance)	Option
Tank Types	**AST/UST**	AST/Pres.	AST/UST/Pres.	AST/UST/Pres.	AST/UST
Installation Impact	**Low**	High	High	High	Mild
Power Location	**Off Tank**	At Tank	On Tank Top	On Tank Top	On Tank Top
Safety	**Very Safe**	Safe	Safe	Safe	Safe
Central System	**Yes**	Yes	Yes	Yes	Yes
Moving Parts	**None**	None	Displacer	None	Per Vendor
Calibration	**None**	High	High	Mild	Low
Installed Cost/Tank	**Low**	High	High	High	Mild

*Only available if personal computer is used.
**Inventory Data available from any TCU, TDU, or PC (running 3500 ATG PC Software) connected to the 3500 LON Network.

AST: Above Ground Storage Tank
UST: Underground Storage Tank
Pres.: Pressurized Storage Tank

SETUP, CALIBRATION, & MAINTENANCE



Setup

Setup can be done using the Tank Control Unit (local keypad and display) or the 3500 ATG PC Software (running on a PC connected to the local LON network).

Setup consists of setting up user (and passwords) for access, TCU and Tank parameters (e.g., probe measurements, offsets, strapping table data, product information), measurement times, measurement units, and alarm setpoints.

Once users are setup, the "login" system prevents unauthorized access. When the TCU is "locked," users at the TCU can view all display pages; however, no settings or variables can be changed and alarms cannot be acknowledged.

In order to make changes to a local TCU settings, acknowledge alarms, or manually operate the TCU solenoids, the user must be "logged-in."

Once a TCU has been "setup" and connected to the local LON network, it can be used to view and control any other TCU on the same network.

Calibration

Like Setup, Calibration can be done using the TCU or by using the 3500 PC Software. The calibration procedure involves comparing the 3500 system measurements (at a single level point) to manual gauging data. If an offset exists, a correction factor is entered into the TCU — no additional calibration is necessary.

Maintenance

Since there are no active components at the tank, periodic maintenance is not necessary after initial installation. Annual service involves changing out the nitrogen bottle (a 15 minute procedure). A pressure switch on the nitrogen regulator assembly provides local/remote notification of low gas pressure weeks before the nitrogen supply runs out.

Nitrogen Gas Supply

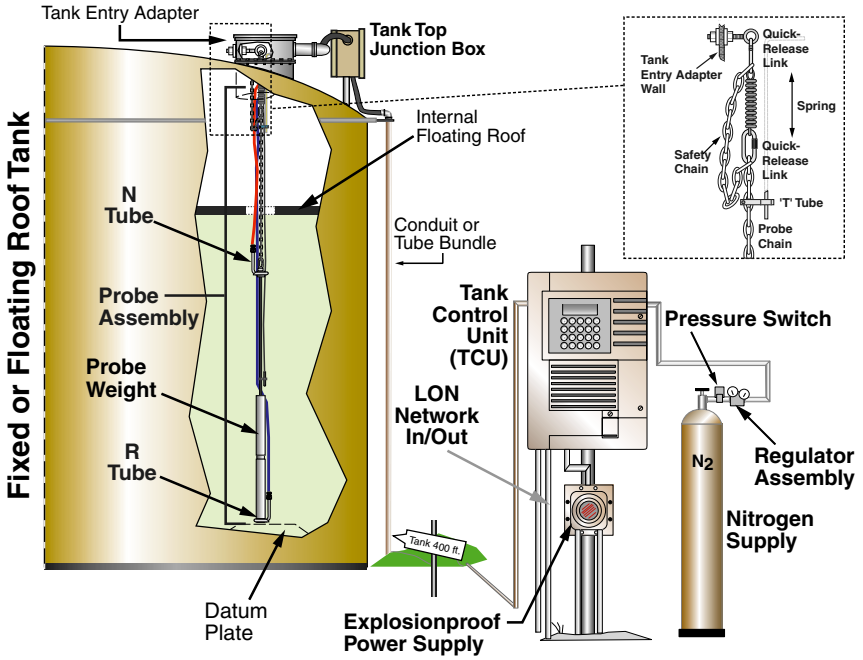
The inert gas is supplied by a standard 300 cu ft. cylinder of purified nitrogen. The standard cylinder will last approximately a year in normal service. However, nitrogen consumption varies due to many factors, including: how often the tanks go into transfer, how tall/full the tanks are (manifold has to be charged at a higher pressure), how many tanks are being measured, and of course, the measurement interval. Larger capacity cylinders can be used, if desired.

The cylinder is normally located next to the TCU; however, it can also be installed remotely for convenience in replacing the cylinder.

An alarm indicates when nitrogen supply is low, giving ample warning to replace the cylinder.

BASIC HARDWARE COMPONENTS

The 3500 system consists of a Probe Assembly, Tank Top Junction Box, Pneumatic Tubing, Temperature Sensor Probe(s), Tank Control Unit (TCU), and a Communications Network (LON). Optional Components include: PC Connection Kit, Network Barrier, and a Modbus™ Interface (RS232/485) with integral I.S. barrier.



Measurement Probe Assembly

The probe consists of a weighted shaft suspended by a chain, sensing tubes, and one or more spot temperature sensors. The number of sensors is determined by the tank height and 3500 system configuration/options.

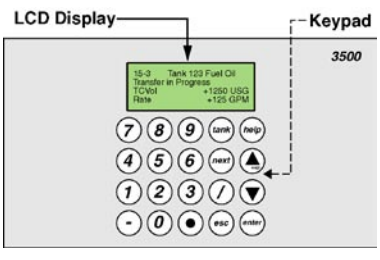
The Probe has a minimum of two pressure measurement points separated by a fixed distance. The probe is lowered down the gauge well by a chain. It attaches itself to the datum point by means of a permanent magnet; allowing easy installation/removal from a tank operating above or below ground. The probe can be removed and reinstalled by one person in approximately 20 minutes.

The probe can be adapted to UST and fixed or floating roof/pan AST tanks (stilling well is not required). The probe's diameter is approx. 2.5" (65mm), so it can be inserted in any available tank top opening that is at least 3" (75mm) in diameter.

Tank access is not affected by the probe location, since the probe is completely retractable at any time, even in small diameter installations. In most installations, manual gauging can be done without probe retraction.

