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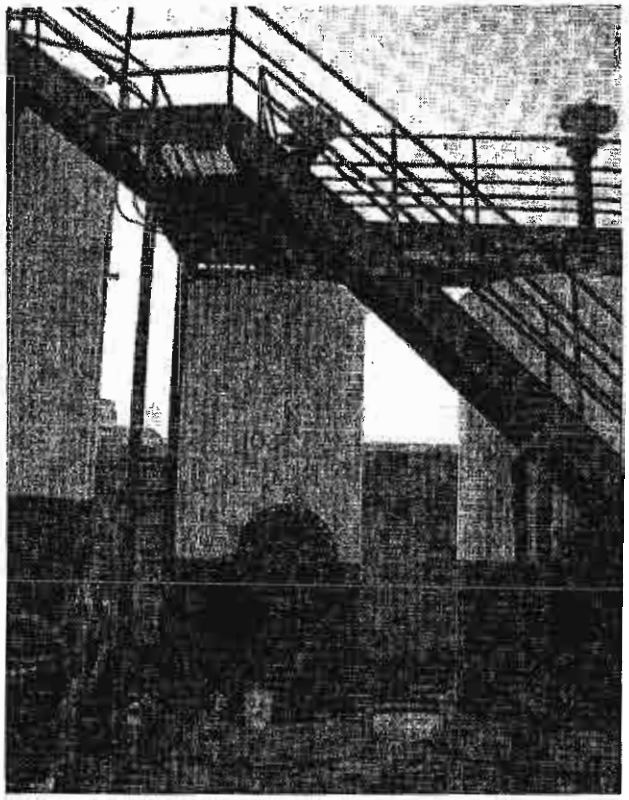
TEAM® Industrial Services, Inc.

TANK INSPECTION REPORT



CLEAN HARBORS
PHOENIX, AZ

STORAGE TANK 103

EXTERNAL / INTERNAL INSPECTION
COMPLETED 10-14-09

Team Work Order #12890215

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TANK / VESSEL DATA

Client: *Clean Harbors*
Location: *1340 West Lincoln St.*
Phoenix, AZ 85007

Inspection Type	Last Insp.	Current Insp.	Next Insp. Due
External	01-08-08	10-14-09	10-14-11
Internal	01-08-08	10-14-09	10-14-11

Service: *Flammable Liquid Waste Tank*
Tank Identification: *Tank 103*
Capacity: *2,500 Gals.* Height: *12' 2"*
Diameter or Length/Width: *8' 0"*
Orientation: ☒ Vertical ☐ Horizontal
Shape: ☒ Circular ☐ Rectangular

Mfg. By: *Unk.*
Mfg. Address: *Unk.*

Date of Manufacture: *1992 (assumed)*
Mfg. Serial Number: *Unk.*
Standard of Construction: *Unk.*
National Board Number: *N/A*
Specific Gravity: Design *Unk.* Product *<1.0*
Product Weight / cu. Ft.: *<62.4 pounds*
Max. Allow. Work. Pres. *2.5 psi (assumed)*
Max. Allow. Work. Temp. *200°F (assumed)*
Operating Pressure: *Atmospheric*
Operating Temperature: *Ambient*
Design Seismic Zone: *Unk.*
Design Wind Load: *Unk.*
Operating Level: *Full*
Gallons / Ft.: *205*

FOUNDATION

Type: ☒ Slab ☐ Ring Wall
Material: ☒ Concrete ☐ Gravel ☐ Soil
Other:

TANK SUPPORT

Type: ☐ Cradle ☐ Skirt ☐ Legs
Other;
Material: ☐ Steel ☐ Concrete

ROOF OR UPPER HEAD CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*
Roof or Head Type: Thickness: *3/16"*
☐ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☒ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other; *Self Supporting*
Dish Depth: *N/A* Flg. Length *N/A* Kn. Radius *N/A*
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

SHELL CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*

Course	1st	2nd	3rd	4th	5th	6th	7th	8th
Ht. or Length	50"	48"	48"					
Nom. Thk.	1/4"	1/4"	1/4"					

Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

BOTTOM OR LOWER HEAD CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*
Bottom or Head Type: Thickness: *1/4"*
☒ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☐ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other;
Dish Depth: *N/A* Flg. Length *N/A* Kn. Radius *N/A*
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☒ Lapped ☐ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

ADDITIONAL INFORMATION

☒ External Coating: *Painted Black & White*
☐ Internal Lining: *None*
☐ Atmospheric Vent: *None*
☒ Normal Vent: *8" Jayco, M/N; JT-20*
☒ Emergency Vent: *8" OPW, M/N; 202-F8*
☐ Pres. Relief Vent: *None*
☒ Roof Access: *Catwalk*
☒ Internal Access: *Shell mounted manway*
☐ Autogauge Device: *None*
☒ High Level Indicator ☐ Internal Coils ☒ Grounded
☐ Overflow Vent ☐ External Jacket ☒ Anchored
☐ Cathodic Protection ☐ Agitator / Mixer
Notes:

METHODOLOGY

Team Industrial Services was contracted to perform an internal / external inspection on Storage Tank 103 located at Clean Harbors; Phoenix, AZ facility. This inspection is intended to meet the mechanical integrity requirements of various state and federal agencies. This section describes the methods and procedures used to perform the inspection.

The Inspection report is a compilation of data obtained through visual inspections, conversations with plant personal and client supplied information. This includes quantitative and qualitative data necessary to document the tank's condition. The inspector prepares the field data in accordance with generally accepted standards, codes and good engineering practice. Recommendations, such as repairs, service modifications, maintenance operations, and additional NDE, are based on the evaluation of the tank's condition. The contents contained within the tank are also taken into consideration when making decisions such as frequency and type of future inspections.

The latest editions of the below referenced codes and/or standards were used in determining the tanks acceptability.

- API 653; Tank Inspection, Repair, Alteration and Reconstruction.
- API 650; Welded Tanks for Oil Storage
- API 2000; Venting Atmospheric & Low-Pressure Storage Tanks
- UL-142; Steel Aboveground Tanks for Flammable & Combustible Liquids

Other Codes and/or Standards related to work practices

- ASME Sec. V; Nondestructive Testing.
- ASTM E 543-96; Standard Practice for Agencies Performing Nondestructive Testing.
- OSHA; 29 CRF 1910 "Occupational Safety and Health Standards"
- API 2015; Safe Entry & Cleaning of Petroleum Storage Tanks

The report is divided into six main activities:

1. Tank/Vessel Data
2. Visual Inspection
3. Drawings
4. Photographs
5. Data Evaluation & Analysis
6. Non-Destructive Examination

Tank/Vessel Data

The **Tank/Vessel Data** form was filled out after the inspection had been completed. It defines the original tank design parameters, the current design parameters, the tank history, the foundation configuration and the current tank configuration. Original client documents, verbal client information and field observations were used to complete this form.

Visual Inspection
The visual inspection was performed using guidelines set forth in current editions of API, ASME and/or ASTM. All accessible areas of the tank and its appurtenances were inspected. Observations made during this inspection are listed in the Summary and Recommendations portion of this report. The following are some of the essential elements of the Visual Inspection:

- Detection of leaks.
- Detection of cracks or potential crack initiators.
- Detection of physical damage, such as gouges or dents.
- Detection of buckles or other forms of distortion.
- Detection of corrosion, erosion or other forms of degradation.
- Detection of appurtenance's which may violate applicable codes, standards or good engineering practice.
- Detection of foundation and/or support deficiencies.
- Verification of venting used for normal breathing and/or emergency pressure release.

Drawings
The drawings show the tanks overall dimensions, general location of nozzles, as well as any other pertinent information.

Photographs
Photographs were taken to show the current condition of the tank and its appurtenances.

Data Evaluation & Analysis
Methods described in the current edition of API 653 were used to calculate items such as;

- Minimum required shell plate thickness
- Corrosion rates
- Inspection Intervals
- Remaining Life

Definitive Inspection
The **Definitive Inspection** is quantitative inspection of the tank components and consisted of the following:

Roof - UT Thickness Survey
Ultrasonic thickness readings were taken from the center of the roof to the outar perimeter at locations shown on the tank drawings.

Shell - UT Thickness Survey
Ultrasonic thickness readings were taken from top to bottom at locations shown on the tank drawings.

Bottom (or Floor) - UT Thickness Survey
Ultrasonic thickness readings were taken on the tank bottom at locations shown on the tank drawings.

Nozzle – UT Thickness Survey
Three to four ultrasonic thickness readings were taken on each of the applicable nozzles and the lowest readings recorded on the tank drawings.

Information such as the referenced codes, standards or procedures, type of equipment used, etc, can be found on the technique sheet (s).

SUMMARY & RECOMMENDATIONS

Recommendations Italicized

DISCUSION AND HISTORICAL INFORMATION

This tank is used for the storage of flammable and non-flammable waste liquids. This tank has a cone roof, a flat bottom, butt welded shell seams and is constructed of carbon steel. The tank has no name plate and the only records are of the inspection performed by myself on 01-08-08. The date and standard of construction is not known, the tank was probably built to either API or UL standards. For the purpose of estimating a corrosion rate, I'm using 1992 for a date of construction, since that's when the plant was built. All of the tanks at this facility were probably used elsewhere before being moved here in 1992. This tank has not been used since the last inspection. All recommended corrective actions mentioned in the previous inspection report have been fulfilled by the client and verified by myself during this inspection.

INSPECTION FINDINGS

Exterior

Roof, Shell & Appurtenances

1) Overall, the tanks coating is oxidized but in fair condition. Some light rust was found at random areas on the roof, shell, nozzles & anchors. The client has purchased paint and has plans on spot coating rusted areas.
   Consider spot coating rusted areas prior to the next scheduled inspection.
2) The NFPA warning label was replaced and is in good condition.
   No action necessary.
3) The area inside the pressure/vacuum vent was cleaned and both pressure and vacuum relieving devices appear to be functioning properly.
   Continue to perform periodic inspections.

FOUNDATION &/OR SUPORT SYSTEM

4) A few tight radial cracks were found on the elevated pad. None are in need of repair at this time.
   Continue to perform periodic visual inspections of the foundation and dike area and repair when needed.
5) Except for some rust, the anchors and anchor bolts appear to be in good shape.
   No action necessary.

INTERIOR

Roof, Shell, Bottom & Appurtenances

Prior to this inspection, the tank was cleaned so that a proper visual inspection could be performed on the roof, shell and tank bottom.

6) The internal visual inspection found the following:

- The roof has a general overall pattern of corrosion; external thickness measurements indicate a minimum remaining thickness of .165" (estimated loss of .075", estimated corrosion rate .0031/year).
  Acceptable, according to API 653, para 4.2.1.2 the roof only has to have an average thickness of .090" in any 100 in.^{2} area and contain no holes.
- The shell has a general overall pattern of corrosion up to .040" deep and random pitting up to .095" deep. The estimated corrosion rate equals .0039/year; at this rate the shell should reach the minimum allowable thickness of .100" in 14 years. API 653, para. 6.3.2.1 provides a formula to determine the inspection interval based on shell corrosion rates. The formula is as follows; RCA/4N, where RCA is the remaining corrosion allowance and N is the corrosion rate. The lesser of 5 years or the results of the formula is to be used for the inspection interval. In this case 5 years is the lesser of the two. See "Data Evaluation & Analysis" portion of this report for more information.
  Acceptable, according to formulas provided in API 653, para 6.3.2.1 re-inspection is not due for another 5 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 10-14-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
- The tank bottom has a general overall pattern of corrosion up to .040" deep and patches of dense pitting up to .120" deep. The estimated corrosion rate equals .0049/year, at this rate the bottom should reach the minimum allowable thickness of .100" in 6 years. API 653 allows for a maximum inspection interval of 20 years if the corrosion rate is known or 10 years if unknown. API also sets a minimum remaining tank bottom thickness at the next scheduled inspection; for this tank that thickness is .100". Reference API 653 paragraphs 4.4.5.1, 6.4.2.1, 6.4.2.2 & Table 6-1. See "Data Evaluation & Analysis" portion of this report for more information.
  Acceptable, according to API 653, re-inspection is not due for 6 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 10-14-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.

Note: To increase the remaining life of this tank, the client should consider sandblasting and coating the interior sometime future. This is providing coatings resistant to intended product are available.

GENERAL NOTES

7) The client should insure that all mechanical and electrical equipment associated with this tank is checked periodically for proper function. In addition, visual inspections should be performed by trained plant personal on a regular basis. These checks should also be done on before the tank is returned to service.

8) The client should retain a copy of this report in their tank files for the life of the tank.

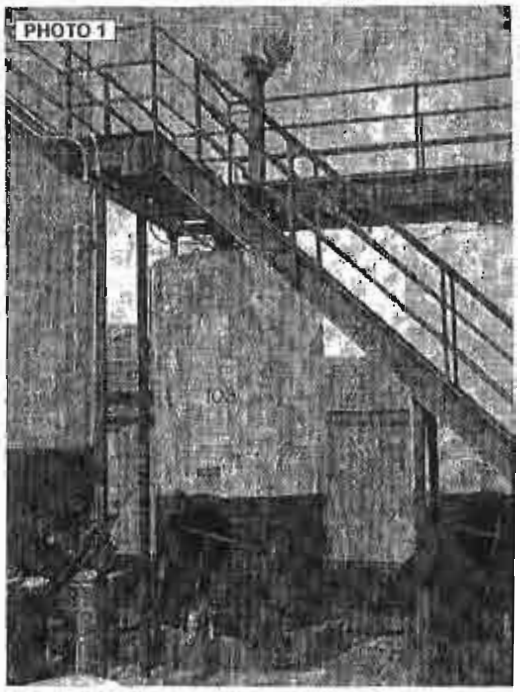
9) Thickness measurements taken during this inspection are essentially the same as taken during the last inspection. Any differences in measured thicknesses are attributed to the varying locations where the measurements taken and not due to an actual loss or gain in thickness.

CONCLUSION

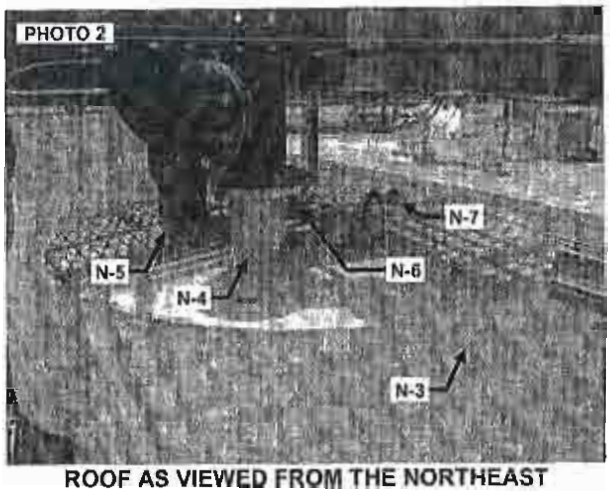
10) The tank and its appurtenances were inspected and evaluated to the best of my abilities. I found no evidence or issues during my inspection and evaluation that would keep the client from returning the tank to service.

INSPECTED BY: _____ John Morton API 653 Cert. #0443 API 510 Cert. #32940 API 570 Cert. #33787 API TES Cert. #34918 AWS/CWI Cert. #94000101 ASNT Level II; MT, PT & VT DATE: 10-14-09

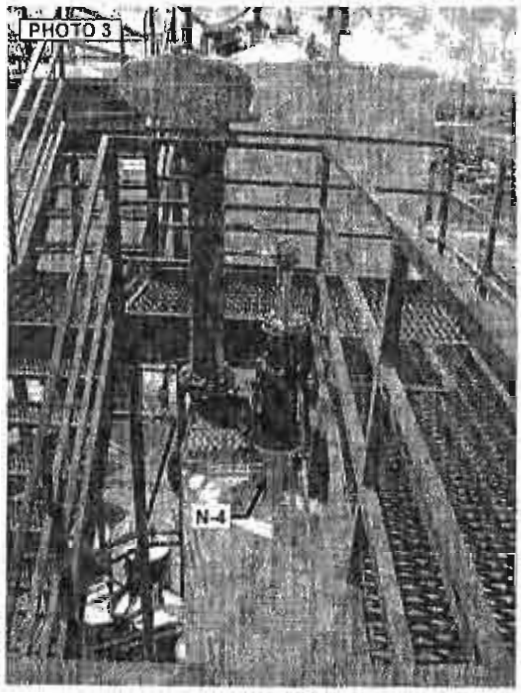
Any recommendations made by the API Tank Inspector are to be used only as a guideline for making repairs, as required by the client. Neither Team Industrial Services nor their inspectors accept responsibility for the tank's integrity, even after these recommendations are followed. All of the data compiled within this tank report should be reviewed by an engineer experienced in the; design, construction and repair of above ground storage tanks. Calculations, recommendations and evaluations contained within this report do not take into consideration the effects of additional loads imposed by wind, seismic activity or attached components. Corrosion rate and remaining life calculations are based on conditions caused by products previously stored inside the tank. Chemical, physical or mechanical changes to the tank and/or its contents may be cause for re-evaluation. Formulas contained in API 650 & 653 and good engineering judgment was used to determine the inspection frequency and next inspection dates. These dates and/or frequencies may differ from agencies other than API, in which case the more stringent should be followed.



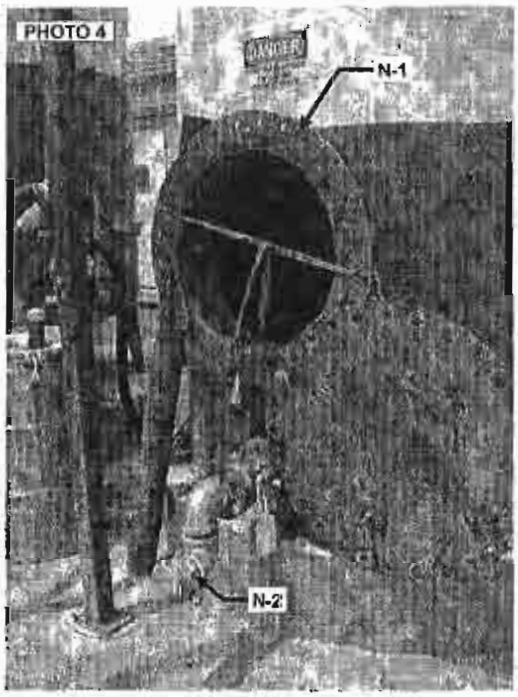
TANK AS VIEWED FROM THE EAST



ROOF AS VIEWED FROM THE NORTHEAST



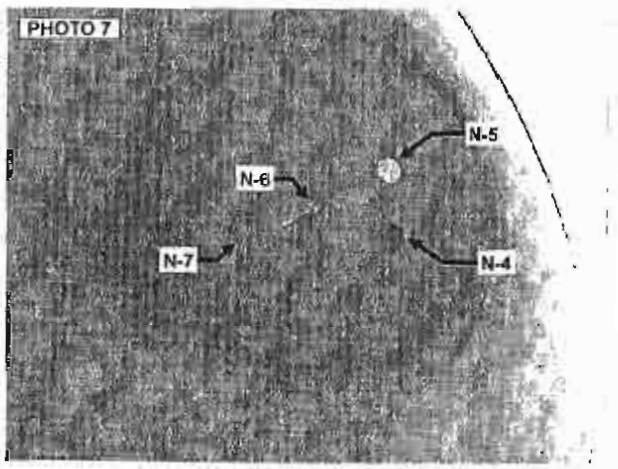
EAST SIDE OF ROOF



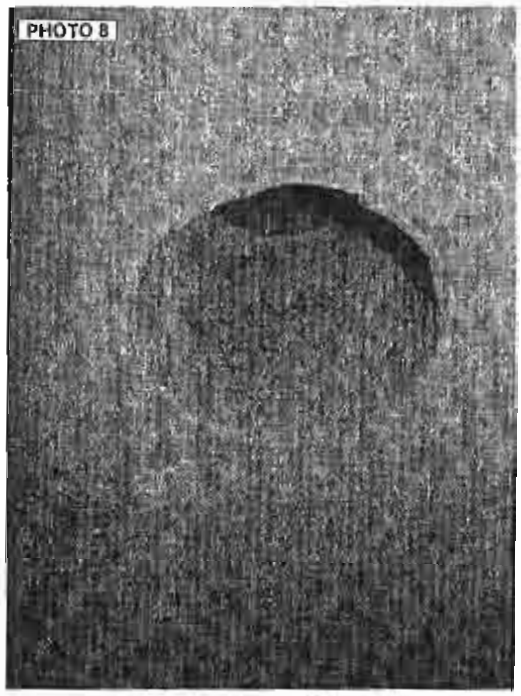
LOWER EAST SIDE OF TANK

WEST SIDE OF TANK

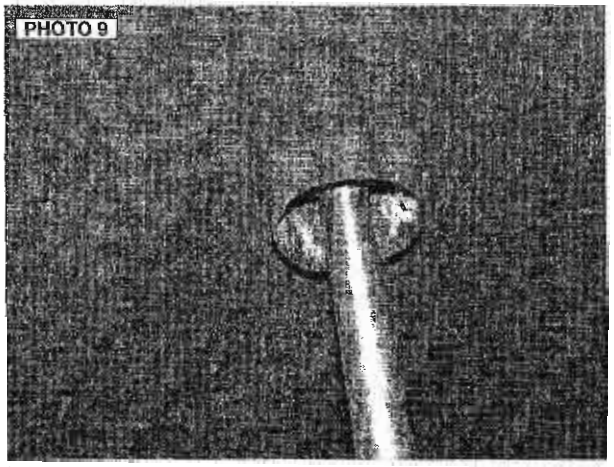
LOWER SOUTHWEST SIDE OF TANK



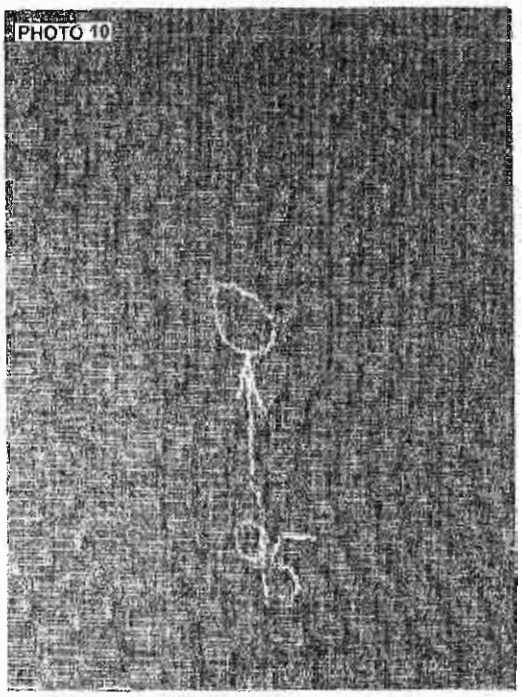
INTERIOR, ROOF



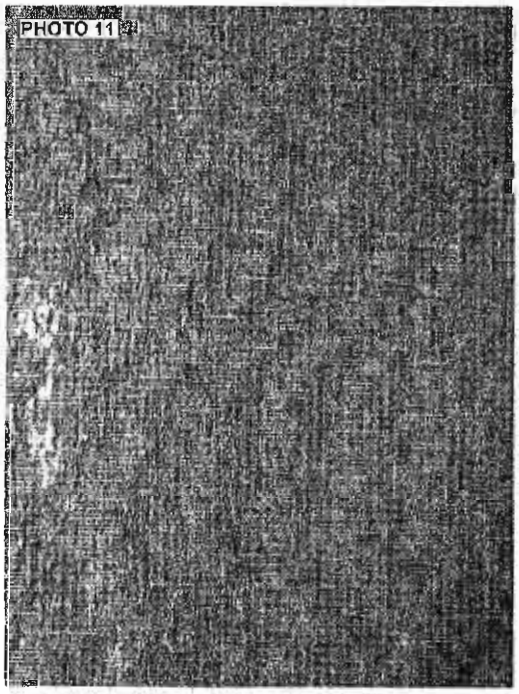
INTERIOR, VIEW SHOWING HEAVY BUILDUP OF CORROSION DEPOSITS INSIDE THE VENT NOZZLE (N-4)



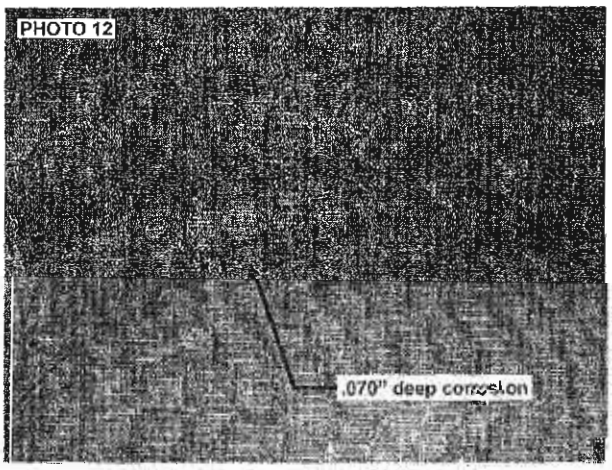
INTERIOR, VIEW SHOWING HOW THE BOTTOM EDGE OF THE HIGH LEVEL ALARM NOZZLE IS THINNING