Tank Control Unit (TCU)

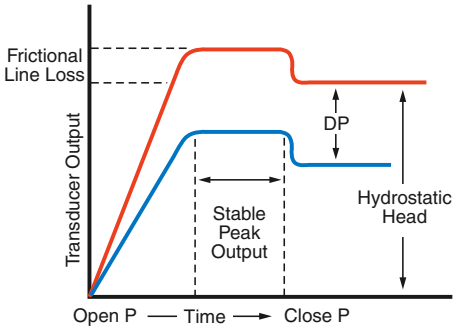
At the heart of the system is the TCU. The TCU contains a DPE (solid state silicon DP transducer), microprocessor (to measure and calculate the fluid density, level, and corrected volume), and a series of microprocessor controlled solenoid valves that direct the flow of nitrogen* to the measurement points and connect the desired points to the pressure transducer for measurement. Pneumatic tubing and temperature sensor cables are run from the TCU manifold to the Tank Probe Assembly. **Note: Pneumatic media typically used with our system is Nitrogen — it is inert, dry, and readily available.*



Each TCU has a keypad and a 4-line by 20-character LCD to display volume, water, temp., measured level, density, and corrected volume. This eliminates the need for external hardware to startup, configure, or operate the TCU.

Each TCU can be used to measure two above-ground tanks or four below-ground tanks. The TCU can be mounted as far as 400 feet from the tank

Measurements are performed by actuating the internal solenoid valves to run back pressure charging sequences through several precisely spaced sensing tubes on the Tank Probe. Both hydrostatic head and DP are monitored by the TCU's DPE transducer.



Measurements are taken once equilibrium is reached. Spot temperature readings are obtained from the probe temperature sensors (per API and ISO inventory standards).

TCU calculates level from the back pressure measurements (using a liquid specific gravity relationship). *Back pressures are also used to determine density and optional water bottoms.*

Actual volume is computed from a 1500 point (maximum) tank specific strapping table that can be downloaded over the network (with 3500 ATG PC Software) or manually entered using the local TCU keypad and display.

Ullage is calculated by subtracting the actual volume from the maximum tank capacity or safe fill level.

LON Communications Network

Communication between all attached TCUs, TDUs, and computers, with redundant information stored in each TCU/TDU - no master device is required. Any tank can be monitored from any TCU, TDU, or computer on the network.

The network will function with multiple device failures or out-of-service conditions— ensuring system reliability.

An optional TCU power supply/ Modbus™ Interface provides RS232/485 communications with an integral intrinsically-safe barrier.

TCU OPERATING MODES

The 3500 TCU has three operating modes: Normal, Transfer, and Leak.

Normal Mode (Figure 14)

This is the mode that the unit is normally left in when the tank is in static condition. The system automatically returns to this mode when switched out of other mode.

All inventory readings should be taken in this mode to obtain the highest degree of accuracy.

Transfer Mode

The transfer function is automatic. The start and stop parameters for each tank are entered individually (i.e., start when three readings differ by more than 100 gallons each, stop when rate drops below 100 gpm).

During transfer operation, the TCU performs measurements continuously (as fast as possible) and the display shows a "T" in the upper right corner.

When the TCU detects that the transfer has stopped, it performs a full level measurement and enters the transfer information into the Transfer Log.

Displayed Values

- Transfer Volume (TVol) Total
- Rate
- Estimated Full at (Est Full at)
- Ullage

The **TVol** is a running total of the volume transferred.

The **Rate** is a running average of flow to or from the tank.

The **Est Full at** value is the estimated time the tank will be full at the current rate of transfer.

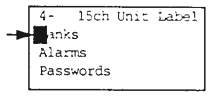
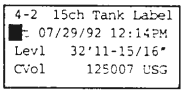
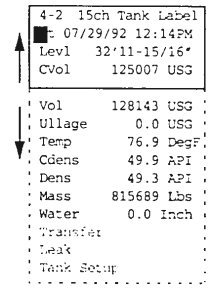
The **Ullage** is a running value that indicates the amount of fluid required to fill the tank to the top.

Transfer Log

The Transfer Log lists the TVol & CVol totals (CVol is corrected TVol), Start and Ending Levels, and the date and time (start/end) of each transfer.

Transfer entries are maintained until log is reset or until 10 entries are accumulated. When the 11th entry is made, the 10th entry (oldest) is erased.

Viewing Measurements on TCU

STEP	ACTION	RESULT	NOTES
1	At the MAIN MENU, move cursor to line 2: (If cursor is on line-2, go to step 2) **Press UP or DOWN Arrow key**		
2	Go to TANK Page: **Press [enter] key**		
3	View Current Measurement Readings: Scroll Display to view additional information, **Press UP or DOWN Arrow key**, as needed.		**Measurement Items Displayed:** • Date and Time • Level • Corrected Volume • Volume • Ullage • Temperature • Corrected Density • Density • Mass • Water Transfer, Leak , and Tank Setup are selections that go to other pages.

Tank Leak Mode

This function is automatic. The TCU goes into leak mode if the tank does not "move" for one hour (approx.). When in the Leak Mode, an "L" is displayed in the upper right corner of the LCD.

The default setup for measurement interval is 2 minutes. This can be lowered (down to a practical limit of 30 seconds for a single tank - more tanks mean a bit slower measurement).

The two minute interval is required to get the correct leak periods (for certified leak detection operation).

Density and water measurements are selectable, with defaults set at six hours (note: actual density is calculated every measurement, based on temperature difference from the last density measurement - assuming corrected density remains constant).

The leak test ends when the tank "moves" or user manually ends the test.

A special EPA Certified Version is available.

Displayed Values

- Elapsed Time (Elap) since start of test
- Leak Volume (LKVol) Total
- Leak Rate
- Start Time

The **Elap**sed Time Value is a running total of the amount of time since the start of the test.

The **LKVol** is the total of the volume of fluid lost.

The **Rate** is a running average of fluid loss from the tank.

The **Start Time** is the time the TCU went into Leak Mode.

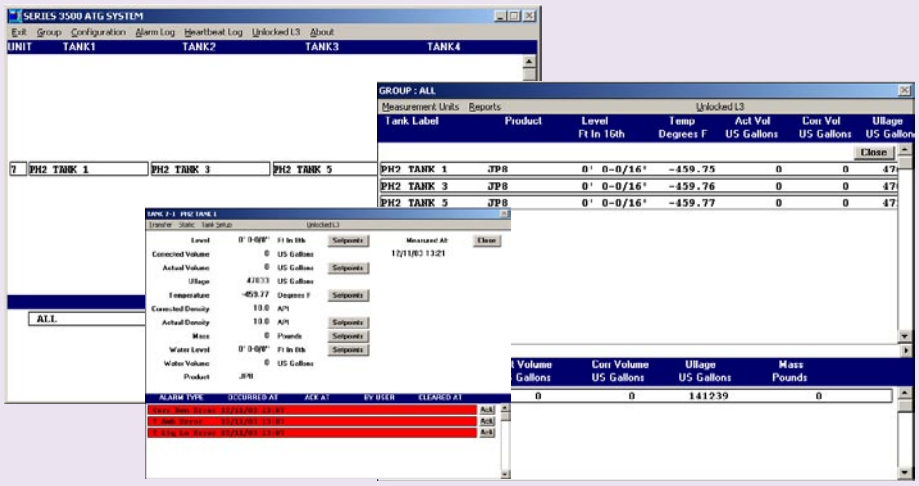
Leak Log

The Leak Log lists the Elapsed Time (ELap), Leak Volume (USG), and Leak Rate (GPH), Tank Temperature, Cell Temperature, and Ambient Temperature values for each 30 minute increment (every 1/2 hour an entry is made in the Leak Log).

Leak History

The Leak History is a summary of past leak tests. The Start Time, Leak Rate, Start Level, Low and High Temperatures (Liquid, Cell, & Ambient) are listed.

3500 ATG PC INVENTORY MANAGEMENT SOFTWARE



The 3500 ATG System uses a Windows™ -based PC software Inventory Management Package — 3500 ATG PC.

Remote Data Access and System Configuration

With the 3500 PC software, a user can monitor tank inventories and alarms, configure TCUs, and perform tasks not available on-site using a TCU (e.g., establishing tank groups, download/ upload a strapping table & TCU configuration data, and print inventories & alarm logs).

Inventory information (data) collected from TCUs can be exchanged with other PC software.

Installation of the 3500 ATG PC software is quick and easy.

Security

While any user can view measurements and settings without logging-in (entering a password), full access is restricted with the built-in user/password system.

Up to 20 users can be setup locally (at any TCU) or via the network, using the 3500 PC Software. Once setup, users can login to a TCU by entering their user name and password.

Their assigned security level determines their access:
Level 1 (view and acknowledge alarms only) or Level 2 (view, acknowledge alarms, and change settings).

Alarms

Alarms are triggered when measurements for a tank move outside the expected range of values or there is a component problem.

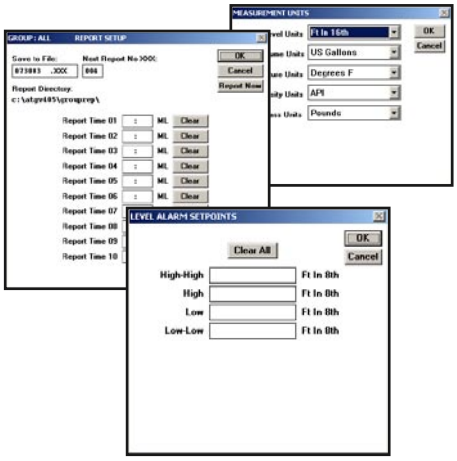
When an alarm condition is detected, the tank name box or TCU unit# flashes RED and the PC starts beeping. If the condition that triggered the alarm moves back into the expected position/range, the indication changes from red to YELLOW. However, the box/# continues to flash either red or yellow and the computer continues to beep until the alarm is acknowledged.

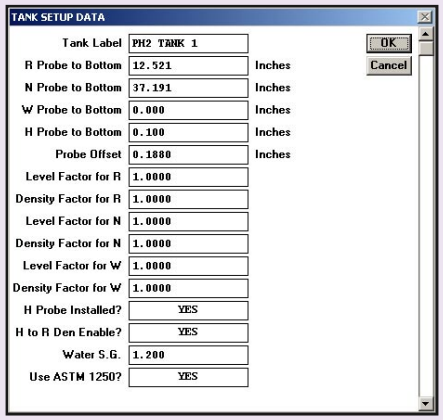
Once an alarm is acknowledged and the alarm condition has been corrected, the alarm is cleared and the Tank/TCU unit number returns to its normal color. All alarm information is saved to the PC hard drive. The alarm log is a historical record of all alarms that have occurred on the system. The alarm log file is appended (added to) whenever any of the following conditions exist:

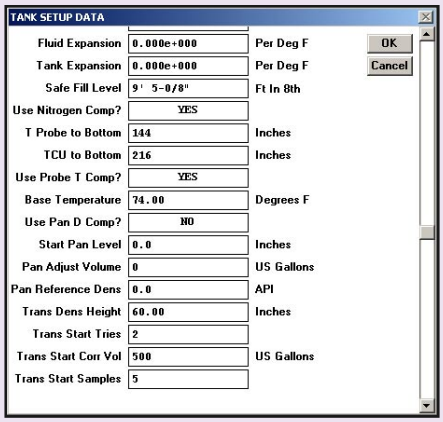
- The 3500 PC program is started.
- An alarm state changes (e.g., new alarm or alarm acknowledged).
- A system alarm occurs. A system alarm is an alarm generated by the 3500 PC software, not by a unit (e.g., system startup, unit 1 on-line, unit 1 off-line, acknowledged/cleared alarms removed by a user).

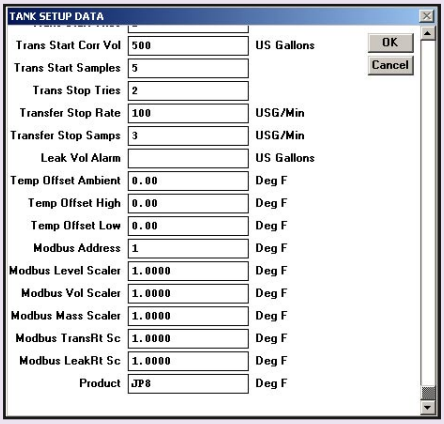
Configuration

Configuration is menu driven, with simple prompts to speed entry.









3500 ATG PC INVENTORY MANAGEMENT SOFTWARE (continued)

Data and Alarm Reporting

Group Reports

Group Report File: d:\tank\testrep.r10
Version 01.00
For Group: TestGroup
Created At: 06-17-2000 14:56:40 Requested At: 14:56

Tank	Label	Product	Level Ft In 16th	Corr Vol US Gal	Act Vol US Gal	Ullage US Gal	Temp Degrees F	C orr Dens Spec Grav	Act Dens Spec Grav	Mass Pounds	Water Ft In 16th
1-1	Test Tank 1	AVGAS	2' 6-7/16"	3172.2	3192.0	1808.0	77.5	1.015	1.009	26848.3	0' 0-0/16"
1-2	DISABLED										

Product	Corr Volume US Gallons	Act Volume US Gallons	Ullage US Gallons	Mass Pounds
AVGAS	3172.2	3192.0	1808.0	26848.3

Alarm Reports

Each entry is preceded by two blank lines and begins with a line indicating the date and time of the entry.