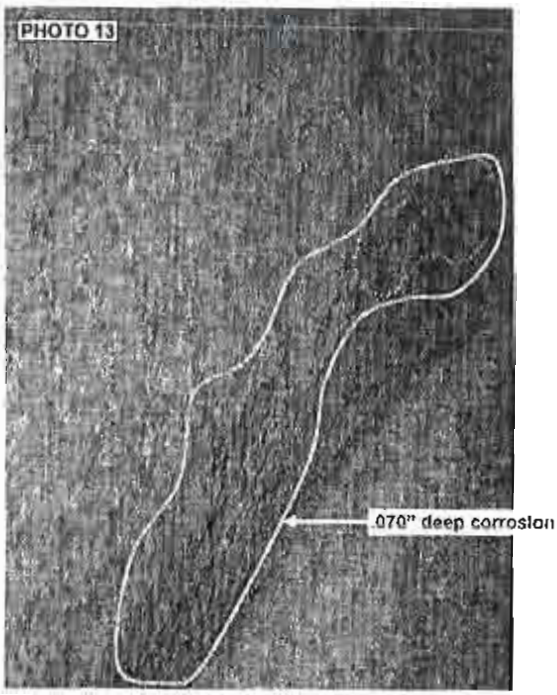
INTERIOR, VIEW SHOWING ONE OF THE DEEPER CORROSION PITS FOUND ON THE UPPER WEST SIDE OF THE SHELL



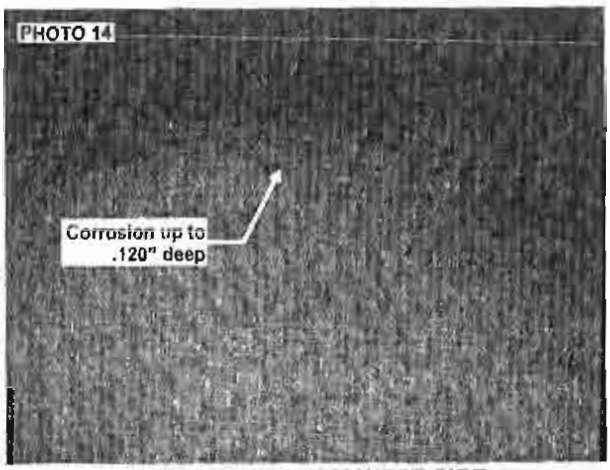
INTERIOR, VIEW SHOWIING TYPICAL VERTICAL PATTERN OFCORROISON FOUND ON THE SOUTH SIDE OF THE SHELL



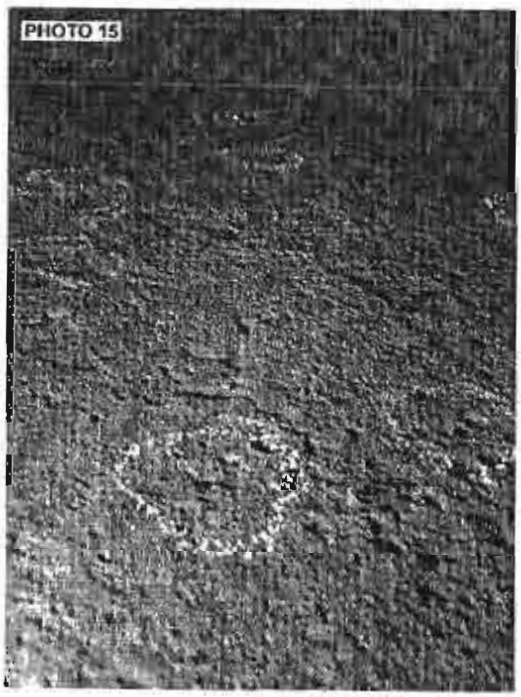
INTERIOR, BOTTOM SOUTH SIDE



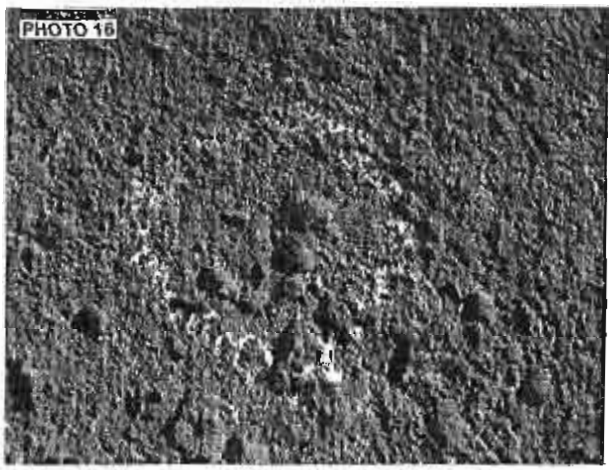
INTERIOR, VIEW SHOWING CORROSION FOUND ON THE BOTTOM SOUTH SIDE OF THE SHELL



INTERIOR, BOTTOM WEST SIDE



CLOSE-UP OF CORROSION FOUND ON THE TANK BOTTOM



CLOSE-UP OF CORROSION FOUND ON THE TANK BOTTOM

DATA EVALUATION & ANALYSIS
CORROSION RATE & REMAINING LIFE CALCULATIONS

Date		Time In Service			
Built	Current	Days	Weeks	Months	Years
7/15/1985	10/14/2009	8857.00	1260.96	290.99	24.25

☐ Date Built obtained from Records or Nameplate

☑ Date Built Estamated

Tank Bottom Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	10/14/09	24.25	0.250	0.120	0.130	0.0049	0.100	0.030	6.062	11/6/2015
External	07/15/85	10/14/09	24.25	0.250	0.000	0.250	0.0000	0.100	0.150	N/A	N/A
Combined	07/15/85	10/14/09	24.25	0.250	0.120	0.130	0.0049	0.100	0.030	6.062	11/6/2015

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.4.5.1

☑ Un-repaired Bottom ☐ Repaired Bottom

MTR = (Minimum of RT_{bo} or RT_{in})-Or(StP_r+Up_r)

MTR	0.120	Minimum remaining thickness at the end of interval Or
O_r	2	In service interval; Max 10 yrs if unknown, 20 yrs if known
RT_{bo}	0.250	Minumum thickness from external corrosion after repairs
Rt_{in}	0.130	Minumum thickness from internal corrosion after repairs
StP_r	0.0049	Maximum rate of un-repaired internal corrosion
Ut_r	0.0000	Maximum rate of external corrosion

Tank Shell Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	10/14/09	24.25	0.250	0.095	0.155	0.0039	0.100	0.055	14.039	10/28/2023
External	07/15/85	10/14/09	24.25	0.250	0.000	0.250	0.0000	0.100	0.150	N/A	N/A
Combined	07/15/85	10/14/09	24.25	0.250	0.095	0.155	0.0039	0.100	0.055	14.039	10/28/2023

Notes: 1) The required thickness shall be the lesser of the current calculated thickness or .100"

Average Shell Thickness Determination of Corroded Areas

$L = 3.7\sqrt{Dt_2}$

D	t_2	t_2 Elev.	L	L / 5
6.00	0.160	2.00	3.63	0.73

Thickness Location	Distance form Top	Measured Thickness
1	0.55	0.200
2	1.27	0.165
3	2.00	0.160
4	2.73	0.175
5	3.45	0.198
Average t_1 →		0.1798

L = Length in inches where hoop stress is assumed to average out around local discontinuities

D = Tank Diameter in feet

t_2 = Least Thickness in inches of Corroded Area

t_2 Elev. = Elevation or Distance from the bottom of the tank to the area of least thickness

t_1 = Average Thickness of five equily spaced thicness measurements

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.3.2.1

2) t_2 & t_1 values shall be used in shell's required thickness calculations on page F-2

UT Inspection Interval = Lesser of RCA/2N or 15 years

RCA/2N = 7.02

External Inspection Interval = Lesser of RCA/4N or 5 years

RCA/4N = 3.51

Conclusion:

Tank Bottom Corrosion Evaluation: Tank can be returned to service and used for two years before another internal inspection is required.

Tank Shell Corrosion Evaluation: Tank can be returned to service and used for two years before another external inspection is required.

DATA EVALUATION & ANALYSIS
REQUIRED THICKNESS DETERMINATION

Shell Design Method To Be Used **OFM**

Enter "VDP" for variable design point method or "OFM" for one foot method.

Tank Diameter 8'
Specific Gravity 1.0

Table 1: Original Tank Data

Course Number	Height (in.)	Height (ft.)	T orig. (in.)	Material Spec.	Min. Yield*	Min. Tensile*	Allow. Stress Product	Allow. Stress Water	Joint Efficiency
1	50.00	04.167	1/4"	C.S.	30,000	55,000	23,600	26,000	0.70
2	48.00	04.000	1/4"	C.S.	30,000	55,000	23,600	26,000	0.70
3	48.00	04.000	1/4"	C.S.	30,000	55,000	26,000	27,000	0.70
Total	146.00	12.17							

* If shell material is known; Minimum yield, Minimum Tensile & Allowable Stress figures were obtained from API 653, table 4.1.
* If shell material is unknown; Minimum yield, Minimum Tensile & Allowable Stress figures derived by using the formulas in API 653. Welded tanks - para. 4.3.3 Riveted tanks – para. 4.3.4.

Table 2: Calculated Tank Data

Course Number	T_1 (Inch)	T_2 (Inch)	T_{min} Product	T_{min} Water	Calculated H. (ft.)	Shell Check Product T_1 Check	Shell Check Product T_2 Check	Shell check Water T_1 Check	Shell check Water T_2 Check
1	0.178	0.150	.011	.010	11.17	Yes	Yes	Yes	Yes
2	0.200	0.197	.007	.006	7.00	Yes	Yes	Yes	Yes
3	0.198	0.190	.003	.002	3.00	Yes	Yes	Yes	Yes

Calculate:

New Fill Height For Product: **No** **New Fill Height For Water:** **No**

Calculate only if shell courses are not adequate due to; minimum or average thickness' (T1 or T2) being less than thickness required (T req'd). See next page if answer is yes.

Notes:

Requirements for continued operations per API 653, Section 4.3.3 or 4.3.4:

1. T_{min} (or required thickness) = 2.6*H-1*D*G / S*E (use the greater of T_{min} in Table 2 or .100" thick)
2. No pitting shall be greater than one half the T_{min} or exceed 2" in 8" in a vertical direction.
3. The value of T_1 shall be greater than or equal to T_{min}.
4. The value of T_2 shall be greater than or equal to 60% of T_{min}.
5. The external inspection interval shall not exceed five years, as per API 653, para. 4.3.3.2a.
6. Any corrosion allowance for service until the time of the next inspection shall be added to the $T_{min's}$ in items 3 & 4.

CONCLUSION

The evaluation shows that the tank can be safely filled to the top of the tank shell or 12' 2"

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT thickness Measurements*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 103*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT.ASME.3 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Thickness measurements were taken on portions of the; Roof, Shell, Tank Bottom & applicable Nozzles

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☒ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

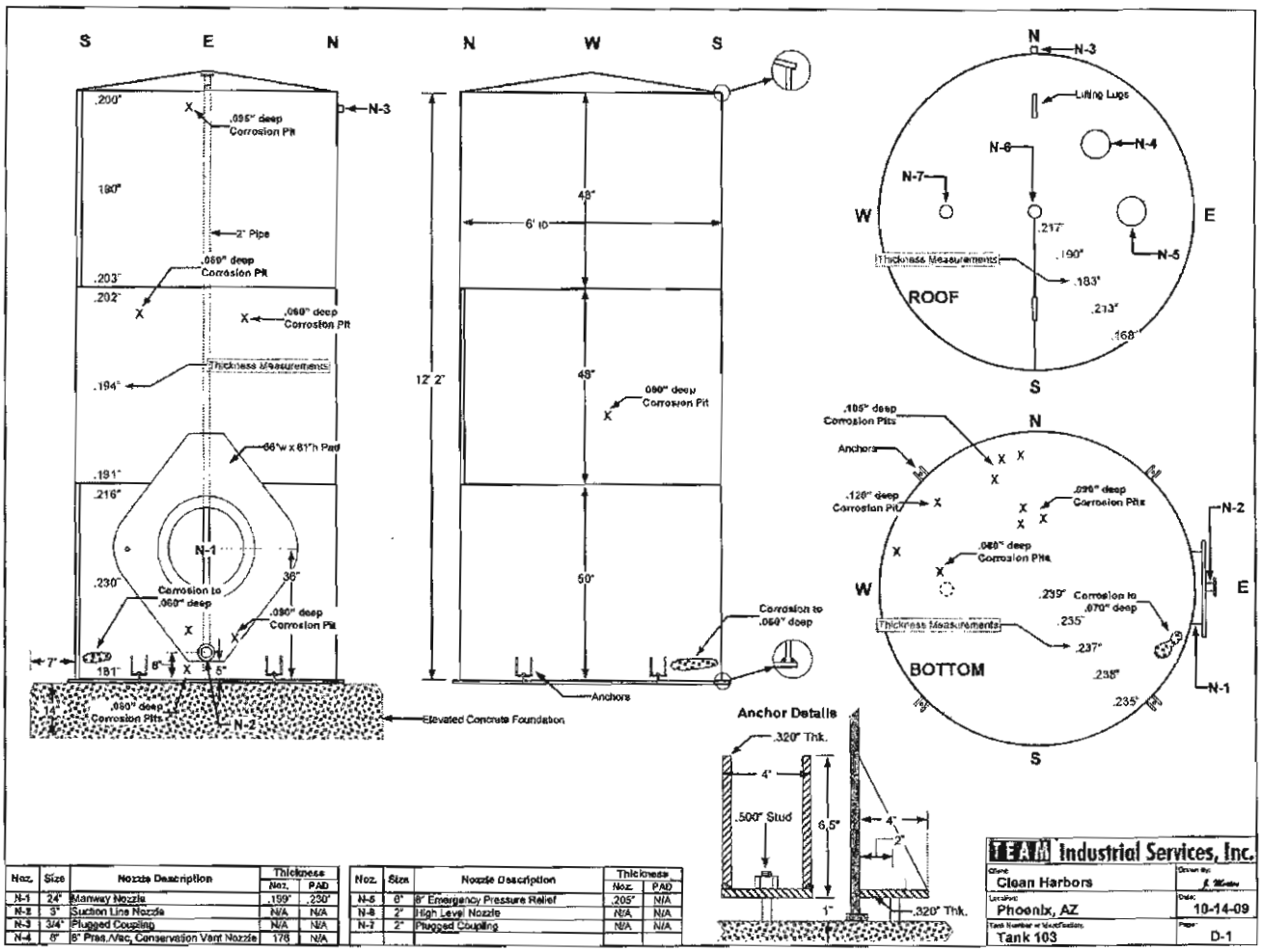
☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*in.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*in.*

EQUIPMENT			CALIBRATION INFORMATION	
Scope Manufacturer: *Krautkramer*			☒ Back Wall Technique	Ref. Signal Amp.: *100+%*
Model: *USN 52*	S/N: *621066*		Calibration Standard Type: *Step Wedge*	
Transducer Manufacturer: *Panametrics*			Calibration Standard Material: *Carbon Steel*	
Model: *V-602*	S/N: *130297*		Reflector: ☐ FBH ☐ SDH ☐ Notch	
Freq.: *3.5MHz*	Size: *.500"*	Angle: *0°*	Reflector Size(s): *N/A*	
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*	
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*	
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*
Couplant: *Cellulose Gell*		Batch No.: *N/A*	Scanning Gain: *N/A*	

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Thickness measurements are shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *10-14-09*



Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-1	24"	Manway Nozzle	.159"	.230"
N-2	3"	Suction Line Nozzle	N/A	N/A
N-3	3/4"	Plugged Coupling	N/A	N/A
N-4	6"	6" Pres./Vac. Conservation Vent Nozzle	178	N/A

Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-5	6"	6" Emergency Pressure Relief	.205"	N/A
N-6	2"	High Level Nozzle	N/A	N/A
N-7	2"	Plugged Coupling	N/A	N/A

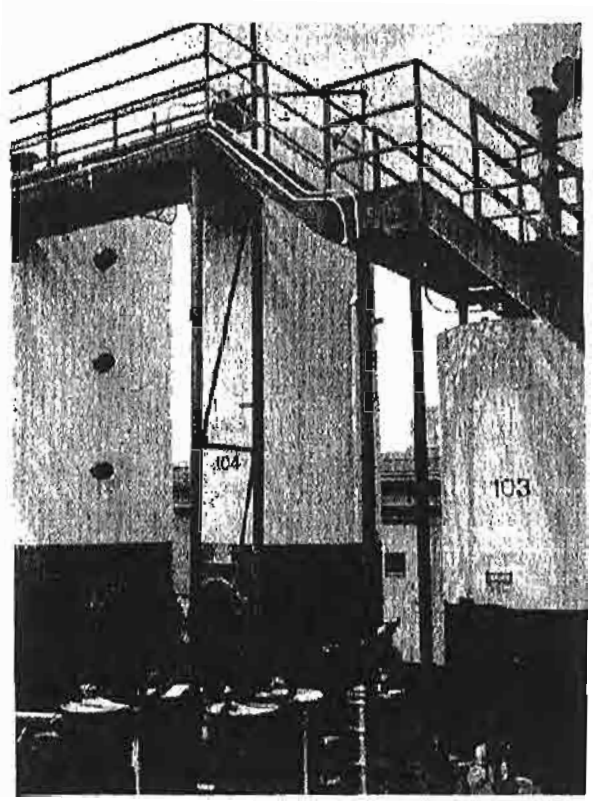
TEAM Industrial Services, Inc.

Client: Clean Harbors	Drawn By:
Location: Phoenix, AZ	Date: 10-14-09
Tank Number or Modification: Tank 103	Page: D-1

2514 N. 33rd Ave.
Phoenix, AZ 85009
Phone: 602-269-7868
Fax: 602-269-9784
www.teamindustrialservices.com

TEAM Industrial Services, Inc.

TANK INSPECTION REPORT



CLEAN HARBORS
PHOENIX, AZ

STORAGE TANK 104

EXTERNAL / INTERNAL INSPECTION
COMPLETED 07-15-09

Team Work Order #12890168

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EQUIPMENT USED, PARAMETERS, ETC.

TANK / VESSEL DATA

Client: *Clean Harbors*
Location: *1340 West Lincoln St.*
Phoenix, AZ 85007

Inspection Type	Last Insp.	Current Insp.	Next Insp. Due
External	01-08-08	07-15-09	07-15-11
Internal	01-08-08	07-15-09	07-15-11

Service: *Flammable Liquid Waste Tank*
Tank Identification: *Tank 104*
Capacity: *4,750 Gals.* Height: *18' 2"+*
Diameter or Length/Width: *6' 6"*
Orientation: ☒ Vertical ☐ Horizontal
Shape: ☒ Circular ☐ Rectangular

Mfg. By: *Unk.*
Mfg. Address: *Unk.*
Date of Manufacture: *1992 (assumed)*
Mfg. Serial Number: *Unk.*
Standard of Construction: *Unk.*
National Board Number: *N/A*
Specific Gravity: Design *Unk.* Product *<1.0*
Product Weight / cu. Ft.: *<62.4 pounds*
Max. Allow. Work. Pres. *2.5 psi (assumed)*
Max. Allow. Work. Temp. *200°F (assumed)*
Operating Pressure: *Atmospheric*
Operating Temperature: *Ambient*
Design Seismic Zone: *Unk.*
Design Wind Load: *Unk.*
Operating Level: *Full*
Gallons / Ft.: *255.92 (above lower head)*

FOUNDATION

Type: ☒ Slab ☐ Ring Wall
Material: ☒ Concrete ☐ Gravel ☐ Soil
Other:

TANK SUPPORT

Type: ☐ Cradle ☐ Skirt ☒ Legs
Other:
Material: ☒ Steel ☐ Concrete

ROOF OR UPPER HEAD CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*
Roof or Head Type: Thickness: *5/8"*
☐ Flat ☐ Flat Flanged ☒ Torispherical (F&D)
☐ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other: *Self Supporting*
Dish Depth: *12"* Flg. Length *2.75"* Kn. Radius *Unk.*
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☒ Lapped ☐ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

SHELL CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*

Course	1st	2nd	3rd	4th	5th	6th	7th	8th
Ht. or Length	109"	109"						
Nom. Thk.	7/16"	7/16"						

Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

BOTTOM OR LOWER HEAD CONSTRUCTION

Material: *Carbon Steel* Cor. Allow. *N/A*
Bottom or Head Type: Thickness: *5/8"*
☒ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☐ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other:
Dish Depth: *12"* Flg. Length *2.75"* Kn. Radius *Unk.*
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☒ Lapped ☐ Butted
Weld Type: *From both sides* Joint Eff. *N/A*

ADDITIONAL INFORMATION

☒ External Coating: *Painted Black & White*
☐ Internal Lining: *None*
☐ Atmospheric Vent: *None*
☒ Normal Vent: *8" Jayco, M/N; JT-20*
☒ Emergency Vent. *8" OPW, M/N; 202-F8*
☐ Pres. Relief Vent: *None*
☒ Roof Access: *Catwalk*
☒ Internal Access: *Two shell mounted manways*
☒ Autogauge Device: *Level Sensor*
☒ High Level Indicator ☐ Internal Coils ☒ Grounded
☐ Overflow Vent ☐ External Jacket ☒ Anchored
☐ Cathodic Protection ☐ Agitator / Mixer

METHODOLOGY

Team Industrial Services was contracted to perform an internal / external inspection on Storage Tank 104 located at Clean Harbors; Phoenix, AZ facility. This inspection is intended to meet the mechanical integrity requirements of the various state and federal agencies. This section describes the methods and procedures used to perform the inspection.

The inspection report is a compilation of data obtained through visual inspections, conversations with plant personal and client supplied information. This includes quantitative and qualitative data necessary to document the tank's condition. The inspector prepares the field data in accordance with generally accepted standards, codes and good engineering practice. Recommendations, such as repairs, service modifications, maintenance operations, and additional NDE, are based on the evaluation of the tank's condition. The contents contained within the tank are also taken into consideration when making decisions such as frequency and type of future inspections.

The latest editions of the below referenced codes and/or standards were used in determining the tanks acceptability.

- API 653; Tank Inspection, Repair, Alteration and Reconstruction.
- API 650; Welded Tanks for Oil Storage
- API 2000; Venting Atmospheric & Low-Pressure Storage Tanks
- UL-142; Steel Aboveground Tanks for Flammable & Combustible Liquids

Other Codes and/or Standards related to work practices

- ASME Sec. V; Nondestructive Testing.
- ASTM E 543-96; Standard Practice for Agencies Performing Nondestructive Testing.
- OSHA; 29 CRF 1910 "Occupational Safety and Health Standards"
- API 2015; Safe Entry & Cleaning of Petroleum Storage Tanks

The report is divided into six main activities:

1. Tank/Vessel Data
2. Visual Inspection
3. Drawings
4. Photographs
5. Data Evaluation & Analysis
6. Non-Destructive Examination

Tank/Vessel Data

The **Tank/Vessel Data** form was filled out after the inspection had been completed. It defines the original tank design parameters, the current design parameters, the tank history, the foundation configuration and the current tank configuration. Original client documents, verbal client information and field observations were used to complete this form.

Visual Inspection
The visual inspection was performed using guidelines set forth in current editions of API, ASME and/or ASTM. All accessible areas of the tank and its appurtenances were inspected. Observations made during this inspection are listed in the Summary and Recommendations portion of this report. The following are some of the essential elements of the Visual Inspection:

- Detection of leaks.
- Detection of cracks or potential crack initiators.
- Detection of physical damage, such as gouges and scratches.
- Detection of blisters, disbond or separations of fiberglass piles.
- Detection of external corrosion, erosion or gel coat failure.
- Detection of appurtenance's which may violate applicable codes, standards or good engineering practice.
- Detection of foundation and/or support deficiencies.
- Verification of venting used for normal breathing and/or emergency pressure release.

Drawings
The drawings show the tanks overall dimensions, general location of nozzles, as well as any other pertinent information.

Photographs
Photographs were taken to show the current condition of the tank and its appurtenances.

Data Evaluation & Analysis
Methods described in the current edition of API 653 were used to calculate items such as;

- Minimum required shell plate thickness
- Corrosion rates
- Inspection Intervals
- Remaining Life

Definitive Inspection
The **Definitive Inspection** is quantitative inspection of the tank components and consisted of the following:

Upper Head - UT Thickness Survey
Ultrasonic thickness readings were taken from the center of the head to the outer perimeter at locations shown on the tank drawings.

Shell - UT Thickness Survey
Ultrasonic thickness readings were taken from top to bottom at locations shown on the tank drawings.

Lower Head - UT Thickness Survey
Ultrasonic thickness readings were taken on the tank bottom at locations shown on the tank drawings.

Corrosion Scans
If applicable, additional corrosion scans were done on the exterior of the tank shell where the internal visual inspection found corrosion.

The results of the UT thickness surveys are shown on the tank drawings. The results of the corrosion scans are discussed in the summary portion of this report. Nozzle thickness measurements shown on the tank drawing were taken from the last inspection. Information such as the referenced codes, standards or procedures, type of equipment used, etc, can be found on the technique sheet (s).

Drawings or Layouts
The drawings show the tanks overall dimensions, general location of nozzles, nozzle identification numbers, as well as any other pertinent information. Ultrasonic thickness data was also recorded on the drawings.

SUMMARY & RECOMMENDATIONS

Recommendations Italicized

DISCUSION AND HISTORICAL INFORMATION

This tank is used for the storage of flammable and non-flammable waste liquids. This tank appears to have been designed as a pressure vessel. The tank is constructed of carbon steel, is elevated on legs and has upper and lower heads. All shell seams are butt welded and the head to shell seams are lap welded. The tank has no name plate and the only records are of the inspection performed by myself on 01-08-08. The date and standard of construction is not known, the tank was probably built as a non-code stamped ASME vessel. For the purpose of estimating a corrosion rate, I'm using 1992 for a date of construction, since that's when the plant was built. All of the tanks at this facility were probably used elsewhere before being moved here in 1992. This tank has not been used since the last inspection. All recommended corrective actions mentioned in the previous inspection report have been fulfilled by the client and verified by myself during this inspection.