At 06-17-02 09:34:49
System Alarm System Startup

At 06-17-02 09:35:00
Current Alarms for All Units

UNIT-TANK	ID	STATUS	ALARM TYPE	OCCURRED AT	ACK AT	BY USER	CLEARED AT
1-1 Tank Test 1	130	CLEAR ACKED	Lo Gas Press	06/17/02-09:35	06/17/02-09:49	SUPER	06/17/02-10:08
1-1 Tank Test 1	130	CLEAR ACKED	Lo Gas Press	06/17/02-10:50	06/17/02-10:50	SUPER	06/17/02-10:59
1-2 Tank Test 2	130	CLEAR ACKED	Lo Gas Press	06/17/02-12:08	06/17/02-12:09	SUPER	06/17/02-12:20
1-2 Tank Test 2	131	CLEAR ACKED	Ram Bty Low	06/17/02-14:22	06/17/02-14:23	SUPER	06/17/02-14:49

At 06-17-02 16:52:12
System Alarm Acknowledged Cleared Alarms for Unit: 1 removed by SUPER

At 06-18-02 08:00:24
System Alarm System Startup

At 06-18-02 08:00:32
Current Alarms for All Units

UNIT-TANK	ID	STATUS	ALARM TYPE	OCCURRED AT	ACK AT	BY USER	CLEARED AT

At 06-19-02 08:07:32
System Alarm System Startup

At 06-19-02 08:07:44
Current Alarms for All Units

UNIT-TANK	ID	STATUS	ALARM TYPE	OCCURRED AT	ACK AT	BY USER	CLEARED AT
1-1 Tank Test 1	128	ALARM ACKED	T Amb Error	06/19/02-08:08	06/19/02-08:08		

At 06-19-02 08:42:36
Alarm Changed

UNIT-TANK	ID	STATUS	ALARM TYPE	OCCURRED AT	ACK AT	BY USER	CLEARED AT
1-1 Tank Test 1	128	ALARM UNACK	T Amb Error	06/19/02-08:19			

Setup Transfer "Reusable Setup/Config. Data"

TCU and Tank setup information can saved to a disk for storage/transport — ideal for installations with large numbers of like tanks. Once a TCU is configured, the configuration data can be saved to disk and uploaded to other TCUs. This eliminates the need for duplicate data entry.

For example, as part of the TCU configuration process, tank strapping tables are created using another application (e.g., spreadsheet) and then loaded into a TCU, using the "Load from Disk" option in the 3500 ATG PC software.

Save Options

Unit Setup Option saves unit label, tank types, enabled/disabled flag, measurement units/times, and unit setup data.

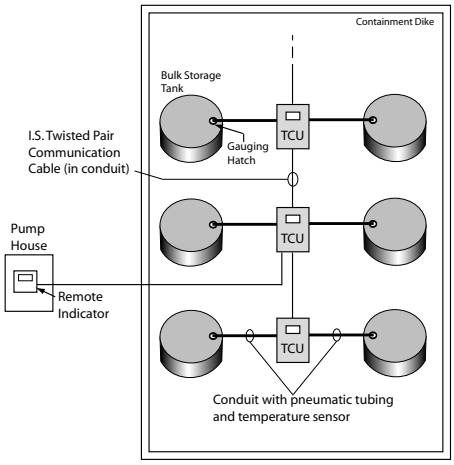
Tank Setup Option saves Tank setup data.

Tank Strapping Table Option saves tank strapping table data.

Entire Unit Option saves Unit, Tank, and Tank Strapping information in files with identical base names.

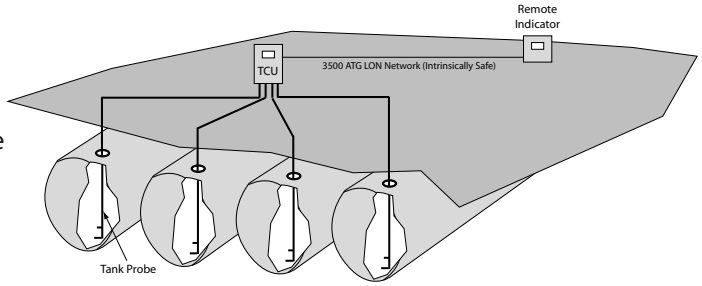
TYPICAL INSTALLATIONS

Above Ground



The illustration above shows the hookup of a site with six large bulk storage tanks. In this case, three TCUs are required. All are hooked together by the communications network, allowing all tanks to be read from any TCU.

If one TCU can be placed in a control room (within 400 feet of any tank), the TCU would act as the display unit for all tanks in the group, thereby saving the cost of a separate display unit.



Below Ground

A typical below ground installation is a 4-tank hydrant system without water measurements, as illustrated above right.

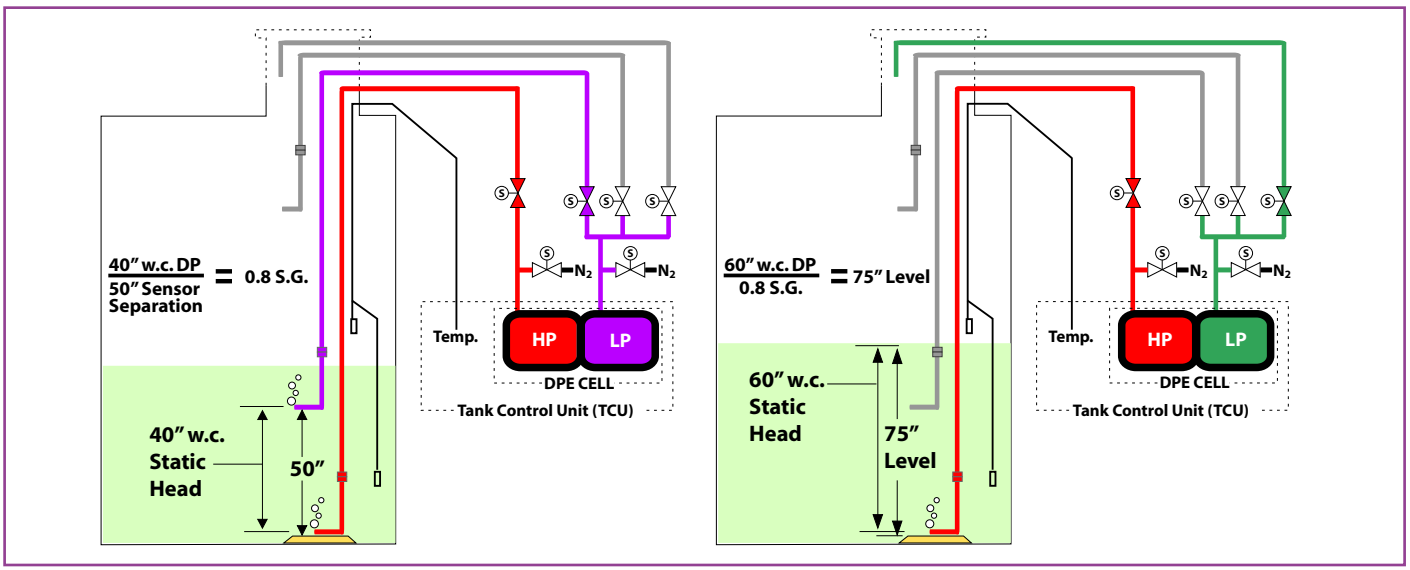
In the vast majority of hydrant systems, the TCU would be mounted in the control room, eliminating the expense of an additional remote display unit.

On hydrant systems, with over 4 tanks, additional TCUs would be required.

In all cases where multiple TCUs are in use, the 3500 ATG LON communications network is installed. This allows users to view tank/unit data and measurements from any connected TCU — eliminating the need for a remote display unit.

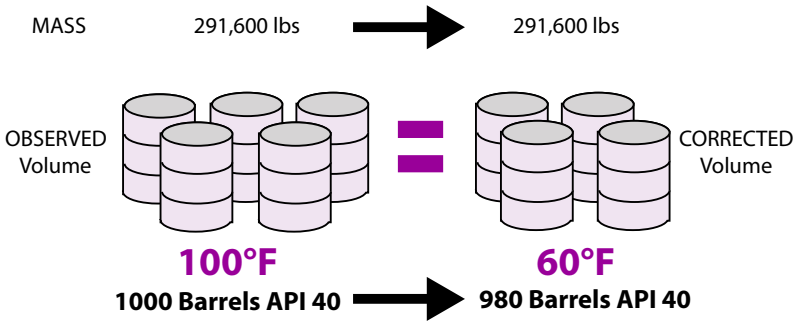
BASIC OPERATION (See Detailed Operation on next page)

Basic TCU valve operation for density and level measurements is illustrated below:



CORRECTED VOLUME

The 3500 ATG system utilizes spot temperature readings and the TCU microprocessor to calculate corrected volume — all without the need for external analysis or lab work.



DETAILED OPERATION

(See Figures 1 through 9)

The high pressure (HP) side of the DPE is connected via a pneumatic line to the reference point "R." The low pressure (LP) side is connected to the tank top. V1 is opened by the TCU and allows a flow of nitrogen (approx. 0.05 cu ft/hr) to charge the line connecting the HP side of the DPE to point "R." The pressure will increase until it is equal to the hydrostatic pressure of the fluid above the reference point "R," plus frictional line loss. This pressure is monitored by the DPE (Figure 2).

At the stable peak output, V1 is closed, locking the nitrogen charge in the system. The pressure in the system will then achieve a natural balance exactly equal to the hydrostatic pressure developed by the fluid. This hydrostatic pressure reading is stored in the TCU.

To calculate level, the density of the fluid along with the hydrostatic head must be determined (Figure 3). The Model 3500 System determines the product density by adding a second tube at a known distance above "R," referred to as the narrow range sensing tube "N." The computer will automatically close V2, and open V3 and V4, allowing nitrogen to charge the impulse line to the narrow range sensing tube. This differential pressure measurement between points "N" and "R" is proportional to the density of the fluid. Knowing this density value, the level can be calculated by the following equation (also see Figure 9, next page):

$$\text{Level} = \frac{\text{Hydrostatic Pressure (R to T)}}{\text{Density Pressure (R to N)}} \text{ X Separation (Distance from R to N)}$$

After the level has been calculated, the volume is determined from the tank strapping tables (previously entered into the TCU). A temperature measurement (Figure 4) obtained from an element placed midway between points "R" and "N" is used to correct the volume to base temperature, normally 60°F or 15°C.

On pressurized or vapor recovery system tanks, the (LP) side of the DPE is connected to the tank via V2 to a point at the top of the tank when the hydrostatic head measurement is made (Figure 5).

Auto Calibration (Figure 6)

An equalizing valve is added to the system that allows periodic auto-zeroing of the DPE Transducer. This eliminates all zero errors.

All of the pressure measurements within the tank are made with the same pressure sensor in the TCU. As a result, any sensor errors are common to all measurements. This allows the system to completely cancel out all sensor offset and slope errors, as well as long-term drift errors. The result — there is no need for field calibration of the pressure sensor or level system after the initial installation.

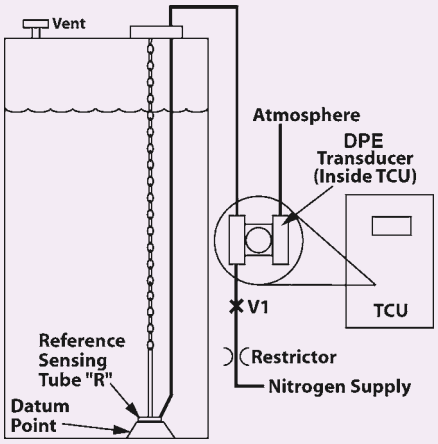


Figure 1 - Hydrostatic System

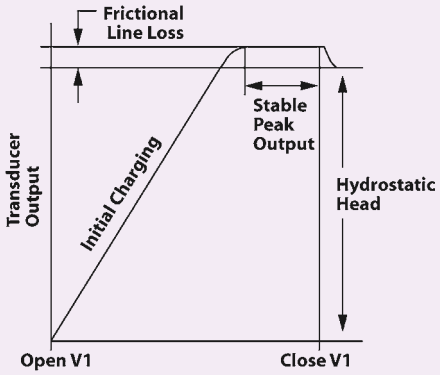


Figure 2 - Transducer Output
(measures exact hydrostatic head compensating for errors due to frictional line loss)

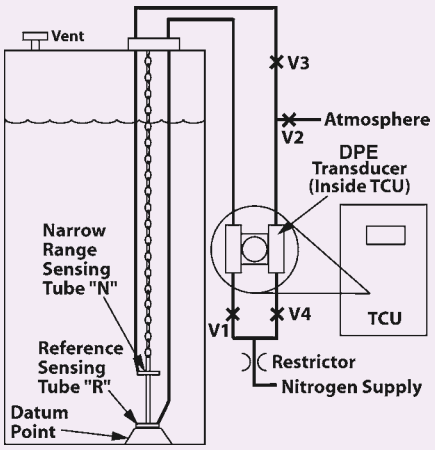


Figure 3 - Fluid Density Measurement
(point "N" added for density measurements)

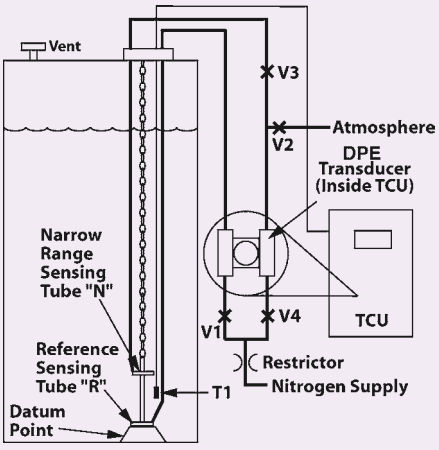


Figure 4 - Temperature Measurement
(temperature measurement used for corrected volume calculations)

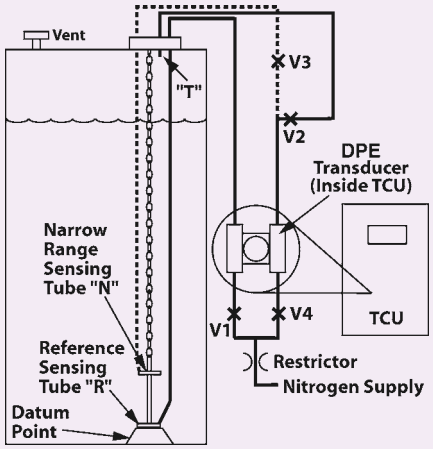


Figure 5 - Pressurized Tanks
(tank top pressure measurement point "T" for pressurized tanks)

Tall Tanks Over 20' (Figure 8)

On taller tanks, small errors in density measurement can develop from fluid stratification. These errors are eliminated with a third pressure measurement point "W" on the probe at a known position above the datum point and a second temperature probe is added.