INSPECTION FINDINGS

Exterior

Roof, Shell & Appurtenances

1) Overall, the tanks coating is oxidized but in fair condition. Some light rust was found at random areas on the roof, shell, nozzles & anchors. The client has purchased paint and has plans on spot coating rusted areas.
   Spot coat rusted areas prior to the next scheduled inspection.
2) The NFPA warning label was replaced and is in good condition.
   No action necessary.
3) The area inside the pressure/vacuum vent has been cleaned and both pressure and vacuum relieving devices appear to be functioning properly.
   Plant personal should perform periodic inspections.

FOUNDATION &/OR SUPORT SYSTEM

4) A few tight radial cracks were found on the elevated pad. None are in need of repair at this time.
   Perform periodic visual inspections of the foundation and dike area and repair when needed.
5) Except for some rust, the anchors and anchor bolts appear to be in good shape.
   No action necessary.

INTERIOR

Roof, Shell, Bottom & Appurtenances

Prior to this inspection, the tank was cleaned so that a proper visual inspection could be performed on the roof, shell and tank bottom.

6) The internal visual inspection found the following:

- The upper head has a general overall pattern of corrosion; external thickness measurements indicate a minimum remaining thickness of .615" (estimated loss of .060", estimated corrosion rate .0002/year).
  Acceptable, according to API 653, para 4.2.1.2 the roof only has to have an average thickness of .090" in any 100 in.^{2} area and contain no holes.
- The shell has a general overall pattern of corrosion with an average depth of about .020". Deeper corrosion was found on the east side between the upper and lower manways. Corrosion scans done at this location indicate a minimum remaining thickness of .250" (estimated loss of .170", estimated corrosion rate .0071/year). At this rate the shell should reach the minimum allowable thickness of .100" in 21 years. API 653, para. 4.3.2.1 provides a formula to determine the inspection interval based on shell corrosion rates. The formula is as follows; RCA/4N, where RCA is the remaining corrosion allowance and N is the corrosion rate. The lesser of 5 years or the results of the formula is to be used for the inspection interval. In this case 5 years is the lesser of the two. See "Data Evaluation & Analysis" portion of this report for more information.
  Acceptable, according to formulas provided in API 653, para 4.3.2.1 re-inspection is not due for another 5 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 07-15-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
- The tank bottom has a nominal thickness of .675". Numerous areas were found to contain isolated corrosion pits up to .185" deep (remaining thickness at worst pitting is .490", estimated corrosion rate .0077/year). At this rate the bottom will reach the minimum allowable thickness of .100" in 50 years. API 653 allows for a maximum inspection interval of 20 years if the corrosion rate is known or 10 years if unknown. API also sets a minimum remaining tank bottom thickness at the next scheduled inspection; for this tank that thickness is .100". Reference API 653 paragraphs 4.4.5.1, 6.4.2.1, 6.4.2.2 & Table 6-1. See "Data Evaluation & Analysis" portion of this report for more information.
  Acceptable, according to API 653, re-inspection is not due for 10 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 07-15-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
  Although not required at this time, the client should plan to have any corrosion pits in excess of .100" deep weld overlayed (puddle welded) during the next inspection. This action will keep the client form having to install patches sometime in the future. If considered, the client shall ensure the welding contractor has the proper documentation.

GENERAL NOTES

7) The client should insure that all mechanical and electrical equipment associated with this tank is checked periodically for proper function. In addition, visual inspections should be performed by trained plant personal on a regular basis. These checks should also be done on before the tank is returned to service.

8) The client should retain a copy of this report in their tank files for the life of the tank.

9) Thickness measurements taken during this inspection are essentially the same as taken during the last inspection. Any differences in measured thicknesses are attributed to the varying locations where the measurements taken and not due to an actual loss or gain in thickness.

CONCLUSION

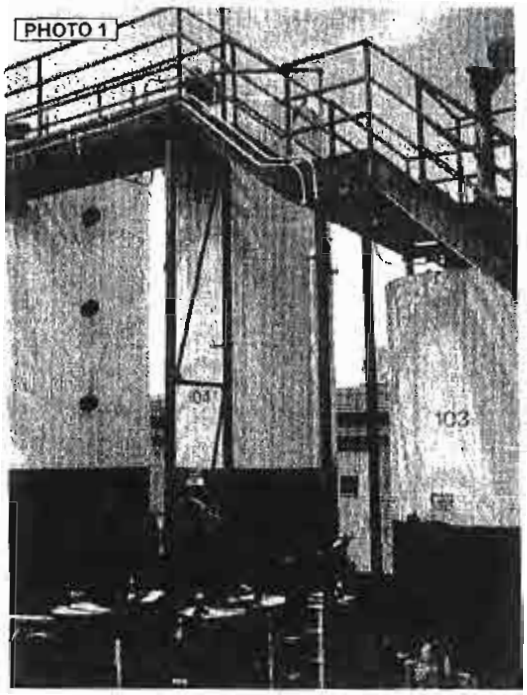
The tank and its appurtenances were inspected and evaluated to the best of my abilities. I found no evidence or issues during my inspection and evaluation that would keep the client from returning the tank to service.

INSPECTED BY: John Morton

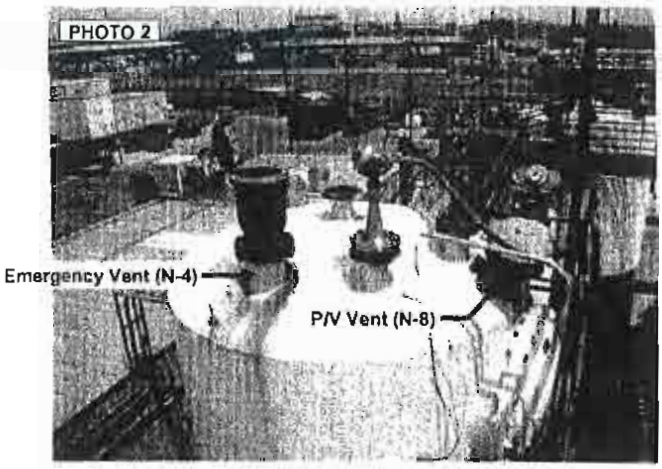
API 653 Cert #0143
API 510 Cert #03049
API 570 Cert #03787
API 1104 Cert #34118
AWS-CWI Cert #04060107
ASNT Level II, MT, PT & UT

DATE: 07-15-09

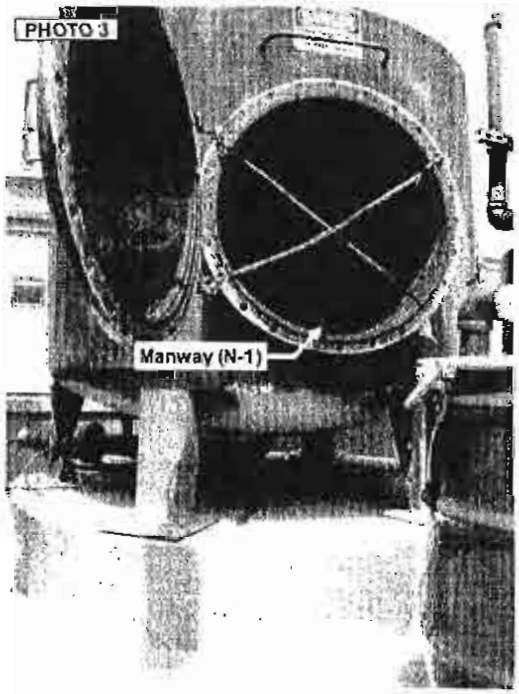
Any recommendations made by the API Tank Inspector are to be used only as a guideline for making repairs, as required by the client. Neither Team Industrial Services nor their inspectors accept responsibility for the tank's integrity, even after these recommendations are followed. All of the data compiled within this tank report should be reviewed by an engineer experienced in the, design, construction and repair of above ground storage tanks. Calculations, recommendations and evaluations contained within this report do not take into consideration the effects of additional loads imposed by wind, seismic activity or attached components. Corrosion rate and remaining life calculations are based on conditions caused by products previously stored inside the tank. Chemical, physical or mechanical changes to the tank and/or its contents may be cause for re-evaluation. Formulas contained in API 650 & 653 and good engineering judgment was used to determine the inspection frequency and next inspection dates. These dates and/or frequencies may differ from agencies other than API, in which case the more stringent should be followed.



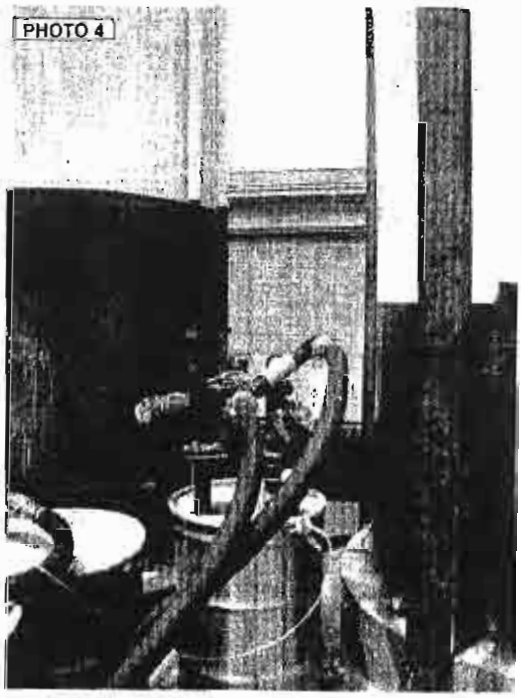
TANK AS VIEWED FROM THE NORTHEAST



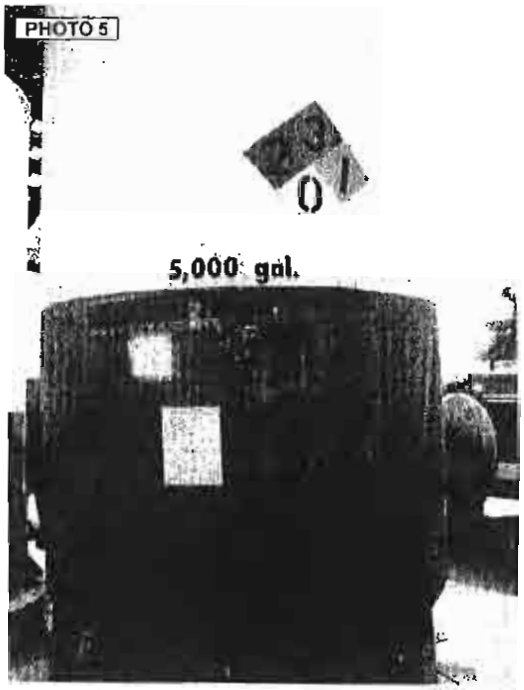
ROOF AS VIEWED FROM THE SOUTH



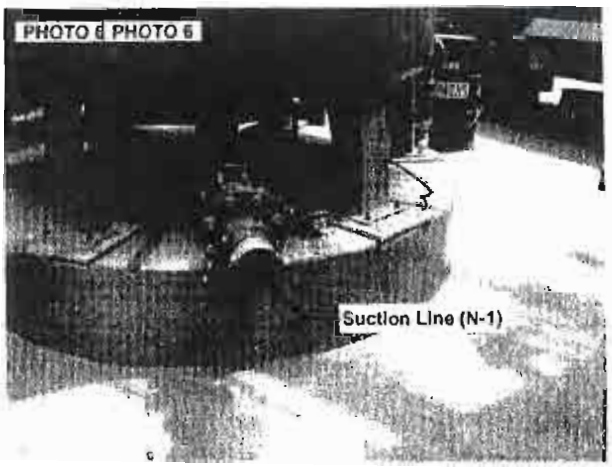
LOWER EAST SIDE OF TANK



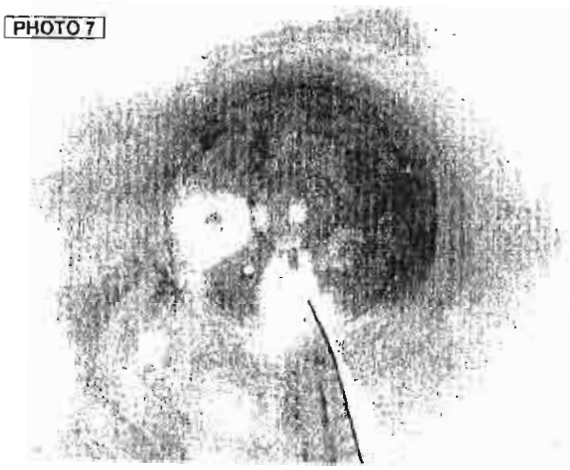
LOWER NORTH EAST SIDE OF TANK;
VIEW SHOWING VAPOR CANISTERS



LOWER WEST SIDE OF TANK

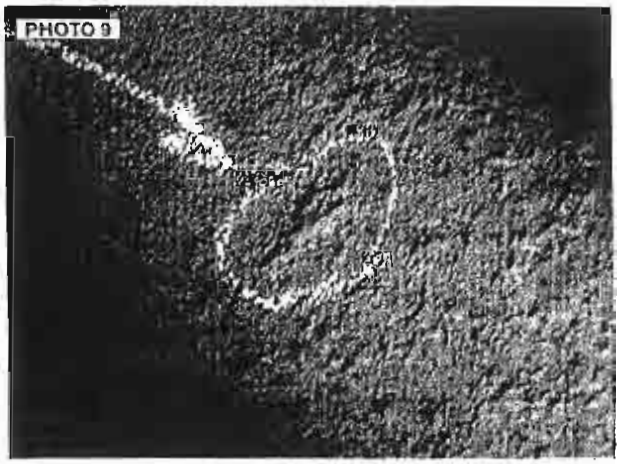


BOTTOM SOUTHWEST SIDE OF TANK



INTERIOR, UPPER HEAD

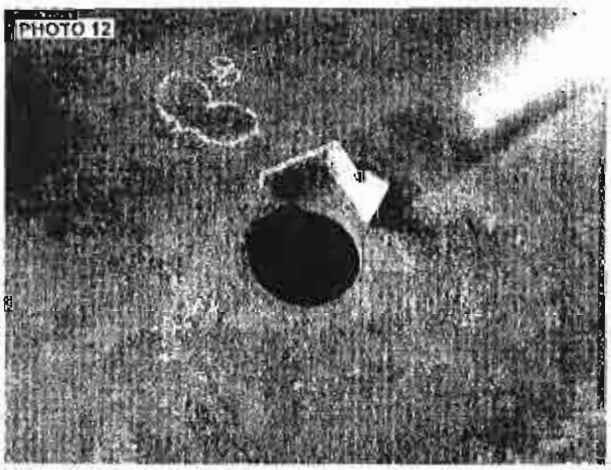
INTERIOR, UPPER EAST SIDE



INTERIOR, EAST SIDE OF SHELL;
VIEW SHOWING CORROSION FOUND BETWEEN THE UPPER AND LOWER MANWAYS

INTERIOR, LOWER HEAD TO SHELL LAP SEAM WELD

INTERIOR, LOWER HEAD;
VIEW SHOWING CORROSION



INTERIOR, CENTER OF LOWER HEAD

DATA EVALUATION & ANALYSIS
CORROSION RATE & REMAINING LIFE CALCULATIONS

Date		Time In Service			
Built	Current	Days	Weeks	Months	Years
7/15/1985	7/15/2009	8766.00	1248.00	288.00	24.00

☐ Date Built obtained from Records or Nameplate

☑ Date Built Estamated

Tank Bottom Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	07/15/09	24.00	0.675	0.185	0.490	0.0077	0.100	0.390	50.595	2/17/2060
External	07/15/85	07/15/09	24.00	0.675	0.000	0.675	0.0000	0.100	0.575	N/A	N/A
Combined	07/15/85	07/15/09	24.00	0.675	0.185	0.490	0.0077	0.100	0.390	50.595	2/17/2060

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.4.5.1

✓ Un-repaired Bottom ☐ Repaired Bottom

MTR = (Minimum of RT_{bc} or RT_{ip})-Or(StP_r+Up_r)

MTR	0.475	Minimum remaining thickness at the end of interval Or
O_r	2	In service interval; Max 10 yrs if unknown, 20 yrs if known
RT_{bc}	0.675	Minumum thickness from external corrosion after repairs
Rt_{ip}	0.490	Minumum thickness from internal corrosion after repairs
StP_r	0.0077	Maximum rate of un-repeired internal corrosion
Ut_r	0.0000	Maximum rate of external corrosion

Tank Shell Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	07/15/09	24.00	0.420	0.170	0.250	0.0071	0.100	0.150	21.176	9/17/2030
External	07/15/85	07/15/09	24.00	0.420	0.000	0.420	0.0000	0.100	0.320	N/A	N/A
Combined	07/15/85	07/15/09	24.00	0.420	0.170	0.250	0.0071	0.100	0.150	21.176	9/17/2030

Notes: 1) The required thickness shell be the lesser of the current calculated thickness or .100"

Average Shell Thickness Determination of Corroded Areas

$L = 3.7\sqrt{Dt_2}$

D	t_2	t_2 Elev.	L	L / S
6.50	0.250	130.00	4.72	0.94

Thickness Location	Distance form Top	Measured Thickness
1	128.11	0.375
2	129.06	0.310
3	130.00	0.250
4	130.94	0.330
5	131.89	0.389
Average t_1 →		0.331

L = Length in inches where hoop stress is assumed to average out around local discontinuities

D = Tank Diameter in feet

t_2 = Least Thickness in inches of Corroded Area

t_2 Elev. = Elevation or Distance from the top of the tank to the area of least thickness

t_1 = Average Thickness of five equily spaced thicness measurements

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.3.2.1

2) t_2 & t_1 values shall be used in shell's required thickness calculations on page F-2

UT Inspection Interval = Lesser of RCA/2N or 15 years

RCA/2N = 10.59

External Inspection Interval = Lesser of RCA/4N or 5 years

RCA/4N = 5.29

Conclusion:

Tank Bottom Corrosion Evaluation: Tank can be returned to service and used for two years before another internal inspection is required

Tank Shell Corrosion Evaluation: Tank can be returned to service and used for two years before another external inspection is required

DATA EVALUATION & ANALYSIS
REQUIRED THICKNESS DETERMINATION

Shell Design Method To Be Used **OFM**

Enter "VDP" for variable design point method or "OFM" for one foot method.

Tank Diameter 6' 6"
Specific Gravity 1.0

Table 1: Original Tank Data

Course Number	Height (in.)	Height (ft.)	T orig. (in.)	Material Spec.	Min. Yield*	Min. Tensile*	Allow. Stress		Joint Efficiency
							Product	Water	
1	109.00	09.08	0.420	C.S.	30,000	55,000	23,600	26,000	0.45
2	109.00	09.08	0.420	C.S.	30,000	55,000	23,600	26,000	0.45
Total	218.00	18.17							

* If shell material is known; Minimum yield, Minimum Tensile & Allowable Stress figures were obtained from API 653, table 4.1
* If shell material is unknown, Minimum yield, Minimum Tensile & Allowable Stress figures derived by using the formulas in API 653. Welded tanks - para. 4.3.3 Riveted tanks – para 4.3.4.

Table 2: Calculated Tank Data

Course Number	T_1 (Inch)	T_2 (Inch)	T_{min}		Calculated H. (ft.)	Shell Check Product		Shell check Water	
			Product	Water		T_1 Check	T_2 Check	T_1 Check	T_2 Check
1	0.331	0.250	.027	.025	17.17	Yes	Yes	Yes	Yes
2	0.408	0.390	.013	.012	8.08	Yes	Yes	Yes	Yes

Calculate:

New Fill Height For Product: **No** **New Fill Height For Water:** **No**

Calculate only if shell courses are not adequate due to; minimum or average thickness' (T1 or T2) being less than thickness required (T req'd). See next page if answer is yes.

Notes:

Requirements for continued operations per API 653, Section 4.3.3 or 4.3.4:

1. T_{min} (or required thickness) = 2.6*H-1*D*G / S*E (use the greater of T_{min} in Table 2 or .100" thick)
2. No pitting shall be greater than one half the T_{min} or exceed 2" in 8" in a vertical direction.
3. The value of T_1 shall be greater than or equal to T_{min}.
4. The value of T_2 shall be greater than or equal to 60% of T_{min}.
5. The external inspection interval shall not exceed five years, as per API 653, para. 4.3.3.2a.
6. Any corrosion allowance for service until the time of the next inspection shall be added to the $T_{min's}$ in items 3 & 4.

CONCLUSION

The evaluation shows that the tank can be safely filled to the top of the tank shell or 19' 2"

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT thickness Measurements*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 104*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT.ASME.3 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Thickness measurements were taken on portions of the; Shell and both Heads

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☒ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*in.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*in.*

EQUIPMENT			CALIBRATION INFORMATION	
Scope Manufacturer: *Panametrics*			☒ Back Wall Technique	Ref. Signal Amp.: *100+%*
Model: *Epoch LT*	S/N: *070149004*		Calibration Standard Type: *Step Wedge*	
Transducer Manufacturer: *Panametrics*			Calibration Standard Material: *Carbon Steel*	
Model: *D-790*	S/N: *803018*		Reflector: ☐ FBH ☐ SDH ☐ Notch	
Freq.: *5MHz*	Size: *.375"*	Angle: *0°*	Reflector Size(s): *N/A*	
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*	
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*	
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*
Couplant: *Cellulose Gell*		Batch No.: *N/A*	Scanning Gain: *N/A*	

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Thickness measurements are shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *07-15-09*

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT Corrosion Scans*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 104*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT-ASME-1 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Ultrasonic (corrosion) scans were performed on the east side of the shell.

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☐ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

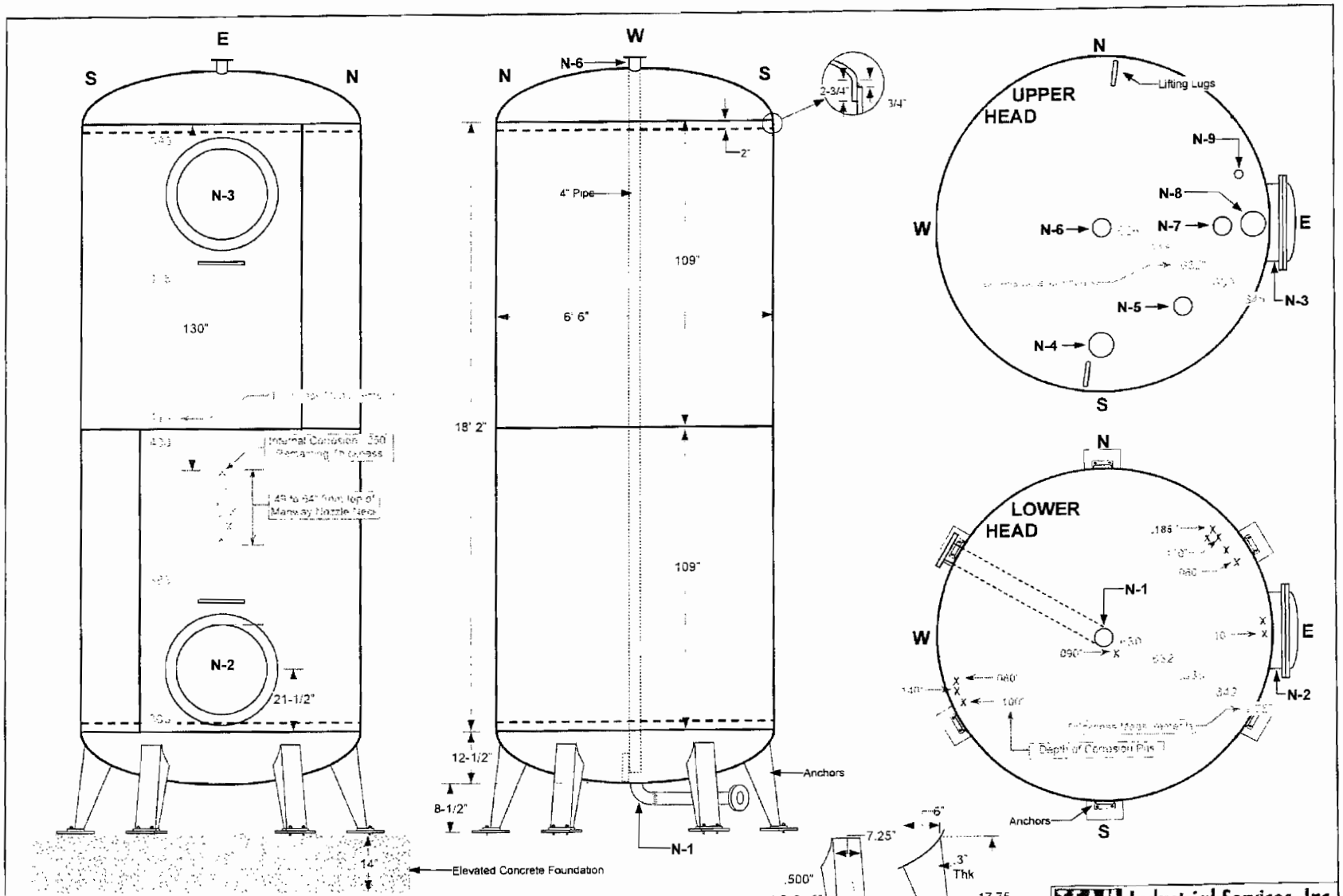
☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*in.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*in.*

EQUIPMENT			CALIBRATION INFORMATION	
Scope Manufacturer: *Panametrics*			☐ Back Wall Technique	Ref. Signal Amp.: *N/A*
Model: *Epoch LT*	S/N: *070149004*		Calibration Standard Type: *Step Wedge*	
Transducer Manufacturer: *Krautkramer*			Calibration Standard Material: *Carbon Steel*	
Model: *Gamma*	S/N: *009YWH*		Reflector: ☐ FBH ☐ SDH ☐ Notch	
Freq.: *5 MHz*	Size: *.5" x .5"*	Angle: *0°*	Reflector Size(s): *N/A*	
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*	
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*	
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*
Couplant: *Cellulose Gell*		Batch No.: *N/A*	Scanning Gain: *N/A*	

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Corrosion data is shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *07-15-09*



Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-1	4"	Suction Line Nozzle	.350"	N/A
N-2	36"	Manway Nozzle	.270"	N/A
N-3	36"	Manway Nozzle	.270"	N/A
N-4	6"	8" Emergency Pressure Relief	.382"	N/A
N-5	4"	Level Transmitter Nozzle	.217"	N/A

Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-6	4"	Blinded Nozzle	.281"	N/A
N-7	4"	2" Fill Line	.285"	N/A
N-8	6"	8" Pres./Vac. Conservation Vent Nozzle	.351"	N/A
N-9	3/4"	Plugged Coupling	N/A	N/A

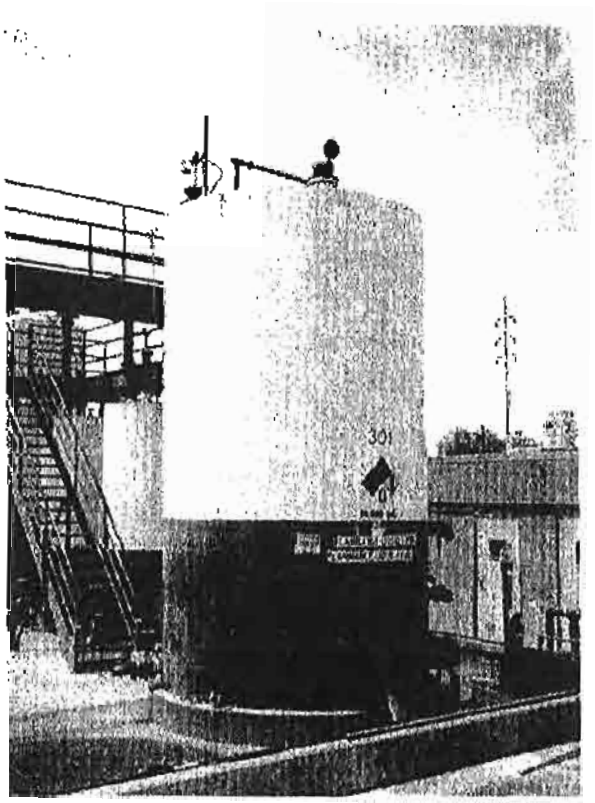
TEAM Industrial Services, Inc.