When the fluid rises above point "W," the reference hydrostatic measurement and density is made to this point. This is like having a second system measuring the top part of the tank, independent of the lower portion of the tank, allowing the use of a low range DPE. This decreases the pressure range by 50% and increases the accuracy by a factor of two.

Water Measurement (Figure 9)

Another reference point "H" is added to the probe at a fixed distance below "R." The output of the hydrostatic pressure at 0% water is calculated by the TCU, using the following formula:

Output = Density (of product) x Distance between "R" and "H."

If water is present above point "H," the resulting output value will increase. The amount of the increase is used to calculate the total amount of water present. The TCU provides both an indication of the presence of water and a calculated total amount of water in the tank.

R = Reference Sensing Tube
N = Narrow Range Sensing Tube
T = Tank Top Sensing Tube
W = Wide Range Sensing Tube
H = H2O Sensing Tube

Level Calculation (based on measured density)

When the level is below the "N" Tube:

$$\text{Level} = \frac{R - T}{\text{Last Density}} \times \text{"N" Probe separation} + \text{Probe zero}$$

When the level is above the "N" Tube & below the "W" Tube:

$$\text{Level} = \frac{R - T}{R - N} \times \text{"N" Probe separation} + \text{Probe zero}$$

When the level is above the "W" Tube:

$$\text{Level} = \frac{(W - T)}{R - W} \times \text{"W" Probe separation} + \text{"W" Probe separation} + \text{Probe zero}$$

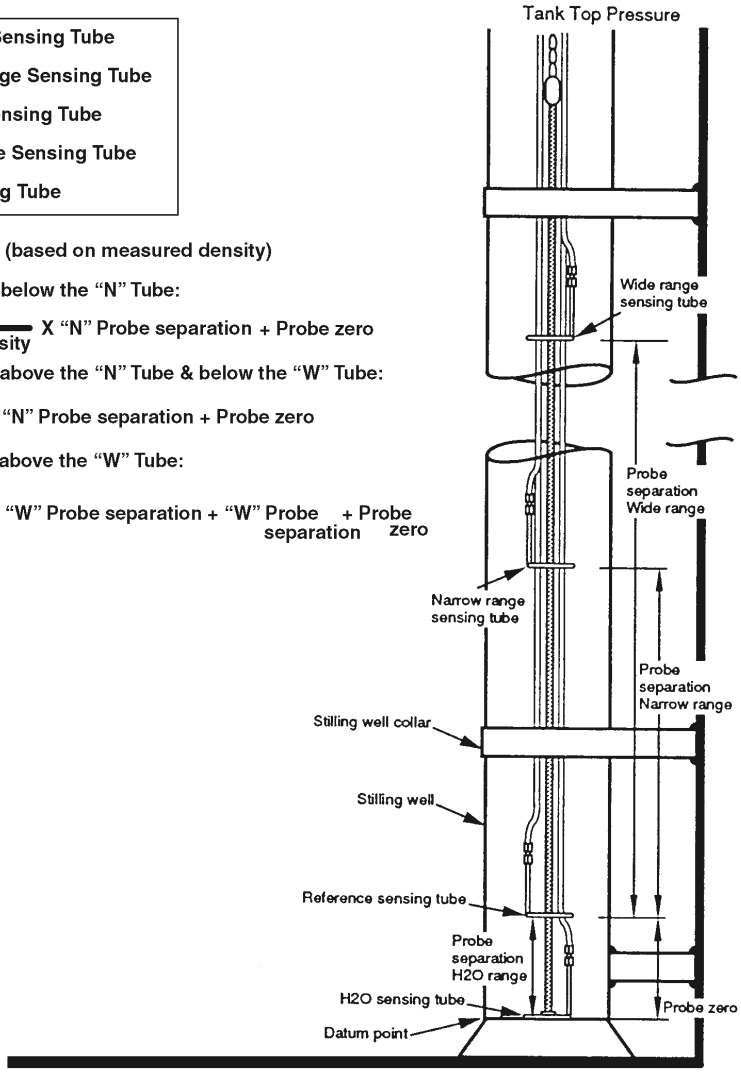


Figure 9 - Probe Points of Measurement

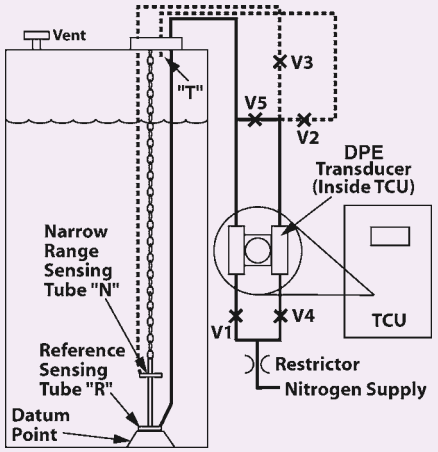


Figure 6 - Auto Calibration
(equalization valve V5 provides auto-calibration of pressure transducer)

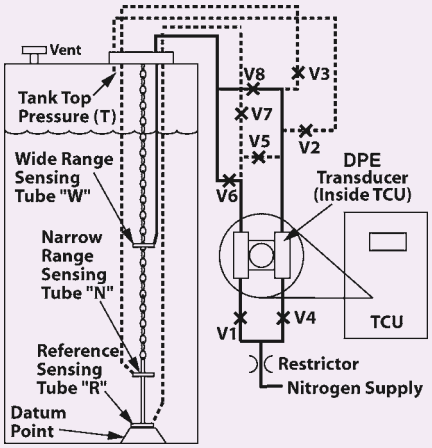


Figure 7 - Large Tanks
(wide range measurement point "W" is like adding a second level system)