Client: Clean Harbors	Drawn By: J. Hodges
Location: Phoenix, AZ	Date: 07-17-09
Tank Number or Identification: Tank 104	Page: D-1

2514 N. 33rd Ave
Phoenix, AZ 85009
Phone 602-269-7868
Fax 602-269-9784
www.teamindustrialservices.com

TEAM Industrial Services, Inc.

TANK INSPECTION REPORT



CLEAN HARBORS
PHOENIX, AZ

STORAGE TANK 301

EXTERNAL / INTERNAL INSPECTION
COMPLETED 07-15-09
Team Work Order #12800168

REPAIR EXAMINATION
COMPLETED 07-22-09
Team Work Order #12800168

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LIST OF ANOMALIES FOUND DURING THE
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CALCULATED; CORROSION RATES, REMAINING LIFE &
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INSPECTION TECHNIQUE SHEETS ---------- **G-1** THRU **G-6**
FORMS SHOWING TYPES OF NDE
EQUIPMENT USED, PARAMETERS, ETC.

TANK / VESSEL DATA

Client: Clean Harbors
Location: 1340 West Lincoln St.
Phoenix, AZ 85007

Inspection Type	Last Insp.	Current Insp.	Next Insp. Due
External	09-26-07	07-15-09	07-15-11
Internal	09-26-07	07-15-09	07-15-11

Service: Flammable Liquid Waste Tank
Tank Identification: Tank 301
Capacity: 9,950 Gals. Height: 17' 1"
Diameter or Length/Width: 9' 11-1/2"
Orientation: ☒ Vertical ☐ Horizontal
Shape: ☒ Circular ☐ Rectangular

Mfg. By: Unk.
Mfg. Address: Unk.

Date of Manufacture: 1992 (assumed)
Mfg. Serial Number: UL – S/N 923700
Standard of Construction: UL-142
National Board Number: N/A
Specific Gravity: Design Unk. Product <1.0
Product Weight / cu. Ft.: <62.4 pounds
Max. Allow. Work. Pres. 2.5 psi (assumed)
Max. Allow. Work. Temp. 200°F (assumed)
Operating Pressure: Atmospheric
Operating Temperature: Ambient
Design Seismic Zone: Unk.
Design Wind Load: Unk.
Operating Level: Full
Gallons / Ft.: 582.63

FOUNDATION

Type: ☒ Slab ☐ Ring Wall
Material: ☒ Concrete ☐ Gravel ☐ Soil
Other:

TANK SUPPORT

Type: ☐ Cradle ☐ Skirt ☐ Legs
Other;
Material: ☐ Steel ☐ Concrete

ROOF OR UPPER HEAD CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A
Roof or Head Type: Thickness: 3/16"
☐ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☒ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other: Self Supporting
Dish Depth N/A Flg. Length N/A Kn. Radius N/A
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: From both sides Joint Eff. N/A

SHELL CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A

Course	1st	2nd	3rd	4th	5th	6th	7th	8th
Ht. or Length	85"	60"	60"					
Nom. Thk.	3/16"	3/16"	3/16"					

Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: From both sides Joint Eff. N/A

BOTTOM OR LOWER HEAD CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A
Bottom or Head Type: Thickness: 1/4"
☒ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☐ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other;
Dish Depth: N/A Flg. Length N/A Kn. Radius N/A
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☒ Lapped ☐ Butted
Weld Type: Joint Eff. N/A

ADDITIONAL INFORMATION

☒ External Coating: Painted Black & White
☐ Internal Lining: None
☐ Atmospheric Vent: None
☒ Normal Vent: 8" Jayco, M/N; JT-20
☒ Emergency Vent: 8" OPW, M/N; 202-F8
☐ Pres. Relief Vent: None
☒ Roof Access: Catwalk
☒ Internal Access: Shell mounted manway
☒ Autogauge Device Level Sensor
☒ High Level Indicator ☐ Internal Coils ☒ Grounded
☐ Overflow Vent ☐ External Jacket ☒ Anchored
☐ Cathodic Protection ☐ Agitator / Mixer

METHODOLOGY

Team Industrial Services was contracted to perform an internal / external inspection on Storage Tank 301 located at Clean Harbors; Phoenix, AZ facility. This inspection is intended to meet the mechanical integrity requirements of the various state and federal agencies. This section describes the methods and procedures used to perform the inspection.

The Inspection report is a compilation of data obtained through visual inspections, conversations with plant personal and client supplied information. This includes quantitative and qualitative data necessary to document the tank's condition. The inspector prepares the field data in accordance with generally accepted standards, codes and good engineering practice. Recommendations, such as repairs, service modifications, maintenance operations, and additional NDE, are based on the evaluation of the tank's condition. The contents contained within the tank are also taken into consideration when making decisions such as frequency and type of future inspections.

The latest editions of the below referenced codes and/or standards were used in determining the tanks acceptability.

- API 653; Tank Inspection, Repair, Alteration and Reconstruction.
- API 650; Welded Tanks for Oil Storage
- API 2000; Venting Atmospheric & Low-Pressure Storage Tanks
- UL-142; Steel Aboveground Tanks for Flammable & Combustible Liquids

Other Codes and/or Standards related to work practices

- ASME Sec. V; Nondestructive Testing.
- ASTM E 543-96; Standard Practice for Agencies Performing Nondestructive Testing.
- OSHA; 29 CRF 1910 "Occupational Safety and Health Standards"
- API 2015; Safe Entry & Cleaning of Petroleum Storage Tanks

The report is divided into six main activities:

1. Tank/Vessel Data
2. Visual Inspection
3. Drawings
4. Photographs
5. Data Evaluation & Analysis
6. Non-Destructive Examination

Tank/Vessel Data

The **Tank/Vessel Data** form was filled out after the inspection had been completed. It defines the original tank design parameters, the current design parameters, the tank history, the foundation configuration and the current tank configuration. Original client documents, verbal client information and field observations were used to complete this form.

Visual Inspection
The visual inspection was performed using guidelines set forth in current editions of API, ASME and/or ASTM. All accessible areas of the tank and its appurtenances were inspected. Observations made during this inspection are listed in the Summary and Recommendations portion of this report. The following are some of the essential elements of the Visual Inspection:

- Detection of leaks.
- Detection of cracks or potential crack initiators.
- Detection of physical damage, such as gouges and scratches.
- Detection of blisters, disbond or separations of fiberglass piles.
- Detection of external corrosion, erosion or gel coat failure.
- Detection of appurtenance's which may violate applicable codes, standards or good engineering practice.
- Detection of foundation and/or support deficiencies.
- Verification of venting used for normal breathing and/or emergency pressure release.

Drawings
The drawings show the tanks overall dimensions, general location of nozzles, as well as any other pertinent information.

Photographs
Photographs were taken to show the current condition of the tank and its appurtenances.

Data Evaluation & Analysis
Methods described in the current edition of API 653 were used to calculate items such as;

- Minimum required shell plate thickness
- Corrosion rates
- Inspection intervals
- Remaining Life

Definitive Inspection
The **Definitive Inspection** is quantitative inspection of the tank components and consisted of the following:

Roof - UT Thickness Survey
Ultrasonic thickness readings were taken from the center of the roof to the outer perimeter at locations shown on the tank drawings.

Shell - UT Thickness Survey
Ultrasonic thickness readings were taken from top to bottom at locations shown on the tank drawings.

Bottom (or Floor) - UT Thickness Survey
Ultrasonic thickness readings were taken on the tank bottom at locations shown on the tank drawings.

Corrosion Scans
A minimum of two 10 x 10" Ultrasonic corrosion scans were done on the tank bottom. One at the tanks center and another at the outer perimeter.
If applicable, additional corrosion scans were done on the exterior of the tank shell where the internal visual inspection found corrosion.

The results of the UT thickness surveys are shown on the tank drawings. The results of the corrosion scans are discussed in the summary portion of this report. Nozzle thickness measurements shown on the tank drawing were taken from the last inspection. Information such as the referenced codes, standards or procedures, type of equipment used, etc, can be found on the technique sheet (s).

Drawings or Layouts
The drawings show the tanks overall dimensions, general location of nozzles, nozzle identification numbers, as well as any other pertinent information. Ultrasonic thickness data was also recorded on the drawings.

SUMMARY & RECOMMENDATIONS

Recommendations Italicized

DISCUSION AND HISTORICAL INFORMATION

This tank is used for the storage of flammable and non-flammable waste liquids. This tank has a cone roof, a flat bottom, butt welded shell seams and is constructed of carbon steel. The tank has a UL plate but no name plate, so the date and manufacture is unknown. The only records are of the inspection performed by myself on 09-26-07. I'm using 1992 for a date of construction, since that's when the plant was built. All of the tanks at this facility were probably used elsewhere before being moved here in 1992. This tank has not been used since the last inspection. All recommended corrective actions mentioned in the previous inspection report have been fulfilled by the client and verified by myself during this inspection.

INSPECTION FINDINGS

Exterior

Roof, Shell & Appurtenances

1) Overall, the tanks coating is oxidized but in fair condition. Some light rust was found at random areas on the roof, shell, nozzles & anchors. The client has purchased paint and has plans on spot coating rusted areas.
   Spot coat rusted areas prior to the next scheduled inspection.
2) The NFPA warning label was replaced and is in good condition.
   No action necessary.
3) The loose flange bolts for the emergency pressure relief were tightened prior to this inspection.
   No action necessary.
4) The area inside the pressure/vacuum vent has been cleaned and both pressure and vacuum relieving devices appear to be functioning properly.
   Plant personal should perform periodic inspections.
5) The sloppy pressure/vacuum vent nozzle to roof weld was cleaned up and re-welded after I completed the internal/external inspection. Welding was performed by Manual Flores of Vic's welding on 07-22-09. Visual inspection and magnetic particle examinations were performed by Lincoln Mosquera of Team Industrial Services on the same day and the weld was found to be acceptable. The inspection reports and welders certification are attached as part of this report, see pages G-3 to G-6.
   Acceptable, no action necessary.

FOUNDATION &/OR SUPPORT SYSTEM

6) A few tight radial cracks were found on the elevated pad. None are in need of repair at this time.
Perform periodic visual inspections of the foundation and dike area and repair when needed.

7) Except for some rust, the anchors and anchor bolts appear to be in good shape.
No action necessary.

INTERIOR

Roof, Shell, Bottom & Appurtenances

Prior to this inspection, the tank was cleaned so that a proper visual inspection could be performed on the roof, shell and tank bottom.

8) The internal visual inspection found the following:
   - The roof has a general overall pattern of corrosion; external thickness measurements indicate a minimum remaining thickness of .173" (estimated loss of .015", estimated corrosion rate .0006/year).
     Acceptable, according to API 653, para 4.2.1.2 the roof only has to have an average thickness of .090" in any 100 in.^{2} area and contain no holes.
   - The shell has a general overall pattern of corrosion. External thickness measurements indicate a minimum remaining thickness of .178" (estimated loss of .010", estimated corrosion rate .0006/year). At this rate the shell won't reach the minimum allowable thickness of .100" for over 50 years. API 653, para. 4.3.2.1 provides a formula to determine the inspection interval based on shell corrosion rates. The formula is as follows; RCA/4N, where RCA is the remaining corrosion allowance and N is the corrosion rate. The lesser of 5 years or the results of the formula is to be used for the inspection interval. In this case 5 years is the lesser of the two. See "Data Evaluation & Analysis" portion of this report for more information.
     Acceptable, according to API 653, re-inspection is not due for 10 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 07-15-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
   - Overall the tank bottom is in fairly good condition. The tank bottom has a nominal thickness of .250". Nine areas were found to contain isolated corrosion pits in excess of .050" deep, with the deepest being .080" (remaining thickness at deepest pit is .170", estimated corrosion rate .0033/year). At this rate the bottom will reach the minimum allowable thickness of .100" in 21 years. API 653 allows for a maximum inspection interval of 20 years if the corrosion rate is known or 10 years if unknown. API also sets a minimum remaining tank bottom thickness at the next scheduled inspection; for this tank that thickness is .100". Reference API 653 paragraphs 4.4.5.1, 6.4.2.1, 6.4.2.2 & Table 6-1. See "Data Evaluation & Analysis" portion of this report for more information.

Acceptable, according to API 653, re-inspection is not due for 10 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 07-15-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
Although not required at this time, the client should plan to have any corrosion pits in excess of .050" deep weld overlayed (puddle welded) during the next inspection. This action will keep the client form having to install patches sometime in the future. If considered, the client shall ensure the welding contractor has the proper documentation.

- During the last inspection, corrosion estimated to be .040" deep was found on the shell manway cover. The cover was properly cleaned prior to this inspection and the corrosion is not a deep as previously estimated, the deepest area found is closer to .020" *Acceptable, the remaining thickness is well above what's needed.*

GENERAL NOTES

9) The client should insure that all mechanical and electrical equipment associated with this tank is checked periodically for proper function. In addition, visual inspections should be performed by trained plant personal on a regular basis. These checks should also be done on before the tank is returned to service.

10) The client should retain a copy of this report in their tank files for the life of the tank.

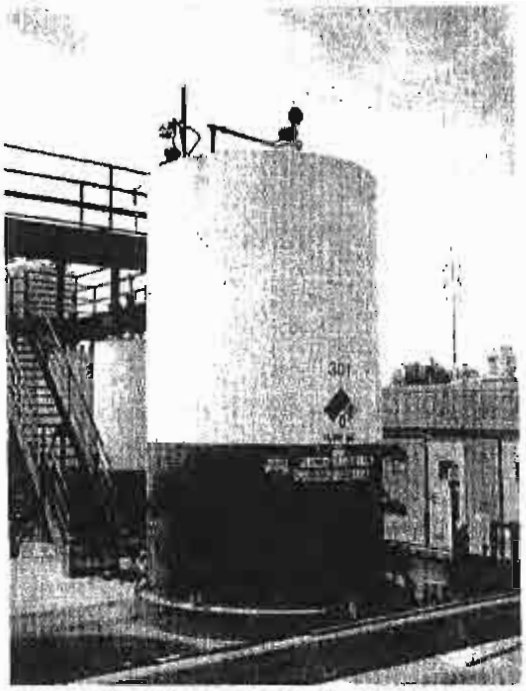
11) Thickness measurements taken during this inspection are essentially the same as taken during the last inspection. Any differences in measured thicknesses are attributed to the varying locations where the measurements taken and not due to an actual loss or gain in thickness.

CONCLUSION

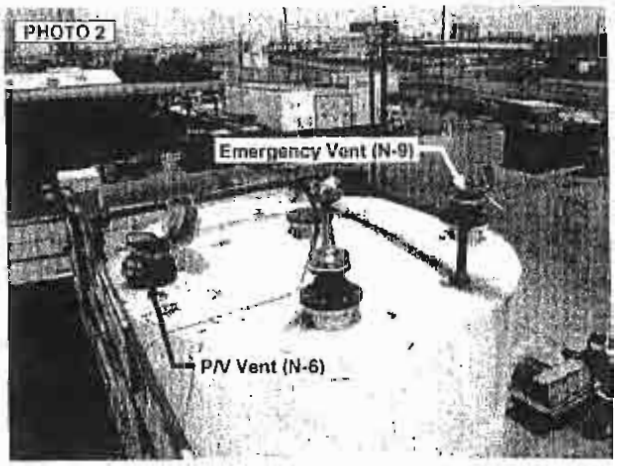
The tank and its appurtenances were inspected and evaluated to the best of my abilities. I found no evidence or issues during my inspection and evaluation that would keep the client from returning the tank to service.

INSPECTED BY: _____ John Morton API 653 Cert. API 510 Cert. API 570 Cert. API 1 ER Cert. AWS/CWI Cert. ASNT Level II MT, PT & UT DATE: 07-15-09

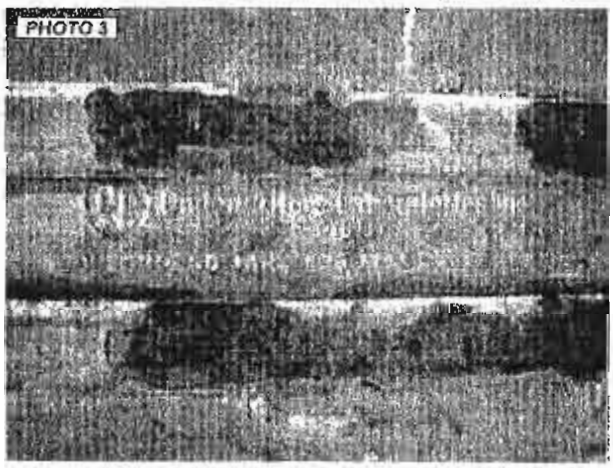
Any recommendations made by the API Tank Inspector are to be used only as a guideline for making repairs, as required by the client. Neither Team Industrial Services nor their inspectors accept responsibility for the tank's integrity, even after these recommendations are followed. All of the data compiled within this tank report should be reviewed by an engineer experienced in the design, construction and repair of above ground storage tanks. Calculations, recommendations and evaluations contained within this report do not take into consideration the effects of additional loads imposed by wind, seismic activity or attached components. Corrosion rate and remaining life calculations are based on conditions caused by products previously stored inside the tank. Chemical, physical or mechanical changes to the tank and/or its contents may be cause for re-evaluation. Formulas contained in API 650 & 653 and good engineering judgment was used to determine the inspection frequency and next inspection dates. These dates and/or frequencies may differ from agencies other than API, in which case the more stringent should be followed.



TANK AS VIEWED FROM THE NORTHEAST



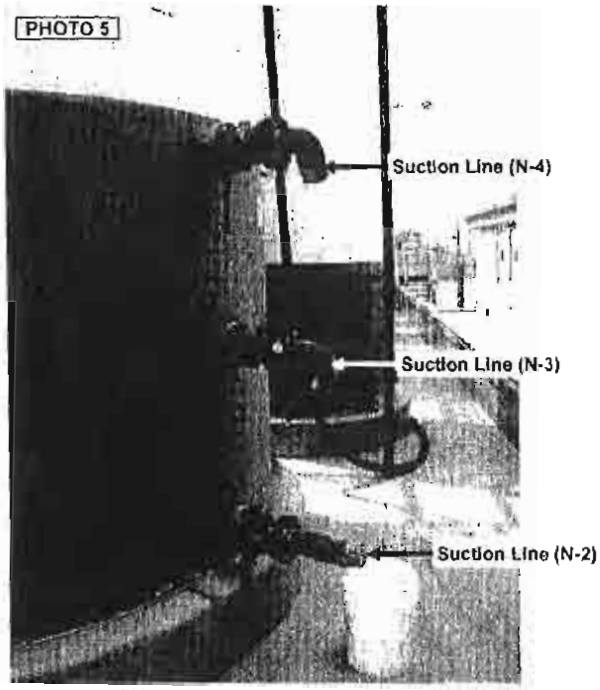
ROOF AS VIEWED FROM THE EAST



SHELL, NORTHEAST SIDE;
VIEW SHOWING THE UL PLATE

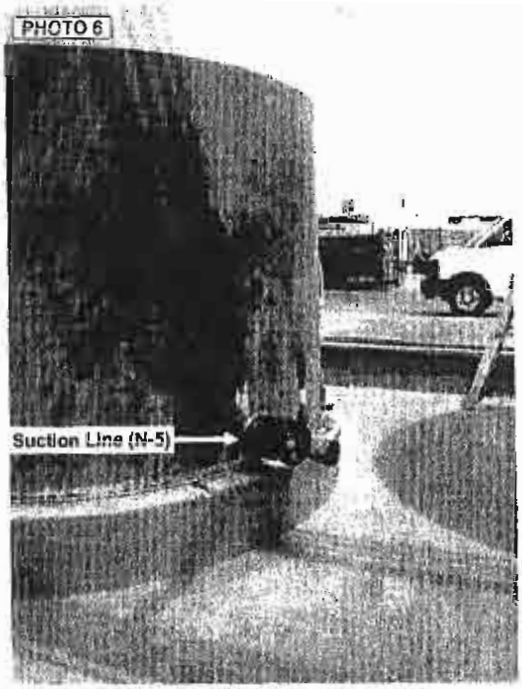
LOWER NORTH SIDE OF TANK

PHOTO 5



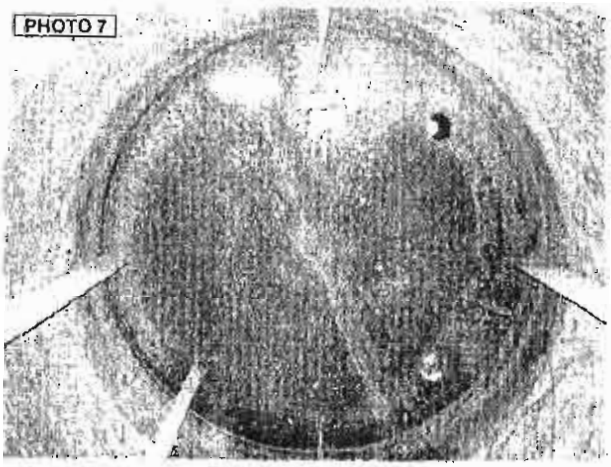
LOWER WEST SIDE OF TANK

PHOTO 6



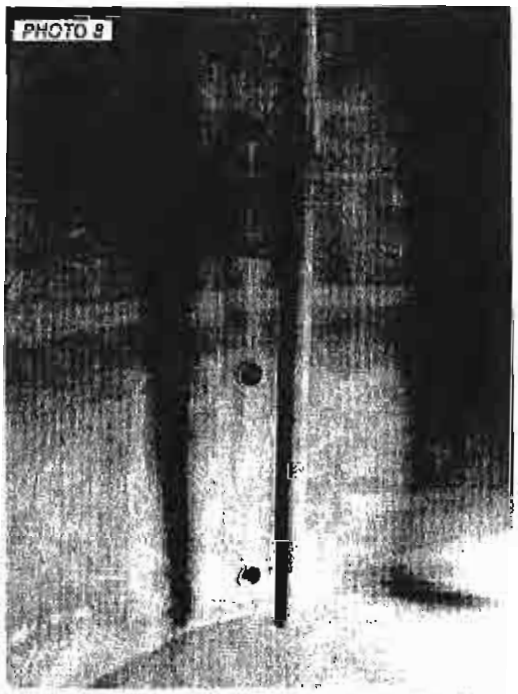
LOWER EAST SIDE OF TANK

PHOTO 7

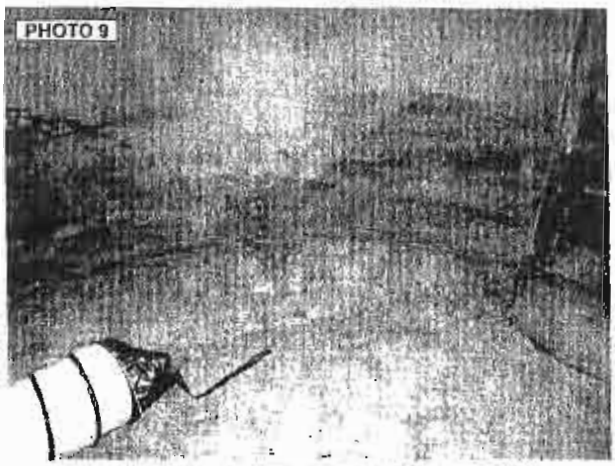


INTERIOR, ROOF

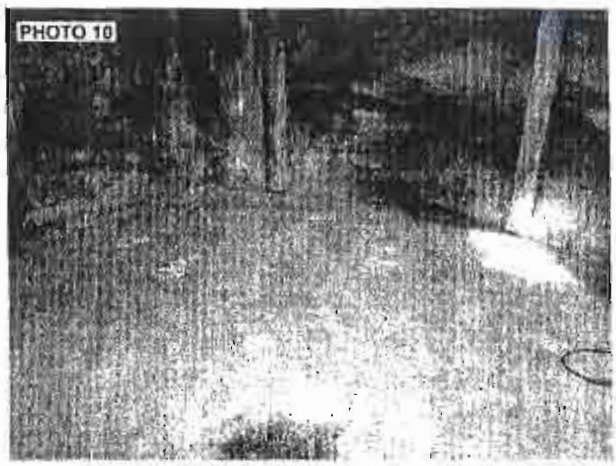
PHOTO 8



INTERIOR, LOWER WEST SIDE OF TANK



INTERIOR, LOWER EAST SIDE OF TANK



INTERIOR, LOWER WEST SIDE OF TANK;
VIEW SHOWING LOCATION OF CORROSION

INTERIOR, TANK BOTTOM;
CLOSE-UP OF CORROISON

INTERIOR, TANK BOTTOM;
CLOSE-UP OF CORROISON

DATA EVALUATION & ANALYSIS
CORROSION RATE & REMAINING LIFE CALCULATIONS

Date		Time In Service			
Built	Current	Days	Weeks	Months	Years
7/15/1985	7/15/2009	8766.00	1248.00	288.00	24.00

☐ Date Built obtained from Records or Nameplate

☑ Date Built Estamated

Tank Bottom Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	07/15/09	24.00	0.250	0.080	0.170	0.0033	0.100	0.070	21.000	7/15/2030
External	07/15/85	07/15/09	24.00	0.250	0.000	0.250	0.0000	0.100	0.150	N/A	N/A
Combined	07/15/85	07/15/09	24.00	0.250	0.080	0.170	0.0033	0.100	0.070	21.000	7/15/2030

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.4.5.1

✓ Un-repaired Bottom ☐ Repaired Bottom

$MTR = (\text{Minimum of } RT_{bo} \text{ or } RT_{ip}) - Or(SIP_r + Up_r)$

MTR	0.163	Minimum remaining thickness at the end of interval Or
O_r	2	In service interval; Max 10 yrs if unknown, 20 yrs if known
RT_{bo}	0.250	Minumum thickness from external corrosion after repairs
RT_{ip}	0.170	Minumum thickness from internal corrosion after repairs
SIP_r	0.0033	Maximum rate of un-repaired internal corrosion
Up_r	0.0000	Maximum rate of external corrosion

Tank Shell Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	07/15/09	24.00	0.188	0.010	0.178	0.0004	0.100	0.078	187.200	9/26/2196
External	07/15/85	07/15/09	24.00	0.188	0.000	0.188	0.0000	0.100	0.088	N/A	N/A
Combined	07/15/85	07/15/09	24.00	0.188	0.010	0.178	0.0004	0.100	0.078	187.200	9/26/2196

Notes: 1) The required thickness shall be the lesser of the current calculated thickness or .100"

Average Shell Thickness Determination of Corroded Areas

$L = 3.7\sqrt{Dt_2}$

D	t_2	t_2 Elev.	L	L / 5
12.00	0.178	N/A	N/A	N/A

Thickness Location	Distance form Top	Measured Thickness
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average t_1 →		N/A

L = Length in inches where hoop stress is assumed to average out around local discontinuities

D = Tank Diameter in feet

t_2 = Least Thickness in inches of Corroded Area

t_2 Elev. = Elevation or Distance from the top of the tank to the area of least thickness

t_1 = Average Thickness of five equily spaced thicness measurements

Notes: 1) No localized areas of corrosion found, "Average Shell Thickness Determination" not required

2) t_2 value shall be used in shell's required thickness calculations on page F-2

UT Inspection Interval = Lesser of RCA/2N or 15 years

RCA/2N = 93.60

External Inspection Interval = Lesser of RCA/4N or 5 years

RCA/4N = 46.80

Conclusion:

Tank Bottom Corrosion Evaluation: Tank can be returned to service and used for two years before another internal inspection is required.

Tank Shell Corrosion Evaluation: Tank can be returned to service and used for two years before another external inspection is required.

DATA EVALUATION & ANALYSIS
REQUIRED THICKNESS DETERMINATION

Shell Design Method To Be Used **OFM**

Enter "VDP" for variable design point method
or "OFM" for one foot method

Tank Diameter 10'
Specific Gravity 1.0

Table 1: Original Tank Data

Course Number	Height (in.)	Height (ft.)	T orig. (in.)	Material Spec.	Min. Yield*	Min. Tensile*	Allow. Stress Product	Allow. Stress Water	Joint Efficiency
1	85.00	07.08	.188"	C.S.	30,000	55,000	23,600	26,000	0.70
2	60.00	05.00	.188"	C.S.	30,000	55,000	23,600	26,000	0.70
3	60.00	05.00	.188"	C.S.	30,000	55,000	26,000	27,000	0.70
Total	205.00	17.08							

* If shell material is known; Minimum yield, Minimum Tensile & Allowable Stress figures were obtained from API 653, table 4.1.
* If shell material is unknown; Minimum yield, Minimum Tensile & Allowable Stress figures derived by using the formulas in API 653. Welded tanks - para. 4.3.3 Riveted tanks – para. 4.3.4.

Table 2: Calculated Tank Data

Course Number	T_1 (inch)	T_2 (inch)	T_{min} Product	T_{min} Water	Calculated H. (ft.)	Shell Check Product T_1 Check	Shell Check Product T_2 Check	Shell check Water T_1 Check	Shell check Water T_2 Check
1	0.180	0.180	.025	.023	16.08	Yes	Yes	Yes	Yes
2	0.181	0.181	.014	.013	9.00	Yes	Yes	Yes	Yes
3	0.181	0.178	.006	.006	4.00	Yes	Yes	Yes	Yes

Calculate:

New Fill Height For Product: **No** **New Fill Height For Water:** **No**

Calculate only if shell courses are not adequate due to; minimum or average thickness (T1 or T2) being less than thickness required (T req'd). See next page if answer is yes

Notes:

Requirements for continued operations per API 653, Section 4.3.3 or 4.3.4:

1. T_{min} (or required thickness) = 2.6*H-1*D*G / S*E (use the greater of T_{min} in Table 2 or .100" thick)
2. No pitting shall be greater than one half the T_{min} or exceed 2" in 8" in a vertical direction.
3. The value of T_1 shall be greater than or equal to T_{min}.
4. The value of T_2 shall be greater than or equal to 60% of T_{min}.
5. The external inspection interval shall not exceed five years, as per API 653, para. 4.3.3.2a.
6. Any corrosion allowance for service until the time of the next inspection shall be added to the $T_{min's}$ in items 3 & 4.

CONCLUSION

The evaluation shows that the tank can be safely filled to the top of the tank shell or 17' 1"

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT Thickness Measurements*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 301*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT.ASME.3 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Thickness measurements were taken on portions of the; Roof, Shell & Tank Bottom

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☒ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*in.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*in.*

EQUIPMENT			CALIBRATION INFORMATION		
Scope Manufacturer: *Panametrics*			☒ Back Wall Technique	Ref. Signal Amp.: *100+%*	
Model: *Epoch LT*	S/N: *070149004*		Calibration Standard Type: *Step Wedge*		
Transducer Manufacturer: *Panametrics*			Calibration Standard Material: *Carbon Steel*		
Model: *D-790*	S/N: *803018*		Reflector: ☐ FBH ☐ SDH ☐ Notch		
Freq.: *5MHz*	Size: *.375"*	Angle: *0°*	Reflector Size(s): *N/A*		
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*		
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*		
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*	
Couplant: *Cellulose Gell*		Batch No.: *N/A*	Scanning Gain: *N/A*		

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Thickness measurements are shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *07-15-09*

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT Corrosion Scans*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 301*	Serial or Item No.: *N/A*

Specification:	Procedure:	Acceptance:
API 653 / ASME Sec. V Art. 5	*UT-ASME-1 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*

SCOPE OF WORK PERFORMED

Ultrasonic (corrosion) scans were performed on random areas of the tank bottom and shell.

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☐ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*In.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*In.*

EQUIPMENT			CALIBRATION INFORMATION		
Scope Manufacturer: *Panametrics*			☐ Back Wall Technique	Ref. Signal Amp.: *N/A*	
Model: *Epoch LT*	S/N: *070149004*		Calibration Standard Type: *Step Wedge*		
Transducer Manufacturer: *Krautkramer*			Calibration Standard Material: *Carbon Steel*		
Model: *Gamma*	S/N: *009YWH*		Reflector: ☐ FBH ☐ SDH ☐ Notch		
Freq.: *5 MHz*	Size: *.5" x .5"*	Angle: *0°*	Reflector Size(s): *N/A*		
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*		
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*		
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*	
Couplant: *Cellulose Gell*		Batch No.: *N/A*	Scanning Gain: *N/A*		

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Corrosion data is shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *07-15-09*

TEAM	Test and Inspection Procedure Supplement	FORM VT.1 Rev: 0 Page 1 of 1

VISUAL EXAMINATION INSPECTION REPORT

Job/Order No. 12890168
Page ____ of ____

Customer CLEAN HARBOR SERVICES Location PHOENIX A.Z. Date 7-22-09

Customer Order Number ____
S/N (s) N6
Procedure VT. ASME 1 REV 5
Specification NON CODE
Configuration ____ Diameter/Length ____ Thickness ____
Full Penetration ☐ Fillet ☑ Other ☐

Part Number TANK # 301
Component I.D. PRESSURE/VACUUM CONSERVATION VENT
Material C/S

Equipment		Status	
Flash Light	☑	Direct Visual	☑
White Light Intensity 200 Footcandles		Remote Visual	☐
(minimum 100fc required)		Pre-cleaning Required	☐
Mirror	☑	Access within 24" & 30°	☐
Magnifier	☑	Restrictions	
Ruler	☑	NONE	
Camera	☐		
Other	☑ CAMONSEGAGE/FILLET		

ROOF TANK FILLET WELD ONLY to N6

INSPECTION RESULTS

	YES	NO	N/A	ACC	REJ
CRACKS	☐	☑	☐	☐	☐
LINEAR INDICATION	☐	☑	☐	☐	☐
LACKM OF FUSION	☐	☑	☐	☐	☐
ARC STRIKES	☐	☑	☐	☐	☐
POROSITY	☐	☑	☐	☐	☐
SLAG	☐	☑	☐	☐	☐
UNDERCUT	☐	☑	☐	☐	☐
OVERLAP	☐	☑	☐	☐	☐
GOUGES	☐	☑	☐	☐	☐
PITTING	☐	☑	☐	☐	☐
EVIDENCE OF LEAKAGE	☐	☐	☑	☐	☐

Technician (Print) LINCOLN MOSQUERA Level CWI 02110451

LINCOLN R. MOSQUERA
CWI 02110451
IAW Exp 11/01/11

Technician Signature ____ Date 7-22-09

TEAM	Test and Inspection Procedure Supplement	FORM MT.1 Rev: 0 Page 1 of 1

MAGNETIC PARTICLE INSPECTION REPORT

Job/Order No: 12890168 Page ___ of ___

Customer CLEANHARBOR Location PHOENIX, AZ Date 7-22-09 S/O # N/A

Sold To N/A Part Number PRESSURE/VACUUM CONSERVATION VENT TK-301

Customer Order Number ___ S/N(s) NG

Procedure MT-ASME Description TANK ROOF FILLET WELD TO NOZZLE #G

Specification NON-CODE

Scope of Examination NO LINEAR NO CRACK Material C/S

Heat Number N/A

Quantity 1 Heat Code N/A

TEST PARAMETERS

WET ☐ DRY ☒ A/C ☒ D/C ☐

Magnetizing Source:
Manufacturer PARKER Model Y30D Serial No. 17410 Date of Calibration 6-5-09

Magnetic Particle Materials:
Brand MAGNAFLUX Type DRY POWDER Batch Number(s) 08C007
Color RED Bath Concentration N/A ml/100ml

Ultraviolet Light Data:
Black Light Mfg. N/A Model N/A Serial No. N/A Intensity @ 16" N/A µW / cm²

U.V. Meter Mfg. N/A Model N/A Serial No. N/A Date of Calibration N/A

White Light Data:
White Light Intensity at Work Surface ___ Foot Candles
White Light Meter Mfg ___ Model ___ Serial No. ___ Date of Calibration ___

Magnetizing Current:
Yoke ☒ Longitudinal Amps ___ Circular Amps ___ Demagnetization N/A

INSPECTION RESULTS

Acceptable ACCEPT Unacceptable ___

Remarks NO INDICATIONS NOTED

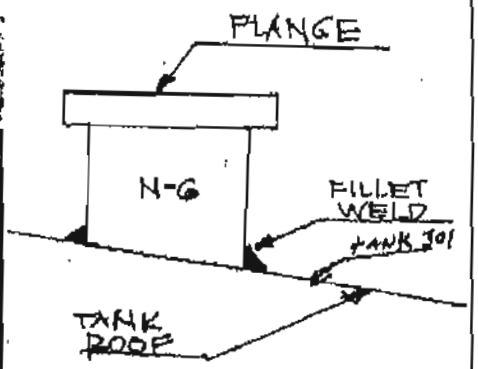
NESTOR G. RAMOS
TECHNICIAN (PRINT)

TECHNICIAN SIGNATURE LEVEL ☒ II ☐ III

ASSISTANT LEVEL ☐ I ☒ II

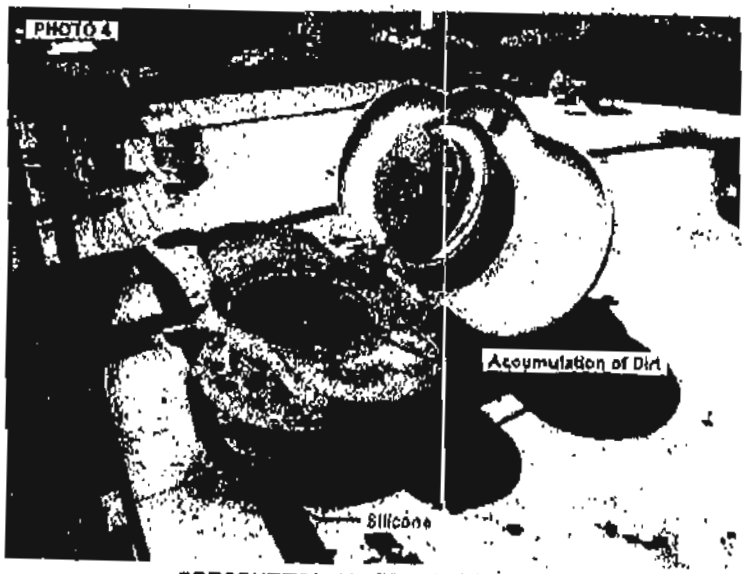
THIS REPORT IS EXPRESSLY LIMITED TO TEAM INDUSTRIAL SERVICES INTERPRETATION OF THE RESULTS OBTAINED FROM THE TEST SPECIFIED AND DOES NOT CONSTITUTE A RESPRESENTATION WARRANTY OR GUARANTY OF THE ACTUAL CONDITION OF THE MATERIALS TESTED. TISI expressly disclaims any responsibility for any loss cost damage or expense including personal injury or death caused by or attributed to TISI misinterpretation of conditions or the performance of any test.

PHOTO 3



PRESSURE/VACUUM CONSERVATION VENT (N-6)

PHOTO 4



PRESSURE/VACUUM VENT OPENED

WELDER PERFORMANCE QUALIFICATION RECORD(WPQ)
ASME SECTION IX, QW-301.4

PNL
Phoenix National Laboratories, Inc.
2637 E. Chambers Street, Phoenix, AZ 85040
P: 602.431.8887 · F: 602.431.8888 · www.pnllabs.com

IDENTIFICATION					
COMPANY NAME	Vic's Welding	PNL PROJECT NO.	26-207197	DATE	07/01/06
WELDER NAME	Manuel Florke	ID #	4079	QUAL. DATE	07/01/06
WELDING PROCESS(ES)	GMAW	PNL LAB NO.	WT607189	WPS NO.	B2.1-1-022-94
				REVISION	0
TYPE	MANUAL X MACHINE ☐ SEMI-AUTOMATIC ☐ AUTOMATIC ☐			TEST ID	Super.6U7

VARIABLES (QW-350)	ACTUAL VALUES ROOT	ACTUAL VALUES FILL	RANGE QUALIFIED
BACKING (QW-402)	Open	Metal Backing	F3 - with or without, F4 and lower - with or backgouge
ASME P-No. To ASME P-No. (QW-403)	P - 1 to P - 1	P - 1 to P - 1	P-1 through P-11, P-No. 34, P-No. 41 through 49.
PLATE OR PIPE (Enter diameter, if pipe)	Pipe, 2 3/4" dia	Pipe, 2 3/4" dia.	Pipe 1" dia, to unlimited
FILLER METAL SPECIFICATION (QW-404)	SFA 5.1	SFA 5.1	SFA 5.1
AWS NO. (Class)	E6010	E7018	Governed by F number
FILLER METAL F-NO.	3	4	F4 and lower within the parameters of this WPQ
CONSUMABLE INSERT FOR GTAW	n/a	n/a	n/a
WELD DEPOSIT THICKNESS	0.125	0.500	Unlimited
WELDING POSITION (QW-405)	6G	6G	All
UPHILL/DOWNHILL PROGRESSION	Uphill	Uphill	Uphill
BACKING GAS (QW-408)	n/a	n/a	n/a
GMAW TRANSFER MODE (QW-409)	n/a	n/a	n/a
GTAW CURRENT TYPE/POLARITY	DCEN	n/a	n/a
OTHER	Fillet Welds	Fillet Welds	All fillet welds

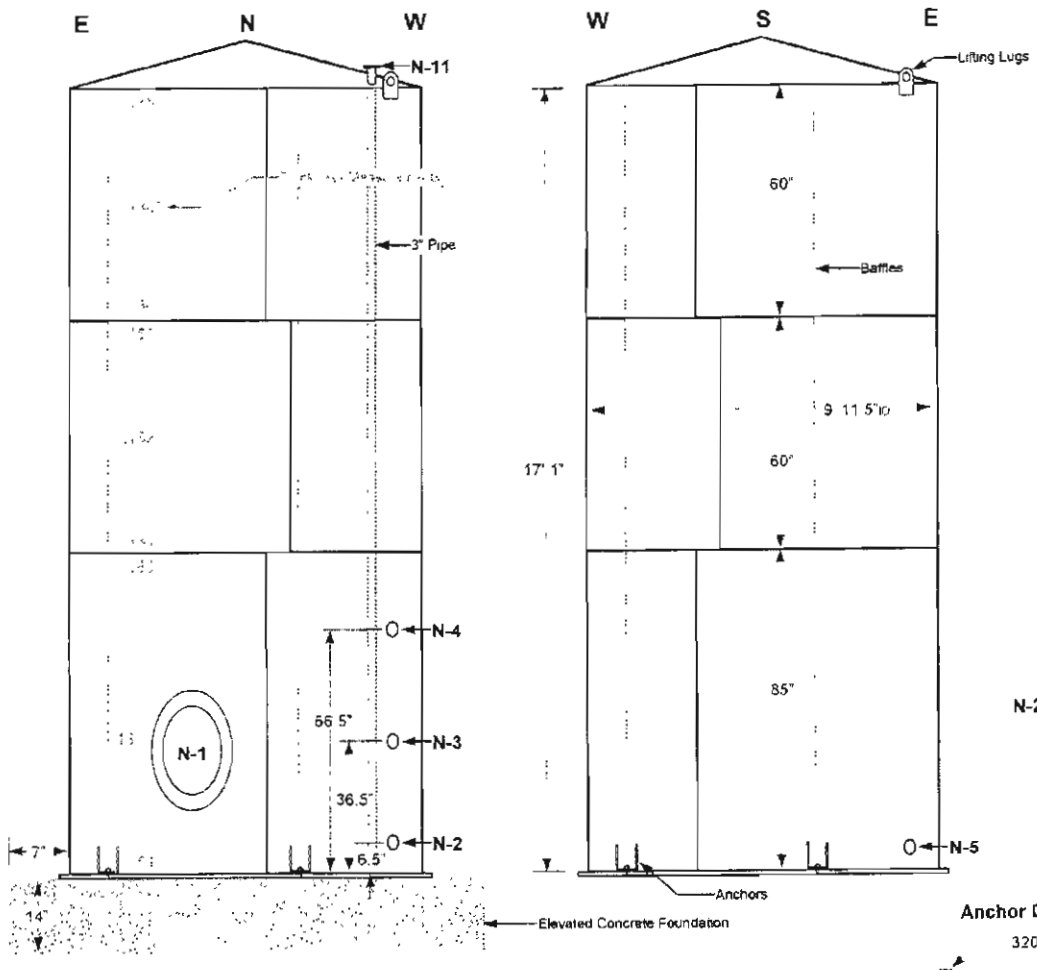
TEST RESULTS				
TEST COUPON MARK	6G	n/a	n/a	n/a
VISUAL EXAMINATION (QW-302.4)	Pass	n/a	n/a	n/a
GUIDED BEND TESTS TYPE	n/a	n/a	n/a	n/a
GUIDED BEND TEST RESULTS	n/a	n/a	n/a	n/a
FILLET WELD CONCAVITY/CONVEXITY	n/a	n/a	n/a	n/a
FILLET SIZE	n/a	n/a	n/a	n/a
FRACT. TEST LENGTH & PERCENT OF DEFECTS	n/a	n/a	n/a	n/a
MACROTEST FUSION	n/a	n/a	n/a	n/a
RADIOGRAPHIC TEST RESULTS (QW-304 & 305)	Pass	n/a	n/a	n/a

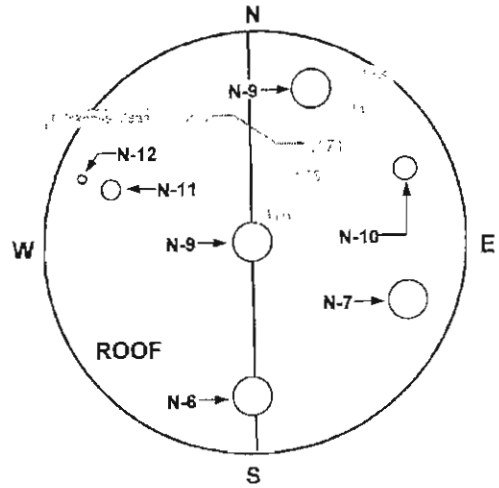
AWS QC 1
ALEXANDER ZURAIK, JR
05050741
CWI

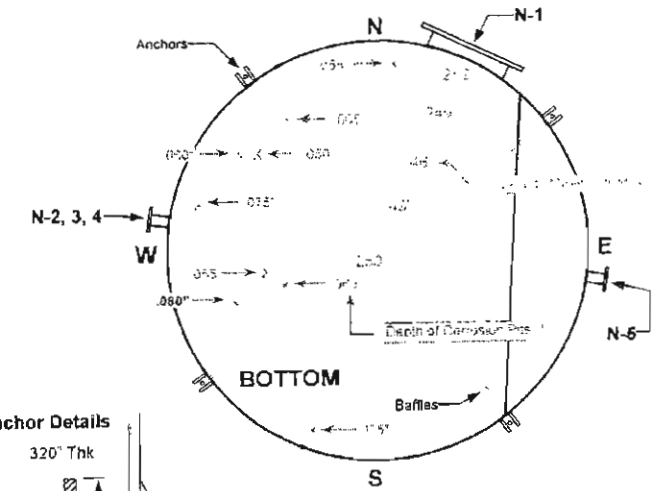
TESTS CONDUCTED BY	Alex Zuraik III/PNL	DATE:	07/01/06
QUALIFICATION ADMINISTERED BY	Client	DATE:	07/01/06

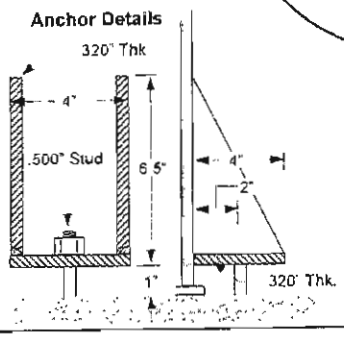
PNL certifies that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of Section IX of the ASME Code, and warrants that the above services and reports were performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated technical personnel. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY: Alex Zuraik III
WELDING PROGRAM ADMINISTRATOR









Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-1	24"	Manway Nozzle	.240"	.188"
N-2	3"	Suction Line Nozzle	.215"	N/A
N-3	3"	Suction Line Nozzle	.215"	N/A
N-4	3"	Suction Line Nozzle	.215"	N/A
N-5	3"	Suction Line Nozzle	.215"	N/A
N-6	8"	Pres./Vac. Conservation Vent Nozzle	.310"	N/A
N-7	8"	Level Sensor Nozzle	.310"	N/A

Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-8	8"	Blinded Nozzle	.310"	N/A
N-9	8"	Emergency Pressure Vent Nozzle	.310"	N/A
N-10	4"	Fill Line Coupling	N/A	N/A
N-11	3"	Blinded Nozzle	.203"	N/A
N-12	1/2"	Plugged Coupling	N/A	N/A

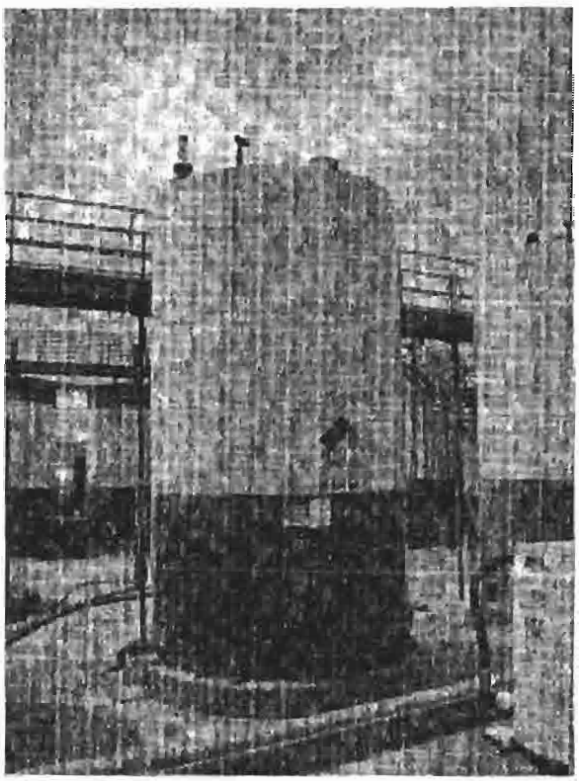
TEAM Industrial Services, Inc.