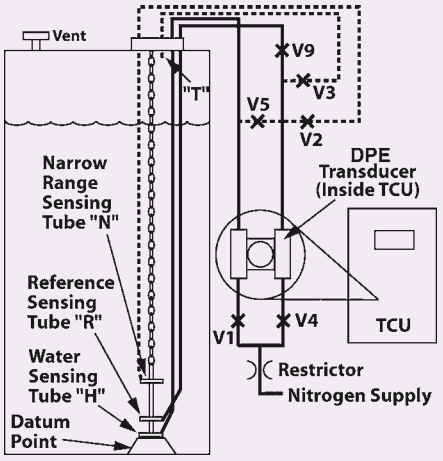


Figure 8 - Water Measurement
(continuous measurement of water above datum point)

SPECIFICATIONS

General

Protection	Transient and Lightning
Nitrogen Consumption	0.008 cu-ft per full cycle
Tanks per TCU	up to 4
TCU Display	4 x 20, backlit LCD
Comm. Network	LON, 78 kbps (I.S.)
Network Capacity	up to 99 TCUs + multiple hosts
Maximum TCU to Tank (base) Distance	400 feet (120 Meters)
Maximum Network Chain Distance	7,000 feet (2 km), unlimited w/ repeater(s)
Probe Materials	Stainless Steel, Nylon, and Teflon
Power	120/220 VAC, 50/60 Hz

Accuracy

Level Measurement	to ±0.04 inches (1 mm)
Corrected Volume	±0.05% @60°F (15°C)
Repeatability	±0.02 inches (0.5mm)
Temperature	±1.0°F (0.5°C)
Specific Gravity	±0.1% of reading
Mass	±0.1% of reading
Water Bottoms	±0.125 inch (3 mm)

Operation

Ambient Temperature Range	-40°F/°C to +160°F (+71°C)
Maximum Tank Pressure	15 PSI (1 Bar)
N2 Supply Pressure	30 PSI max. (2 Bar)
Humidity Limits	up to 100% RH
Operating Modes	Normal, Transfer (UST Only), and Leak
Maximum Fill Level	User configurable
Alarms:	
User Set Alarms (per Tank)	(4) each for temperature, level, volume, density, and mass; (2) each for water level (optional)
System Alarms (per TCU)	Temp. probe fail, low gas supply, low pressure, backup battery low, and low input voltage
User Set Default Values	Temperature, density, and water bottoms

Optional Interface

I.S. Network Connection	CSA, Intrinsically-safe; Class I, Div. 1, Group D
Communications	RS232/485 w/barrier

Certifications

TCU	CSA, Intrinsically-safe; Class I, Div. 1, Group D
Power Supply	CSA, Explosionproof; Class I, Div. 1, Group D
Optional Interface Power Supply	CSA, General Purpose
Network Barrier or Repeater	CSA, Explosionproof; Class I, Div. 1, Group D
RS232/485 Interface	CSA; Class I, Div. 2, Groups A, B, C, and D

Note:
A single RS232/485 Power Supply option provides an Intrinsically-safe connection to the ATG network.

Leak Detection (optional)

EPA Approved for USTs up to 75,000 gallons

3500 ATG PC Software System Requirements:

- IBM-compatible computer (486 or higher)
- Mouse
- (1) available Serial Port (COM1 or COM2)

FEATURES/BENEFITS SUMMARY

High Reliability

No preventative or minimal routine maintenance (superior uptime with low maintenance costs)

Intrinsically Safe System

CSA Certified - eliminates potentially dangerous situations due to human error or negligence involving explosionpoof systems.

Datum Point Reference (Probe attached to Datum Point)

Eliminates effects of tank growth, shrinkage, bulge, or bottom movement.

Wide Range Density Measurement

Eliminates effects of fluid stratification in large tanks.

Spot Temperature Readings

Eliminates the need for complicated and expensive average temperature sensors.

Corrected Volume

Utilizes spot temperature readings and the TCU microprocessor to calculate corrected volume — all without the need for external analysis or lab work.

Modbus™ Interface Option

For linking to a wide variety of host systems.

Single DP Transducer Design

Eliminates errors found in multiple transducer systems.

ORDERING INFORMATION

3500 ATG CONFIGURATION	ORDER CODE									
	35 -	#	#	X	X	X	X	#	X	#	X
TANK TYPE (see **Table A**)											
Short or Underground Tank **without** water bottoms *Standard Configuration* (4 probes maximum)		0									
Short or Underground Tank with water bottoms (3 probes maximum)		1									
Tall Tank **without** water bottoms (2 probes maximum)		2									
Tall Tank with water bottoms (2 probes maximum)		3									
PROBE QUANTITY (1, 2, 3, or 4)			#								
PROBE(S) (Enter zero (0) for probes not used) (see **Table A**)											
Probe 1				Code							
Probe 2					Code or Ø						
Probe 3						Code or Ø					
Probe 4							Code or Ø				
DPE CELL (300 inches water column range) P/N: TS10-1344A								3			
POWER SUPPLY											
120/240VAC, 45-65 Hz. (Explosionproof Housing; Class I, Div. 1) (P/N: TS10-1020A)									1		
120/240VAC, 45-65 Hz. (Weatherproof Housing;General Purpose) (P/N: TS10-1495A)									2		
120/240VAC, 45-65 Hz. (Weatherproof,General Purpose Housing; RS485 Serial/Modbus™) (P/N: TS10-1490A)									3		
120/240VAC, 45-65 Hz. (Weatherproof,General Purpose Housing; RS232 Serial/Modbus™) (P/N: TS10-1500A)									4		
TCU (On-board Software and Communications) (Standard Version)										1	
CERTIFICATION (CSA, Intrinsically Safe (I.S.) for Class I, Div. 1, Group D)											1

ACCESSORIES (ordered separately):
3500 ATG PC Software Package (1 per PC required for remote monitoring/operation/setup); includes: PC Connection Kit (Network to RS232 Interface) (1 per PC) (P/N: TS10-1180A)
Network Barrier (I.S.) for hazardous location installation (P/N: TS10-1300A) (Minimum 1 per network)*
*Note: Not required, if RS232/485 Modbus™ option is used.

TABLE A —PROBE SELECTION

Tank Type	Tank Maximum Fill Level		Probe P/N (Ref. Only)	Water Bottoms	Probe Code
	Feet	Meters (approx.)			
TALL	24-35	7-11	TS10-1330A	Yes	Q
TALL	35-45	11-14	TS10-1331A	Yes	R
TALL	45-55	14-17	TS10-1332A	Yes	S
TALL	24-35	7-11	TS10-1333A	No	T
TALL	35-45	11-14	TS10-1334A	No	U
TALL	45-55	14-17	TS10-1335A	No	V
SHORT	5-12	2-4	TS10-1336A	Yes	W
SHORT	12-24	4-7	TS10-1337A	Yes	X
SHORT	5-12	2-4	TS10-1338A	No	Y
SHORT	12-24	4-7	TS10-1339A	No	Z
NONE					Ø

INSTALLATION ACCESSORIES
(TCU to TankTop signal transmission alternatives)*

Tubing Bundles:

Parker 5PT4-FB084: five colored polyethelene tubes plus temperature sensor wire. Rugged thick PVC jacket. Approx. 1-inch O.D. Available in 100, 500, and 1,000 foot lengths.