Client: Clean Harbors	Drawn By: J. Mooney
Location: Phoenix, AZ	Date: 07-15-09
Tank Number or Identification: Tank 301	Page: D-1

2514 N. 33rd Ave.
Phoenix, AZ 85009
Phone: 602-269-7868
Fax: 602-269-9784
www.teamindustrialservices.com

TEAM® Industrial Services, Inc.

TANK INSPECTION REPORT



CLEAN HARBORS
PHOENIX, AZ

STORAGE TANK 303

EXTERNAL / INTERNAL INSPECTION
COMPLETED 10-14-09
Team Work Order #12890215

TABLE OF CONTENTS

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GENERAL TANK INFORMATION ---------- **A-1**
SPECIFIC INFORMATION ABOUT THE
TANKS CONSTRUCTION

METHODOLOGY ---------- **B-1 & B-2**
DETAILS ABOUT THE INSPECTIONS PERFOMED

SUMMARY & RECOMMENDATIONS ---------- **C-1** THRU **C-3**
LIST OF ANOMALIES FOUND DURING THE
INSPECTION & RECOMMENDED ACTIONS

TANK DRAWINGS ---------- **D-1**
INCLUDES NOZZLE DATA AS WELL AS THICKNESS
READINGS OF THE SHELLS, ROOF AND NOZZLES

PHOTOGRAPHS ---------- **E-1** THRU **E-3**
PHOTOS SHOWING VARIOUS TANK ELEMENTS

DATA EVALUATION & ANALYSIS ---------- **F-1 & F-2**
CALCULATED; CORROSION RATES, REMAINING LIFE &
REQUIRED THICKNESS

INSPECTION TECHNIQUE SHEETS ---------- **G-1 & G-2**
FORMS SHOWING TYPES OF NDE
EQUIPMENT USED, PARAMETERS, ETC.

TANK / VESSEL DATA

Client: Clean Harbors
Location: 1340 West Lincoln St.
Phoenix, AZ 85007

Inspection Type	Last Insp.	Current Insp.	Next Insp. Due
External	*07-16-09	10-14-09	10-14-11
Internal	N/A	10-14-09	10-14-11

Service: Flammable Liquid Waste Tank
Tank Identification: Tank 303
Capacity: 10,000 Gals. Height: 17' 2"
Diameter or Length/Width: 9' 11-1/2"
Orientation: ☒ Vertical ☐ Horizontal
Shape: ☒ Circular ☐ Rectangular

Mfg. By: Unk.
Mfg. Address: Unk.

Date of Manufacture: 1992 (assumed)
Mfg. Serial Number: Unk.
Standard of Construction: UL-142
National Board Number: N/A
Specific Gravity: Design Unk. Product <1.0
Product Weight / cu. Ft.: <62.4 pounds
Max. Allow. Work. Pres. 2.5 psi (assumed)
Max. Allow. Work. Temp. 200°F (assumed)
Operating Pressure: Atmospheric
Operating Temperature: Ambient
Design Seismic Zone: Unk.
Design Wind Load: Unk.
Operating Level: Full
Gallons / Ft.: 582.63

FOUNDATION

Type: ☒ Slab ☐ Ring Wall
Material: ☒ Concrete ☐ Gravel ☐ Soil
Other:

TANK SUPPORT

Type: ☐ Cradle ☐ Skirt ☐ Legs
Other;
Material: ☐ Steel ☐ Concrete

ROOF OR UPPER HEAD CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A
Roof or Head Type: Thickness: 3/16"
☐ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☒ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other; Self Supporting
Dish Depth: N/A Flg. Length N/A Kn. Radius N/A
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: From both sides Joint Eff. N/A

SHELL CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A

Course	1st	2nd	3rd	4th	5th	6th	7th	8th
Ht. or Length	85"	60"	60"					
Nom. Thk.	3/16"	3/16"	3/16"					

Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☐ Lapped ☒ Butted
Weld Type: From both sides Joint Eff. N/A

BOTTOM OR LOWER HEAD CONSTRUCTION

Material: Carbon Steel Cor. Allow. N/A
Bottom or Head Type: Thickness: 1/4"
☒ Flat ☐ Flat Flanged ☐ Torispherical (F&D)
☐ Conical ☐ Toriconical ☐ Hemispherical
☐ Elliptical Other;
Dish Depth: N/A Flg. Length N/A Kn. Radius N/A
Joint Type:
☒ Welded ☐ Riveted ☐ Bolted ☒ Lapped ☐ Butted
Weld Type: Joint Eff. N/A

ADDITIONAL INFORMATION

☒ External Coating: Painted Black & White
☐ Internal Lining: None
☐ Atmospheric Vent: None
☒ Normal Vent: 8" Clay & Bailey, M/N; T56-2 (8oz. pres./8oz. vac.)
☐ Emergency Vent: Removed
☐ Pres. Relief Vent: None
☒ Roof Access: Catwalk
☒ Internal Access: Shell mounted manway
☒ Autogauge Device: Level & High Alarms to be Installed
☒ High Level Indicator ☐ Internal Coils ☒ Grounded
☐ Overflow Vent ☐ External Jacket ☒ Anchored
☐ Cathodic Protection ☐ Agitator / Mixer
*Last external inspection partial only.

METHODOLOGY

Team Industrial Services was contracted to perform an internal / external inspection on Storage Tank 303 located at Clean Harbors; Phoenix, AZ facility. This inspection is intended to meet the mechanical integrity requirements of various state and federal agencies. This section describes the methods and procedures used to perform the inspection.

The inspection report is a compilation of data obtained through visual inspections, conversations with plant personal and client supplied information. This includes quantitative and qualitative data necessary to document the tank's condition. The inspector prepares the field data in accordance with generally accepted standards, codes and good engineering practice. Recommendations, such as repairs, service modifications, maintenance operations, and additional NDE, are based on the evaluation of the tank's condition. The contents contained within the tank are also taken into consideration when making decisions such as frequency and type of future inspections.

The latest editions of the below referenced codes and/or standards were used in determining the tanks acceptability.

- API 653; Tank Inspection, Repair, Alteration and Reconstruction.
- API 650; Welded Tanks for Oil Storage
- API 2000; Venting Atmospheric & Low-Pressure Storage Tanks
- UL-142; Steel Aboveground Tanks for Flammable & Combustible Liquids

Other Codes and/or Standards related to work practices

- ASME Sec. V; Nondestructive Testing.
- ASTM E 543-96; Standard Practice for Agencies Performing Nondestructive Testing.
- OSHA; 29 CRF 1910 "Occupational Safety and Health Standards"
- API 2015; Safe Entry & Cleaning of Petroleum Storage Tanks

The report is divided into six main activities:

1. Tank/Vessel Data
2. Visual Inspection
3. Drawings
4. Photographs
5. Data Evaluation & Analysis
6. Non-Destructive Examination

Tank/Vessel Data

The **Tank/Vessel Data** form was filled out after the inspection had been completed. It defines the original tank design parameters, the current design parameters, the tank history, the foundation configuration and the current tank configuration. Original client documents, verbal client information and field observations were used to complete this form.

Visual Inspection
The visual inspection was performed using guidelines set forth in current editions of API, ASME and/or ASTM. All accessible areas of the tank and its appurtenances were inspected. Observations made during this inspection are listed in the Summary and Recommendations portion of this report. The following are some of the essential elements of the Visual Inspection:

- Detection of leaks.
- Detection of cracks or potential crack initiators.
- Detection of physical damage, such as gouges or dents.
- Detection of buckles or other forms of distortion.
- Detection of corrosion, erosion or other forms of degradation.
- Detection of appurtenance's which may violate applicable codes, standards or good engineering practice.
- Detection of foundation and/or support deficiencies.
- Verification of venting used for normal breathing and/or emergency pressure release.

Drawings
The drawings show the tanks overall dimensions, general location of nozzles, as well as any other pertinent information.

Photographs
Photographs were taken to show the current condition of the tank and its appurtenances.

Data Evaluation & Analysis
Methods described in the current edition of API 653 were used to calculate items such as;

- Minimum required shell plate thickness
- Corrosion rates
- Inspection Intervals
- Remaining Life

Definitive Inspection
The **Definitive Inspection** is quantitative inspection of the tank components and consisted of the following:

Roof - UT Thickness Survey
Ultrasonic thickness readings were taken from the center of the roof to the outer perimeter at locations shown on the tank drawings.

Shell - UT Thickness Survey
Ultrasonic thickness readings were taken from top to bottom at locations shown on the tank drawings.

Bottom (or Floor) - UT Thickness Survey
Ultrasonic thickness readings were taken on the tank bottom at locations shown on the tank drawings.

Nozzle – UT Thickness Survey
Three to four ultrasonic thickness readings were taken on each of the applicable nozzles and the lowest readings recorded on the tank drawings.

Corrosion Scans
Three 10 x 10" Ultrasonic corrosion scans were done on the tank bottom; one at the tanks center, one at the outer perimeter and another between the two. In addition, corrosion scans were done on the exterior of the tank at the top of the shell and at two locations on the roof.

The results of the UT thickness surveys and corrosion scans are discussed in the summary portion of this report and shown on the tank drawings. Information such as the referenced codes, standards or procedures, type of equipment used, etc, can be found on the technique sheet (s).

SUMMARY & RECOMMENDATIONS

Recommendations Italicized

DISCUSION AND HISTORICAL INFORMATION

This tank is used for the storage of flammable and non-flammable waste liquids. This tank has a cone roof, a flat bottom, butt welded shell seams and is constructed of carbon steel. The tank has a UL plate but no name plate, so the date and manufacture is unknown. The only records are of a partial external inspection performed by myself on 07-15-09. I'm using 1992 for a date of construction, since that's when the plant was built. All of the tanks at this facility were probably used elsewhere before being moved here in 1992. This tank has not been used since the last inspection.

INSPECTION FINDINGS

Exterior

Roof, Shell & Appurtenances

1) Overall, the tanks coating is oxidized but in fair condition. Some light rust was found at random areas on the roof, shell, nozzles & anchors. The client has purchased paint and has plans on spot coating rusted areas.
   Spot coat rusted areas prior to the next scheduled Inspection.
2) The current NFPA warning label has no hazard classifications numbers other than O's.
   Determine classification and apply proper numbers to the NFPA label.
3) The rubber seal for the vacuum side of the pressure/vacuum vent was hard and cracked. The plant installed a newer seal that's in good shape.
   No action necessary.

FOUNDATION &/OR SUPPORT SYSTEM

4) Except for some rust, the anchors and anchor bolts appear to be in good shape.
   No action necessary.

INTERIOR

Roof, Shell, Bottom & Appurtenances

Prior to this inspection, the tank was cleaned so that a proper visual inspection could be performed on the roof, shell and tank bottom.

5) The internal visual inspection found the following:
   - The roof has a general overall pattern of corrosion; external thickness measurements indicate a minimum remaining thickness of .165" (estimated loss of .025", estimated corrosion rate .001/year).
     Acceptable, according to API 653, para 4.2.1.2 the roof only has to have an average thickness of .090" in any 100 in.^{2} area and contain no holes.
   - The shell has random areas with corrosion pits up to .035" deep. The estimated corrosion rate equals .0014/year; at this rate the shell should reach the minimum allowable thickness of .100" in 38 years. API 653, para. 6.3.2.1 provides a formula to determine the inspection interval based on shell corrosion rates. The formula is as follows; RCA/4N, where RCA is the remaining corrosion allowance and N is the corrosion rate. The lesser of 5 years or the results of the formula is to be used for the inspection interval. In this case 5 years is the lesser of the two. See "Data Evaluation & Analysis" portion of this report for more information.
     Acceptable, according to formulas provided in API 653, para 6.3.2.1 re-inspection is not due for another 5 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 10-14-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.
   - The tank bottom has a random pattern of corrosion up to .020" deep. The estimated corrosion rate equals .0008/year, at this rate the bottom won't reach the minimum allowable thickness of .100" for over 50 years. API 653 allows for a maximum inspection interval of 20 years if the corrosion rate is known or 10 years if unknown. API also sets a minimum remaining tank bottom thickness at the next scheduled inspection; for this tank that thickness is .100". Reference API 653 paragraphs 4.4.5.1, 6.4.2.1, 6.4.2.2 & Table 6-1. See "Data Evaluation & Analysis" portion of this report for more information.
     Acceptable, according to API 653, re-inspection is not due for 6 years. As an extra margin of safety, I'm recommending the next internal/external inspection be performed in another 2 years or by 10-14-11. The reason for the extra margin of safety is due to factors such as; inconsistency of products stored inside the tank, varying corrosion rates and lack of historical information.

6) The ultrasonic corrosion scans done on the tank bottom found no signs of underside corrosion.
   Acceptable

GENERAL NOTES

7) The client should insure that all mechanical and electrical equipment associated with this tank is checked periodically for proper function. In addition, visual inspections should be performed by trained plant personal on a regular basis. These checks should also be done on before the tank is returned to service.

8) The client should retain a copy of this report in their tank files for the life of the tank.

9) Thickness measurements taken during this inspection are essentially the same as taken during the last inspection. Any differences in measured thicknesses are attributed to the varying locations where the measurements taken and not due to an actual loss or gain in thickness.

CONCLUSION

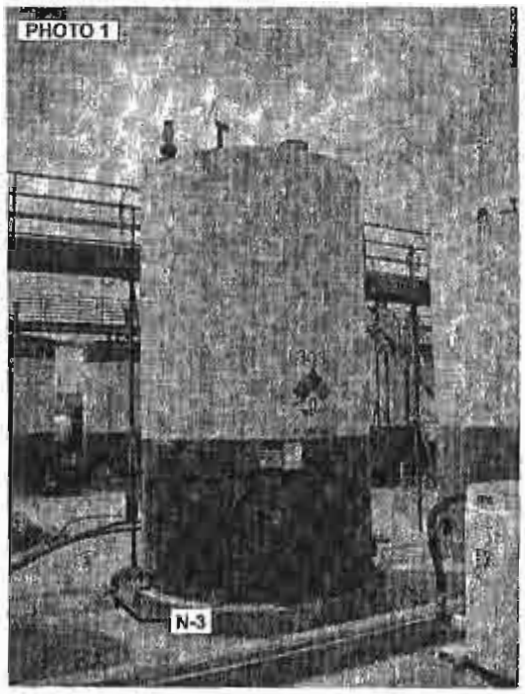
The tank and its appurtenances were inspected and evaluated to the best of my abilities. I found no evidence or issues during my inspection and evaluation that would keep the client from returning the tank to service.

INSPECTED BY: John Morton

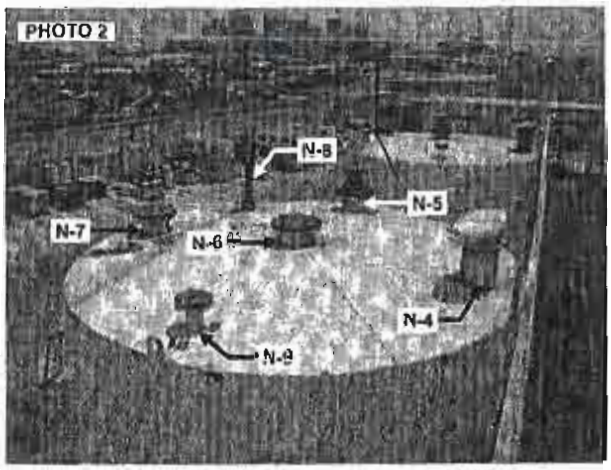
API 653 Cert. #0443
API 510 Cert. #32049
API 570 Cert. #53787
API TEB Cert. #34919
AWS/CWI Cert. #04060101
ASNT Level II; MT, PT & UT

DATE: 10-14-09

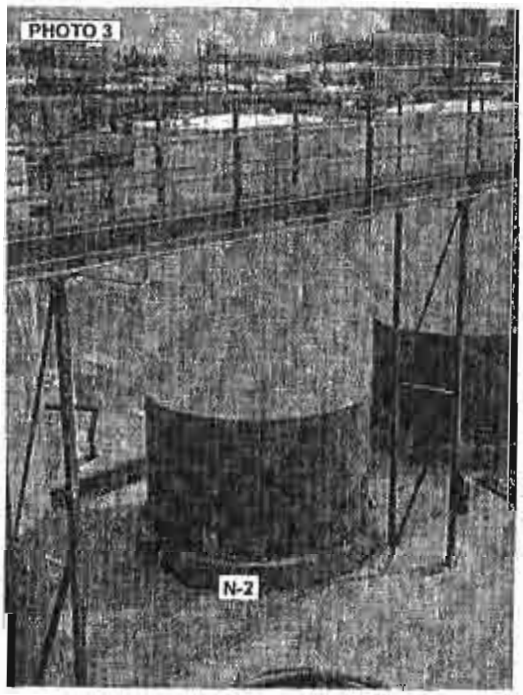
Any recommendations made by the API Tank Inspector are to be used only as a guideline for making repairs, as required by the client. Neither Team Industrial Services nor their inspectors accept responsibility for the tank's integrity, even after these recommendations are followed. All of the data compiled within this tank report should be reviewed by an engineer experienced in the: design, construction and repair of above ground storage tanks. Calculations, recommendations and evaluations contained within this report do not take into consideration the effects of additional loads imposed by wind, seismic activity or attached components. Corrosion rate and remaining life calculations are based on conditions caused by products previously stored inside the tank. Chemical, physical or mechanical changes to the tank and/or its contents may be cause for re-evaluation. Formulas contained in API 650 & 653 and good engineering judgment was used to determine the inspection frequency and next inspection dates. These dates and/or frequencies may differ from agencies other than API, in which case the more stringent should be followed.



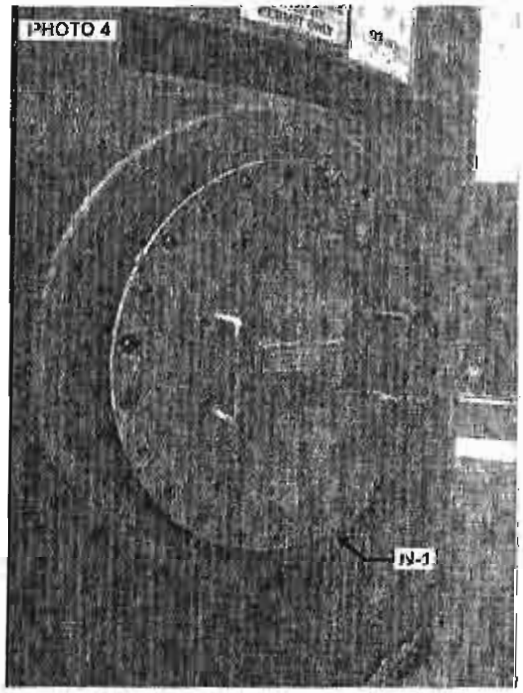
TANK AS VIEWED FROM THE NORTHEAST



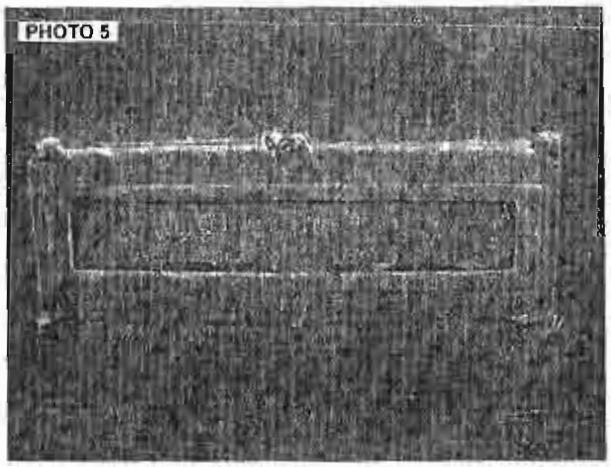
ROOF AS VIEWED FROM THE SOUTHWEST



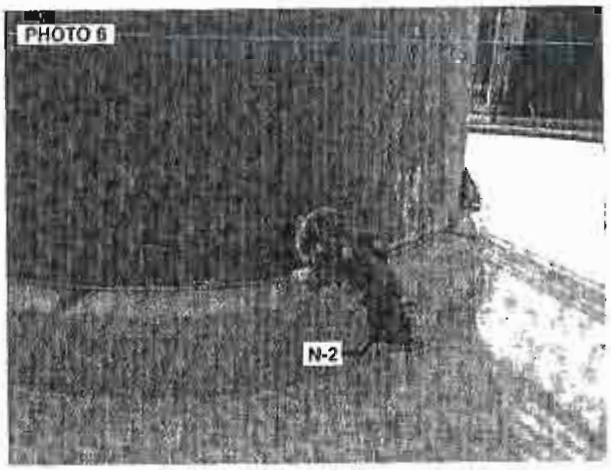
TANK AS VIEWED FROM THE SOUTHWEST



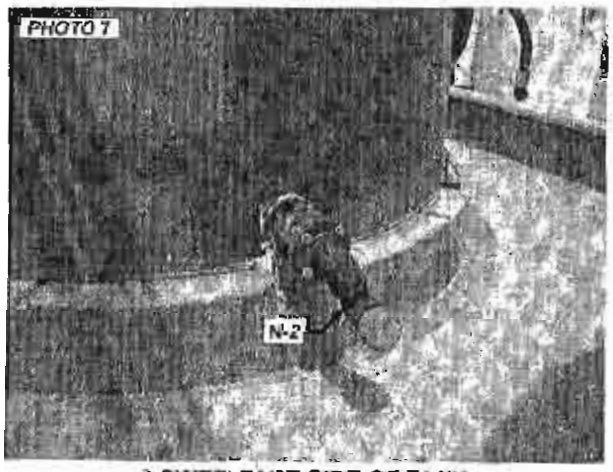
LOWER NORTHEAST SIDE OF TANK



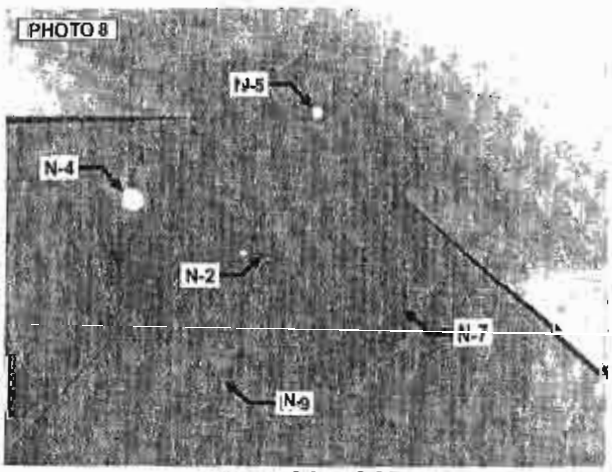
MANWAY COVER, VIEW SHOWING UL NAMEPLATE



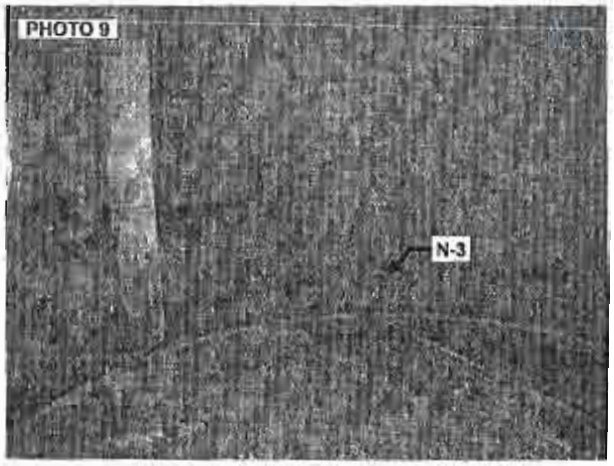
LOWER WEST SIDE OF TANK



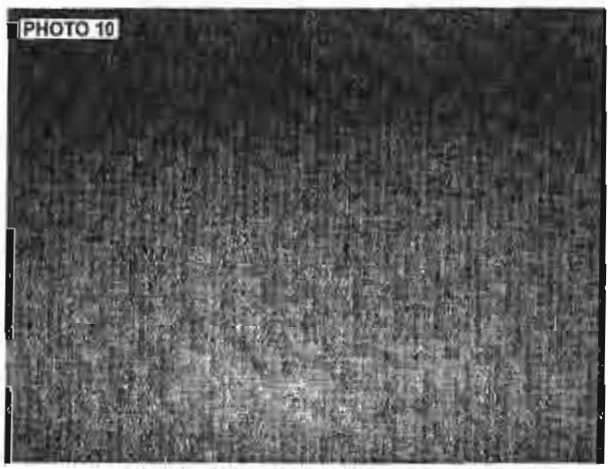
LOWER EAST SIDE OF TANK



INTERIOR, ROOF



INTERIOR, LOWER EAST SIDE OF TANK



INTERIOR, FLOOR

DATA EVALUATION & ANALYSIS
CORROSION RATE & REMAINING LIFE CALCULATIONS

Date		Time In Service			
Built	Current	Days	Weeks	Months	Years
7/15/1985	10/14/2009	8857.00	1260.96	290.99	24.25

☐ Date Built obtained from Records or Nameplate

☑ Date Built Estamated

Tank Bottom Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	10/14/09	24.25	0.240	0.020	0.220	0.0008	0.100	0.120	145.495	4/14/2155
External	07/15/85	10/14/09	24.25	0.240	0.000	0.240	0.0000	0.100	0.140	N/A	N/A
Combined	07/15/85	10/14/09	24.25	0.240	0.020	0.220	0.0008	0.100	0.120	145.495	4/14/2155

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.4.5.1

☑ Un-repaired Bottom ☐ Repaired Bottom

MTR = (Minimum of RT_{bo} or RT_{ip})-Or(StP_r+Up_r)

MTR	0.218	Minimum remaining thickness at the end of Interval Or
O_r	2	In service interval; Max 10 yrs if unknown, 20 yrs if known
RT_{bo}	0.240	Minumum thickness from external corrosion after repairs
Rt_{ip}	0.220	Minumum thickness from internal corrosion after repairs
StP_r	0.0008	Maximum rate of un-repaired internal corrosion
Ut_r	0.0000	Maximum rate of external corrosion

Tank Shell Corrosion

Area Affected	Date Built	Date Inspected	Years of Service	Beginning Thickness	Depth Corrosion	Remaining Wall	Corrosion Rate	Req'ed Thickness	Corrosion Allowance	Years to Retirement	Retirement Date
Internal	07/15/85	10/14/09	24.25	0.190	0.035	0.155	0.0014	0.100	0.055	38.106	11/22/2047
External	07/15/85	10/14/09	24.25	0.190	0.000	0.190	0.0000	0.100	0.090	N/A	N/A
Combined	07/15/85	10/14/09	24.25	0.190	0.035	0.155	0.0014	0.100	0.055	38.106	11/22/2047

Notes: 1) The required thickness shall be the lesser of the current calculated thickness or .100"

Average Shell Thickness Determination of Corroded Areas

$L = 3.7\sqrt{Dt_2}$

D	t_2	t_2 Elev.	L	L / 5
10.00	0.155	3.00	4.61	0.92

Thickness Location	Distance form Top	Measured Thickness
1	1.16	0.190
2	2.08	0.185
3	3.00	0.155
4	3.92	0.190
5	4.84	0.198
Average t_1 →		0.1836

L = Length in inches where hoop stress is assumed to average out around local discontinuities

D = Tank Diameter in feet

t_2 = Least Thickness in inches of Corroded Area

t_2 Elev. = Elevation or Distance from the bottom of the tank to the area of least thickness

t_1 = Average Thickness of five equily speced thicness measurements

Notes: 1) Calculated using formulas provided in the 2008 edition of API 653, para. 4.3.2.1

2) t_2 & t_1 values shall be used in shell's required thickness calculations on page F-2

UT Inspection Interval = Lesser of RCA/2N or 15 years

RCA/2N = 19.05

External Inspection Interval = Lesser of RCA/4N or 5 years

RCA/4N = 9.53

Conclusion:

Tank Bottom Corrosion Evaluation: Tank can be returned to service and used for two years before another internal inspection is required.

Tank Shell Corrosion Evaluation: Tank can be returned to service and used for two years before another external inspection is required

DATA EVALUATION & ANALYSIS
REQUIRED THICKNESS DETERMINATION

Shell Design Method To Be Used **OFM**

Enter "VDP" for variable design point method or "OFM" for one foot method.

Tank Diameter 10'
Specific Gravity 1.0

Table 1: Original Tank Data

Course Number	Height (In.)	Height (ft.)	T orig. (in.)	Material Spec.	Min. Yield*	Min. Tensile*	Allow. Stress		Joint Efficiency
							Product	Water	
1	85.00	07.083	3/16"	C.S.	30,000	55,000	23,600	26,000	0.70
2	60.00	05.000	3/16"	C.S.	30,000	55,000	23,600	26,000	0.70
3	60.00	05.000	3/16"	C.S.	30,000	55,000	26,000	27,000	0.70
Total	205.00	17.08							

* If shell material is known; Minimum yield, Minimum Tensile & Allowable Stress figures were obtained from API 653, table 4.1.
* If shell material is unknown; Minimum yield, Minimum Tensile & Allowable Stress figures derived by using the formulas in API 653. Welded tanks - para. 4.3.3 Riveted tanks – para. 4.3.4.

Table 2: Calculated Tank Data

Course Number	T_1 (inch)	T_2 (inch)	T_{min}		Calculated H. (ft.)	Shell Check Product		Shell check Water	
			Product	Water		T_1 Check	T_2 Check	T_1 Check	T_2 Check
1	0.199	0.195	.025	.023	16.08	Yes	Yes	Yes	Yes
2	0.191	0.190	.014	.013	9.00	Yes	Yes	Yes	Yes
3	0.194	0.190	.006	.006	4.00	Yes	Yes	Yes	Yes

Calculate:

New Fill Height For Product: **No** **New Fill Height For Water:** **No**

Calculate only if shell courses are not adequate due to; minimum or average thickness' (T1 or T2) being less than thickness required (T req'd). See next page if answer is yes.

Notes:

Requirements for continued operations per API 653, Section 4.3.3 or 4.3.4:

1. T_{min} (or required thickness) = 2.6*H-1*D*G / S*E (use the greater of T_{min} in Table 2 or .100" thick)
2. No pitting shall be greater than one half the T_{min} or exceed 2" in 8" in a vertical direction.
3. The value of T_1 shall be greater than or equal to T_{min}.
4. The value of T_2 shall be greater than or equal to 60% of T_{min}.
5. The external inspection interval shall not exceed five years, as per API 653, para. 4.3.3.2a.
6. Any corrosion allowance for service until the time of the next inspection shall be added to the $T_{min's}$ in items 3 & 4.

CONCLUSION

The evaluation shows that the tank can be safely filled to the top of the tank shell or 17' 2"

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT Thickness Measurements*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 303*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT.ASME.3 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Thickness measurements were taken on portions of the; Roof, Shell, Tank Bottom & applicable Nozzles.

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☒ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*In.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*In.*

EQUIPMENT			CALIBRATION INFORMATION	
Scope Manufacturer: *Krautkramer*			☒ Back Wall Technique	Ref. Signal Amp.: *100+%*
Model: *USN-52*	S/N: *621066*		Calibration Standard Type: *Step Wedge*	
Transducer Manufacturer: *Panametrics*			Calibration Standard Material: *Carbon Steel*	
Model: *V-602*	S/N: *130297*		Reflector: ☐ FBH ☐ SDH ☐ Notch	
Freq.: *3.5MHz*	Size: *.500"*	Angle: *0°*	Reflector Size(s): *N/A*	
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*	
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*	
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*
Couplant: *Cellulose Gel*		Batch No.: *N/A*	Scanning Gain: *N/A*	

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Thickness measurements are shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *10-14-09*

ULTRASONIC EXAMINATION - TECHNIQUE SHEET

Client Name: *Clean Harbors*	Jobsite: *Phoenix, AZ*
Job Description: *UT Corrosion Scans*	
Project Number:	Job or Operation No.:
Drawing / Part No.: *Tank 303*	Serial or Item No.: *N/A*

API 653 / ASME Sec. V Art. 5	*UT-ASME-1 Rev.1*	*API 650, 653 &/or ASME Sec. VIII*
Specification:	Procedure:	Acceptance:

SCOPE OF WORK PERFORMED

Ultrasonic (corrosion) scans were performed on random areas of the Roof, Shell & Tank Bottom.

COMPONENT INFORMATION

Material: ☒ C.S. ☐ S.S. ☐ Al. ☐ Babbitt ☐ Other: Dimensions: *N/A* Thickness: *N/A*

Component Type: ☒ Plate ☐ Bar ☐ Pipe ☐ Tube ☐ Forging ☐ Extrusion ☐ Billet ☐ Other:

EXAMINATION TECHNIQUE

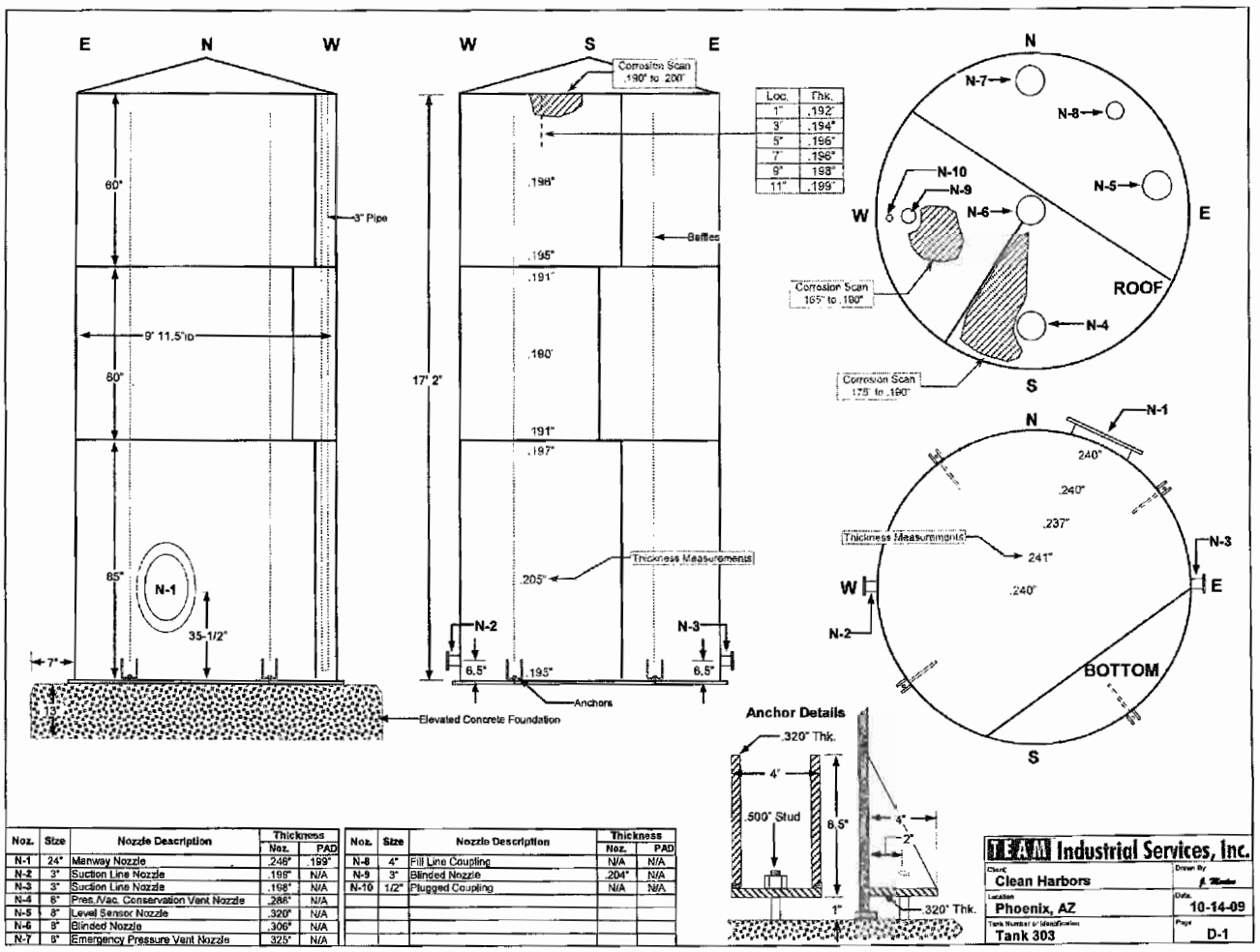
☒ Contact	☒ Pulse Echo	☒ Longitudinal	☐ Water Path:	*in.*
☐ Immersion	☐ Thru-Transmission	☐ Shear	☐ Delay Line:	*in.*

EQUIPMENT			CALIBRATION INFORMATION	
Scope Manufacturer: *Krautkramer*			☐ Back Wall Technique	Ref. Signal Amp.: *N/A*
Model: *USN-52*	S/N: *621066*		Calibration Standard Type: *Step Wedge*	
Transducer Manufacturer: *Krautkramer*			Calibration Standard Material: *Carbon Steel*	
Model: *Gamma*	S/N: *009YWH*		Reflector: ☐ FBH ☐ SDH ☐ Notch	
Freq.: *5 MHz*	Size: *.5" x .5"*	Angle: *0°*	Reflector Size(s): *N/A*	
Transducer Manufacturer: *N/A*			Reflector Depth(s): *.100" to .500"*	
Model: *N/A*	S/N: *N/A*		DAC Settings: *N/A*	
Freq.: *N/A*	Size: *N/A*	Angle: *N/A*	Reference Level: *N/A*	Attenuation Correction: *N/A*
Couplant: *Cellulose Gel*		Batch No.: *N/A*	Scanning Gain: *N/A*	

EXAMINATION RESULTS

Remarks	Sketch / Drawing
Corrosion data is shown on the tank drawings and discussed in the summary portion of the report.	

Inspector: John Morton ASNT UT Level: *II* Date: *10-14-09*



Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-1	24"	Manway Nozzle	.246"	.199"
N-2	3"	Suction Line Nozzle	.199"	N/A
N-3	3"	Suction Line Nozzle	.198"	N/A
N-4	8"	Pres./Vac. Conservation Vent Nozzle	.288"	N/A
N-5	8"	Level Sensor Nozzle	.320"	N/A
N-6	8"	Blinded Nozzle	.306"	N/A
N-7	8"	Emergency Pressure Vent Nozzle	.325"	N/A

Noz.	Size	Nozzle Description	Thickness Noz.	Thickness PAD
N-8	4"	Fill Line Coupling	N/A	N/A
N-9	3"	Blinded Nozzle	.204"	N/A
N-10	1/2"	Plugged Coupling	N/A	N/A

APPENDIX D-3

DRAINAGE EVALUATION

Peterson Geotechnical Group, LLC
Specialists in Forensic Geotechnical Engineering

December 28, 2007
Project No. 1117

Mr. David S. Komm, P.E.
Augspurger Komm Engineering, Inc.
3315 East Wier Avenue
Phoenix, Arizona

Subject: Drainage Evaluation
Clean Harbors Environmental Services
1340 West Lincoln Street
Phoenix, Arizona

Dear Mr. Komm:

In accordance with your request, Peterson Geotechnical Group, LLC (PGG) has performed a drainage evaluation of the Clean Harbors Environmental Services property, located at 1340 West Lincoln Street in Phoenix, Arizona (Figure 1). The purposes of our study were to evaluate the on-site drainage conditions and the deficiencies noted by ADEQ in the RCRA Part B Application submitted by Clean Harbors Arizona, LLC. This report presents our preliminary findings, conclusions, and recommendations for the subject property.

BACKGROUND

Clean Harbors Arizona, LLC (Facility) is located on the northeast corner of 15th Avenue and Lincoln Street in Phoenix, Arizona (Figure 1). The site consists of various buildings, hazardous waste containment areas, loading areas, and on-site retention basins (Figure 2). The site encompasses approximately 2.3 acres and the surface is approximately 80% covered with concrete flatwork and buildings.

ADEQ has requested further information about the flow of precipitation around the facility, more specifically, that during a rain event, water does not run on the facility from

2954 East Mahogany Place, Chandler, Arizona 480-219-0014 480-219-0756 (fax)

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off site and that water does not flow into the hazardous waste storage areas. In November 2007, Guida Surveying, Inc. (Guida) performed a land survey of the subject property. A topographic map of the surrounding area was created from an aerial survey. Numerous elevation readings were obtained throughout the site to create a contoured topography map. PGG was retained by Augspurger Komm Engineering, Inc. (AKE) to provide the requested information from ADEQ, which is discussed in detail in the following sections.

PETERSON GEOTECHNICAL GROUP STUDY

PGG was retained on behalf of AKE to provide the information requested by ADEQ with regards to the on-site grading and drainage. On December 6, 2007, Miss Lindsey Lawlis, E.I.T., a Project Engineer for PGG, visited the subject property. The purposes of the visit were to observe the site conditions, the conditions noted by ADEQ, as well as to obtain relative elevation readings to spot-check the survey data obtained by Guida. The elevation points were evaluated and our discussions regarding these points are presented below. In addition, the following sections provide the ADEQ deficiency items as well as the PGG response.

ADEQ Deficiency Item Number 40:

"Although Sheet 581-CDA-105 shows an elevation change, no information supplied that quantifies the elevation change (no scale or dimension call-out). Demonstrate that the grade change is sufficient to prevent run-on per 40 CFR 270.15(a)(4) and 264.175(b)(4). See also grading and drainage plan Sheet 581-YDA-102."

PGG DISCUSSION:

The standards cited by ADEQ are as follows:

270.15(a)(4): Provisions for preventing or managing run-on.

264.175(b)(4): Run-on into the containment system must be prevented unless the collection system has sufficient excess capacity in addition to that required in paragraph (b)(3) of this section to contain any run-on which may enter the system. Paragraph (b)(3) of 264.175 states: The containment system must have sufficient capacity to contain 10% of the volume of containers or the volume of the largest container, whichever is greater.

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PGG evaluated the drainage conditions outside of the containment storage areas to determine if the adjacent grade is adequate to prevent run-on onto the site and into the containment areas. Based on our evaluation, the site has a system in place to prevent/manage run-on. The area surrounding the Facility is relatively flat at generally less than one foot per 100 feet fall from north to south. Along the north and east sides of the site, a poured concrete curb, ranging from 4- to 6-inches in height, was observed. To the north of the Facility, the general ground elevation is sloped such that during a rain event precipitation would not accumulate and breach the curb, which is approximately 8 inches above the adjacent grade. The curb will therefore prevent run-on from the adjacent properties.

Along the south side of the site, the facility is at a higher elevation than the surrounding area. The driveways along Lincoln Street leading into the Facility are greater than one foot higher than the street and thus have adequate elevation gain to prevent run-on from the street along the south side of the Facility.

The Facility building and parking areas are located on the west side of the site. In these areas, no visible path of moisture run-on was observed, and the curbs located between the Facility and 15th Avenue prevent run-on from entering along the west side of the site. The dirt parking area located at the northwest corner of the site has approximately one foot of fall to the west with a curb separating the parking lot from the Facility concrete. This curb creates a high ridge that forces water that falls to the east to remain within the active portion of the facility and the water to the west flows away from the active portion.

ADEQ Deficiency Item Number 41:

"The Grading and Drainage Plan provided is useful in showing that impoundment areas are located in regions other than containment areas and that rainwater may be directed away from containment areas. However, certain additional detail must be provided by CHA:

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- A photograph of CSA V shows that the discharge of the roof down-spout is located immediately adjacent to the work station entrance, possibly allowing for roof run-off to flow into the work stations.
- There is limited detail in the text and secondary containment calculations regarding why run-on is not an issue (and an apparent discrepancy in noted elevations for Cross Section 5 between the plan and profile).
- There is no discussion regarding the sufficiency of the design.

Please provide supporting engineering analysis of grading and drainage for this area."

PGG DISCUSSION:

Two down-spouts are located on the west side of the work stations, one on the north corner and one on the south corner. PGG obtained relative elevation readings in these areas using a Pro-Level Manometer (water level). Based on our findings and a review of the Guida survey, the slope down and away from the work stations is adequate to discharge roof run-off away from the work stations and the corresponding containment areas. The slope by the north downspout was approximately 2.6 percent away from the structure, and the slope away from the south downspout was approximately 6.1 percent; however, the elevation readings taken south of the southern downspout indicated that some water may flow from the downspout adjacent to the outside south wall of the building before flowing towards the south. This area was not low enough to create ponding, and the southern most work station was did not appear to be susceptible to roof runoff. All four workstations appeared to have adequate drainage sloped away from the opening to prevent roof runoff from entering the containment areas. Observations inside the workstations did not indicate any previous accumulations of standing water. The general pattern of flow can be observed in Figure 3 attached to this report.

ADEQ Deficiency Item Number 42:

"Provide an adequate demonstration and/or supporting discussion (or engineering analysis) that site grading is sufficient to prevent run-on to specified CSAs."

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PGG DISCUSSION:

Some of the survey points obtained by Guida were spot-checked in the field using a Pro-Level Manometer. Based on our results, the survey contours are generally an accurate depiction of the site conditions. CSA I is surrounded by buildings and appurtenant structures, and a path for moisture infiltration was not observed. The grade to the east of CSA II falls away from the structure at a slope of approximately 2.5 percent. The grade to the west of the work stations falls away from the structure at a slope of approximately 4.3 percent. The grades direct the drainage towards an appropriate holding area (Basin 1 in Figure 2), located north of the loading docks and east of CSA II, where water is allowed to accumulate up to a volume of 403 cubic feet (ft^3) before it flows out to the south.

CSAs IV, V, VI, VII, and the roll off bin area are located to the north and east of the tank farm and are delineated by raised curbs. The raised curbs were installed to prevent water from entering the containment areas. In our opinion, adequate sloping was constructed in these areas to prevent water accumulation adjacent to the containment areas. Precipitation in this area would sheet flow both to the east and west around the tank farm. The divide between east and west flow is a north-south high area between CSA V and CSA VII. Containers in these areas are placed on pallets that are taller than the depth of the containment and therefore are not submerged in the accumulated rainfall. Based on our observations, elevation readings, and survey data, it is our opinion that the raised curbs are adequate to prevent rain run-off from entering the containment areas. Two cross-sectional areas, considered critical areas due to the lowest curb elevation or a possible source of moisture infiltration, were evaluated to determine if the volume of water from a 25-year, 24-hour storm would over-top the curb surrounding the containment areas. The locations of the two cross-sectional areas evaluated are observed on Figure 2. Based on these cross-sectional areas, the curbs and adjacent grades are adequate to prevent run-off from entering the containment areas.

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On-Site Drainage:

The survey points indicate the drainage on the site is generally separated into three areas, labeled as Drainage Basins 1, 2, and 3 (Figure 3), and are discussed below.

Drainage Basin 1:

The contour lines of Drainage Basin 1 indicate that the drainage generally flows from the north towards Basin 1, where it is allowed to pond up to a volume of 403 ft^3. Once Basin 1 is overtopped, the water will flow to the south and into Basin 2.

Drainage Basin 2:

The contour lines of Drainage Basin 2 indicate that the water will flow towards Basin 2, where it will be allowed to pond up to a volume 313 ft^3 before flowing out of the southwest driveway. Once Basin 2 has reached its capacity, the water will flow out of the southwest driveway. A truck loading/unloading area is located within Drainage Basin 2. This area is surrounded by a raised curb, and a low area is located adjacent to the tank farm. Based on the survey points, the truck loading/unloading area will retain the rainfall that falls in this area before flowing out towards Basin 2.

Drainage Basin 3:

The contour lines of Drainage Basin 3 indicate that the drainage generally flows from the north around the roll off storage area to the east towards the southeast driveway. During a rain event that produces a large volume of water, sheet flow will exit out of the southeast driveway, as seen in Figure 3. However, based on observations of Facility personnel during a light rain event, the water flows from the north and towards Basin 2, without exiting out of the southeast driveway.

CONCLUSIONS

In general, the following was concluded at the site:

- The survey produced by Guida is generally an accurate depiction of the site drainage conditions.

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- The drainage around the site is generally directed towards on-site retention basins, After Basin 1 has reached its capacity, drainage will flow out towards the south and into Basin 2. After Basin 2 has reached capacity, the water will flow out of the southwest driveway. Basin 3 was observed to flow into Basin 2 under light rainfall conditions but would likely flow out the southeast driveway under heavier rainfall conditions.
- The drainage slopes and raised curbs adjacent to the containment areas are adequate to prevent run-off from entering the containment areas.
- The downspouts located along the west side of the work stations discharge on grade that slopes away from the structures, preventing roof run-off from entering the work stations and containment areas.

LIMITATIONS

The engineering services described in this report have been conducted in general accordance with the standard of care exercised by local engineering consultants. No warranty, expressed or implied, is made regarding the conclusions, and recommendations presented in this report. Our conclusions and recommendations are based on an analysis of the observed site conditions, and our experience with similar projects.

We appreciate the opportunity to be of service. If you have any questions or comments regarding this report, please contact the undersigned.

Respectfully Submitted,
Peterson Geotechnical Group, LLC

Registered Professional Engineer (Civil)
CERTIFICATE NO. 39513
CURT R. PETERSON
Date Signed 12-28-07
ARIZONA U.S.A.