Parker 5PAT4-FB088: five colored polyethelene tubes plus temperature sensor wire. Galv. armor with PVC outer jacket. Approx. 1-inch O.D. Available in 100, 500, and 1,000 foot lengths.

Thomas & Betts 2548: Conduit fitting will fit either bundle. Fits 1-inch conduit hole in TCU or Tank Top Box. Cable size range 0.880 to 1.065 inch.

Individual Polyethelene Tubes: 1/4 inch O.D., 1,000 foot rolls, P/N: 0800-1033P; specify color as: Black (H Probe - water), Brown (R Probe - reference), Red (N Probe - narrow), Orange (W Probe - wide [tall tanks only]), Yellow (T Probe - tank top)

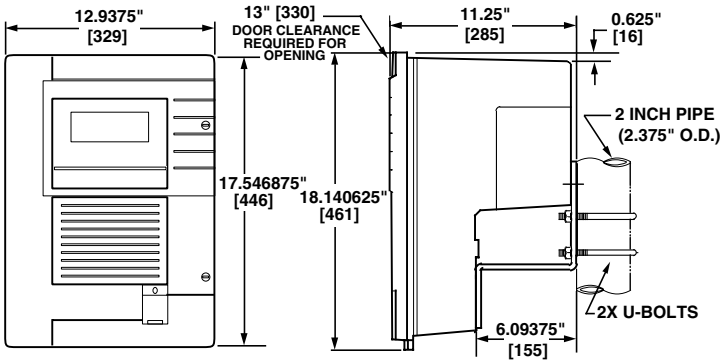
Temperature Sensor Wire (for non-bundle applications between TCU and tank): Belden 8723, 4 cond. 22 ga. stranded w/shield, PVC jacket.

Network Wire: Belden 8442, 2 cond. 22 ga. stranded, PVC jacket

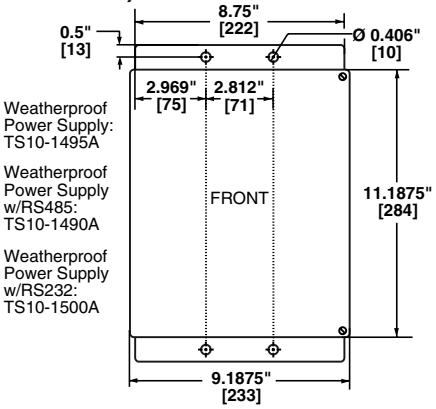
***Note:** These items can be customer supplied.

BASIC DIMENSIONS

TCU



Optional Power Supply (weatherproof RS232 or RS485 Modbus™)

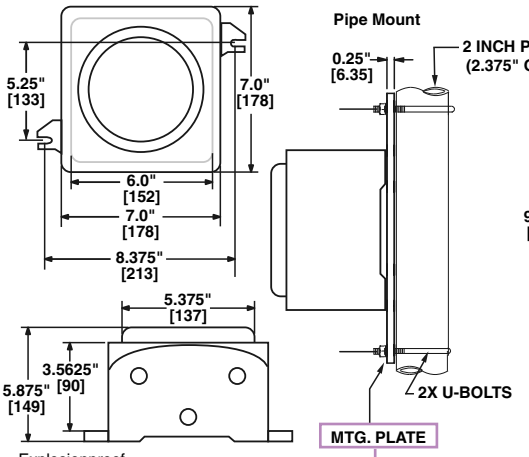


Weatherproof Power Supply: TS10-1495A

Weatherproof Power Supply w/RS485: TS10-1490A

Weatherproof Power Supply w/RS232: TS10-1500A

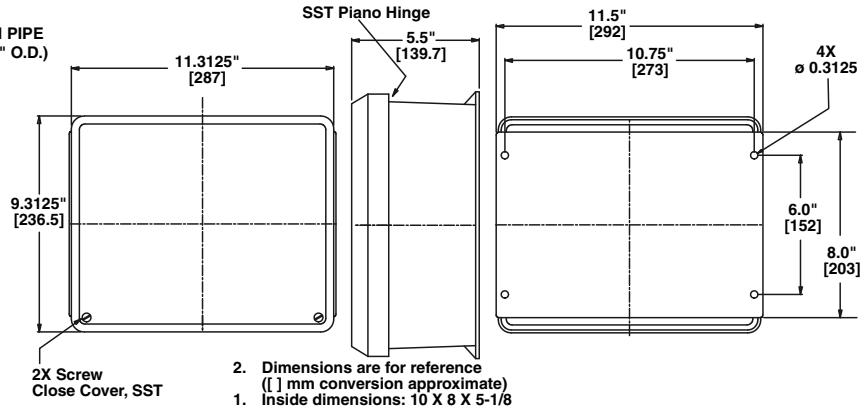
Explosionproof Power Supply



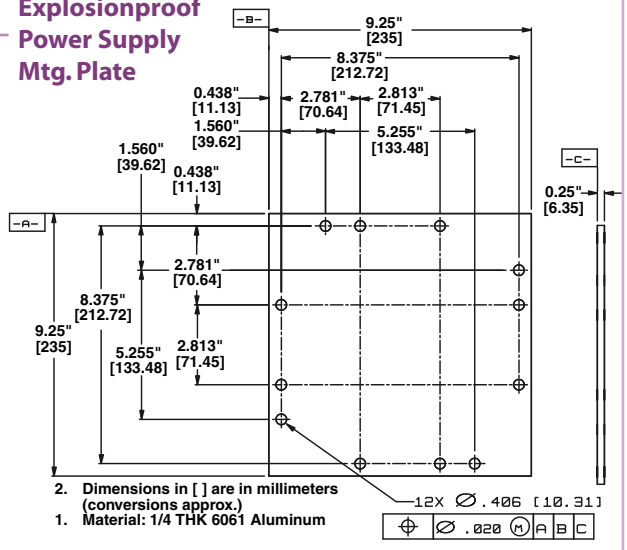
Explosionproof Power Supply: TS10-1020A

Network Barrier: TS10-1300A

Tank Top Junction Box



Explosionproof Power Supply Mtg. Plate



Other PRIME Products

- TankScan® T-Series — Wireless Measurement and Reporting for Distributed Level Measurement Applications (MIR waveguide-based measurement with one-way communications)
- TankScan® W-Series — Wireless Measurement and Reporting for Distributed Inventory Applications (multiple sensor types and two-way communications)
- DP Instruments — Indicators, Switches, and Transmitters
- Pneumatics — Transmitters/Controllers
- Vortex Meters — for gas, steam, and liquids
- 330/340/343/345 XTC® — DP Transmitters, Transmitter-Controllers, Critical Pressure Transmitter, and modular Temperature Transmitter

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