Curt R. Peterson, P.E.
Senior Engineer

Distribution: (1) Addressee

Figures: Figure 1 – Site Location Map
Figure 2 – Site Plan
Figure 3 – Basin Location Map

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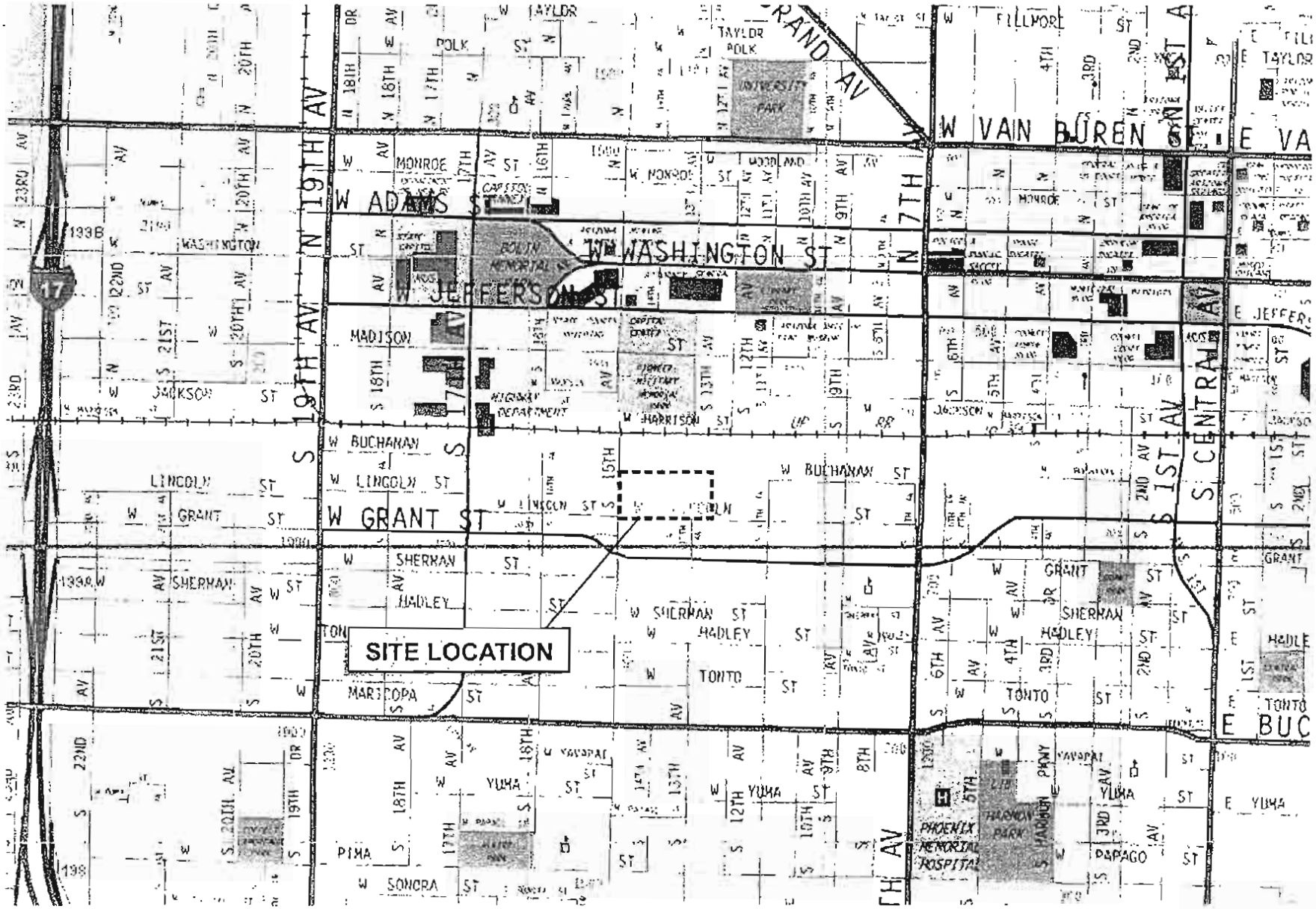

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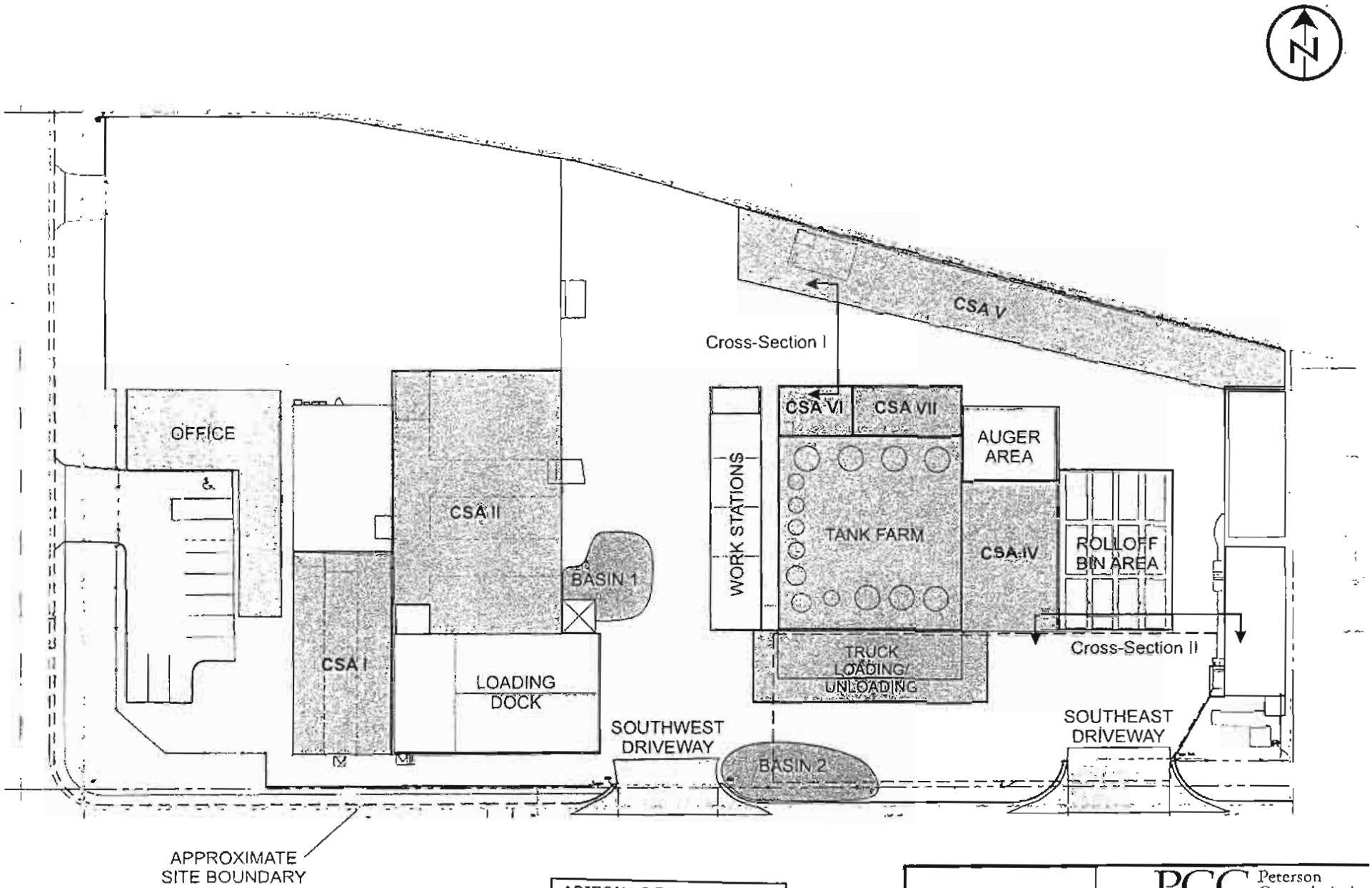
SITE LOCATION MAP		PGG Peterson Geotechnical Group, LLC
PROJECT NUMBER: 1117	DATE: 12/07	Clean Harbors Arizona, LLC 1340 West Lincoln Street Phoenix, Arizona
FIGURE 1		



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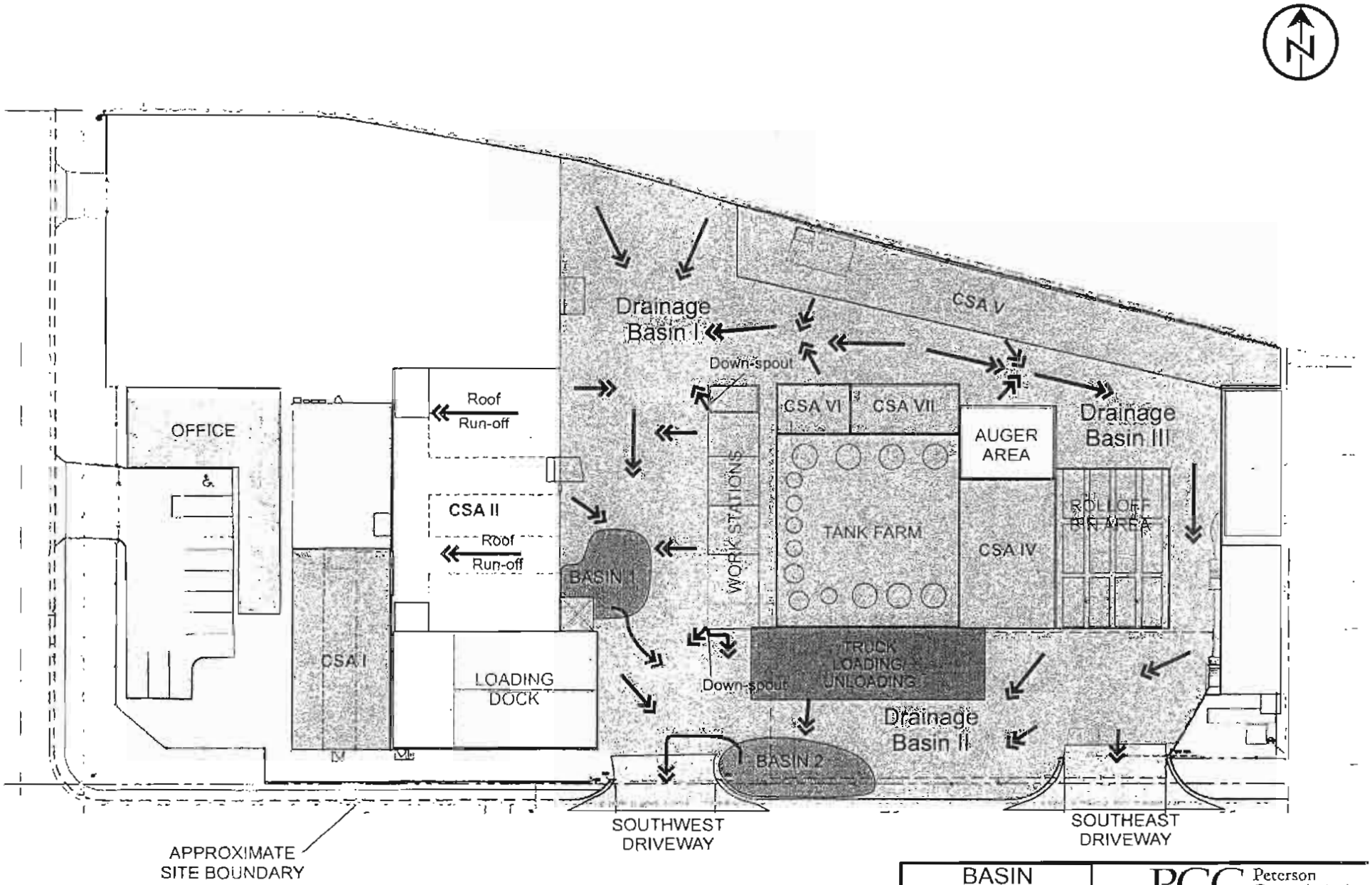
SITE PLAN		PGG Peterson Geotechnical Group, LLC
PROJECT NUMBER: 1117	DATE: 12/07	Clean Harbors Arizona, LL 1340 West Lincoln Street Phoenix, Arizona
FIGURE 2		



LEGEND

General Direction of Drainage

BASIN LOCATION MAP		PGG Peterson Geotechnical Group, LLC
PROJECT NUMBER: 1117	DATE: 12/07	Clean Harbors Arizona, LLC 1340 West Lincoln Street Phoenix, Arizona
FIGURE 3		

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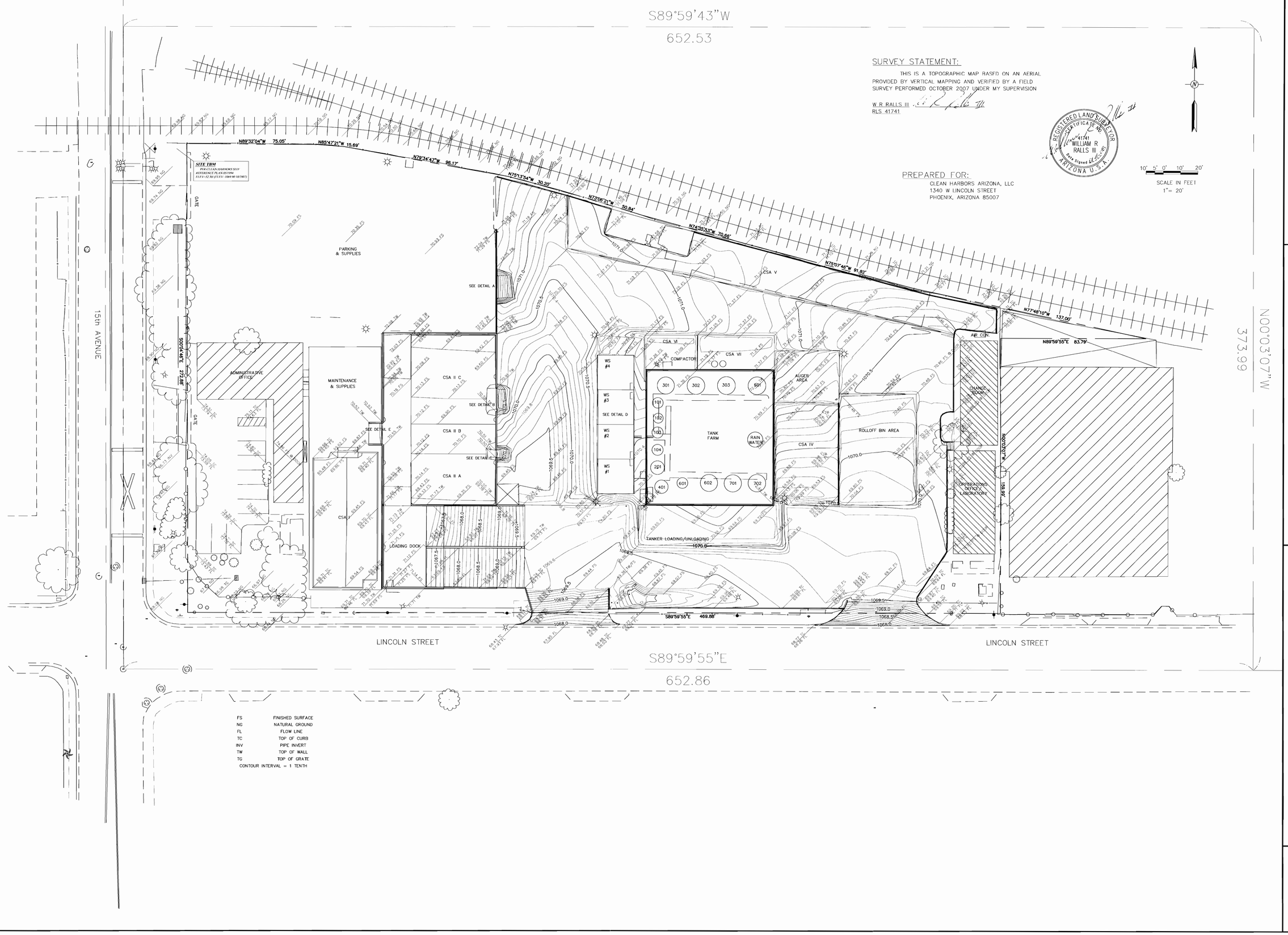


SURVEY STATEMENT:

THIS IS A TOPOGRAPHIC MAP BASED ON AN AERIAL PROVIDED BY VERTICAL MAPPING AND VERIFIED BY A FIELD SURVEY PERFORMED OCTOBER 2007 UNDER MY SUPERVISION

W R RALLS III
RLS 41741

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
41741
WILLIAM R
RALLS III
Date Signed
ARIZONA U.S.A.

PREPARED FOR:
CLEAN HARBORS ARIZONA, LLC
1340 W LINCOLN STREET
PHOENIX, ARIZONA 85007

10' 5' 0' 10' 20'
SCALE IN FEET
1"= 20'

FS	FINISHED SURFACE
NG	NATURAL GROUND
FL	FLOW LINE
TC	TOP OF CURB
INV	PIPE INVERT
TW	TOP OF WALL
TG	TOP OF GRATE

CONTOUR INTERVAL = 1 TENTH

REVISIONS

NO.	DATE	DESCRIPTION	BY

PREPARED BY:

GUIDA SURVEYING INC.
5016 S ASHAVE • SUITE 101
TEMPE, ARIZONA • 85282
(480) 889-2232 • FAX (480) 355-1401
EMAIL gsicorp@guidasurveying.com

BENCHMARK
CITY OF PHOENIX BENCHMARCK
NGVD-29 ELEVATION=1074.602
CHISLED SQUARE ON WEST WING OF CATCH BASIN
ON NORTHEAST CORNER OF INTERSECTION OF
15TH AVENUE AND HARRISON

APPENDIX D-4

TANK LEVEL CONTROLLER INFORMATION

Product Data Sheet
00813-0100-4026, Rev FA
June 2007

Rosemount 5400 Series

Two-wire Radar Level Transmitter

The Rosemount 5400 Series is a reliable 2-wire radar level transmitter for liquids and slurries, designed for outstanding performance in a wide range of applications and process conditions. It measures level directly and is therefore unaffected by most fluid property changes, including changes in temperature, pressure, vapor gas mixture, density, turbulence, bubbling/boiling, dielectric, pH, viscosity, crystallization etc.

- *Innovative design. Best-in-class performance.*
- *Non-contacting, making it virtually unaffected by process conditions.*
- *No moving parts, means little or no maintenance.*
- *Application flexibility with full range of antennas, and two models 5402 (26 GHz) and 5401 (6 GHz).*
- *Less affected by coating with Condensation Resistant Antenna*
- *Reduced echoes from obstacles / tank walls with Circular Polarization*
- *Powerful, easy-to-use configuration tool with"Measure-and-Learn" function.*

Content

"Innovative Measurement Technologies for a Better Bottom Line" 2
"Reliable Measurements through Advanced Surface Tracking Capability" 5
"System Integration" 6
"Transmitter and Antenna Overview" 8
"Measuring Range" 11
"Mechanical Mounting Recommendations" 12
"Specifications" 15
"Product Certifications" 19
"Dimensional Drawings and Mechanical Properties" 21
"Ordering Information" 28
"Application & Configuration Data Sheet" 34

Innovative Measurement Technologies for a Better Bottom Line

Radar is a continuous level measurement technique that offers several advantages.

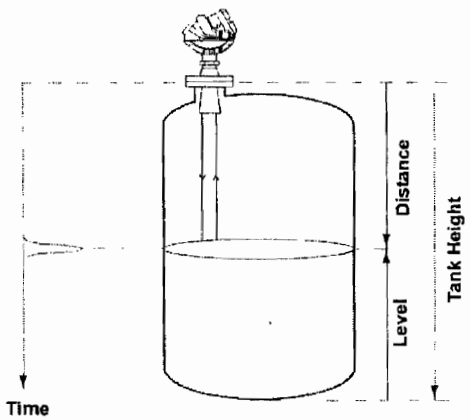
The 5400 Series transmitter is used for level measurements on liquids and slurries with various temperatures, pressures and vapor gas mixtures. Due to its advanced surface tracking capability, the transmitter can detect and evaluate all echoes within the tank.

Rosemount 5400 Series is easily configured for a wide range of applications and process conditions. In addition, it incorporates advanced signal processing and smart echo tracking features.

MEASUREMENT PRINCIPLE

The distance to the surface is measured by short radar pulses, which are transmitted from the antenna at the tank top.

When a radar pulse reaches a media with a different dielectric constant, part of the energy is reflected back to the transmitter. The time difference between the transmitted and the reflected pulse is proportional to the distance, from which the level, and if desired, volume and level rate, is calculated.

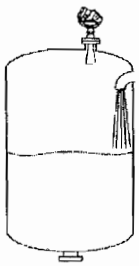


MODELS

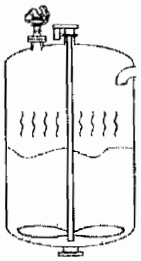
The 5400 Series consists of two models:

- Rosemount 5401, Low Frequency Transmitter (~ 6 GHz).
- Rosemount 5402, High Frequency Transmitter (~ 26 GHz).

The availability of two frequencies allows the user to choose the model that will best fit the installation and process conditions, although the 5402 is the preferred choice for most applications.

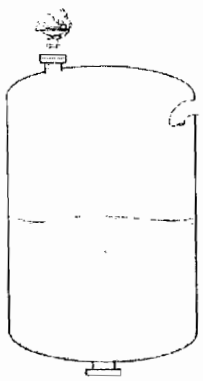


The 5402 transmitter is the preferred choice in most applications due to its narrow radar beam that offers greater mounting flexibility.



The 5401 transmitter is used in applications with some extreme process conditions.

APPLICATION EXAMPLES FOR THE 5400 SERIES RADAR LEVEL TRANSMITTER



Tanks, vessels, containers with calm surfaces

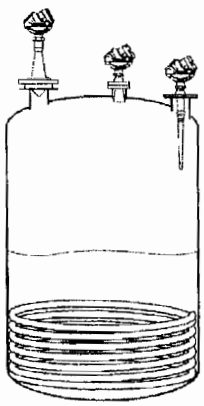
Take advantage of non-contacting radar also in less challenging applications, such as storage and buffer tanks:

- It is easy to mount, maintenance-free, and highly accurate
- Gives precise monitoring and control of the process

Overfill and underfill detection

The 5400 Series can also be advantageous in risk reduction systems:

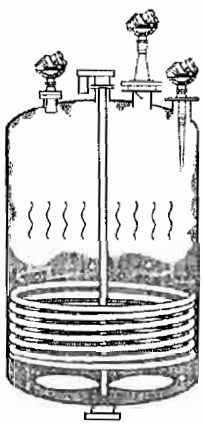
- Continuous measurement may reduce or simplify proof-tests
- Multiple 5400's can be used in the same tank



Corrosives

Radar measurement is ideal for most corrosive products, such as caustics, acids, solvents and many other chemicals:

- Not in contact with process product
- Wide material offering such as PTFE, Hastelloy and Monel
- Works well also in non-metallic tanks



Sticky, viscous and crystallizing products

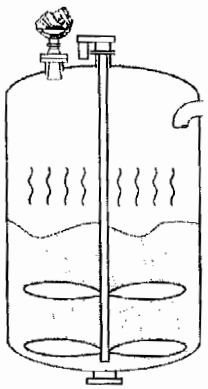
The best-in-class 5400 Series can provide an accurate and reliable level reading also with difficult products, such as resins and adhesives:

- Non-contacting is best practice
- Almost unaffected by coating and build-up due to the uniquely designed condensation resistant antennas

Sludges and slurries

Applications like mud, pulp-stock and lime slurries are ideal for non-contacting measurement:

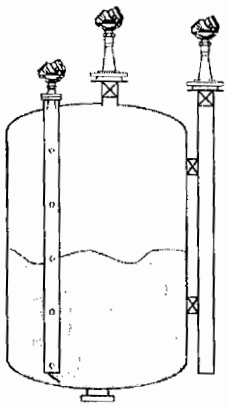
- Immune to splashing and solids content
- Unaffected by density changes
- No re-calibration, no or little maintenace



Reactor vessels

The innovative design of the 5400 Series makes it an excellent choice for the most difficult applications, such as reactor vessels:

- Unique circular polarization provides greater mounting flexibility – no clearance distance from tank wall is needed!
- Direct measurement – independent of most variations in process conditions, such as density, dielectric, vapor, temperature and pressure
- Can handle turbulent conditions, whether created by agitation, top-filling or process reaction

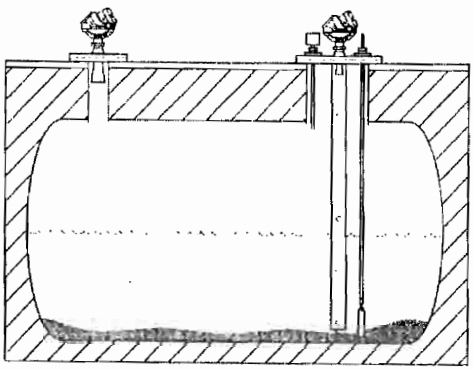


Mounting flexibility

The versatile 5400 Series can be used also in other mounting configurations than standard nozzles:

- Fits most existing pipes: 2-8 in.
- Easy to isolate from the process – use a ball-valve

Stilling-pipes and bridles can be advantageous since they reduce the influence of foam, turbulence and tank obstructions. Ball-valves can be used on both still-pipes and nozzles.



Underground tanks

The mounting flexibility of the 5400 Series makes it an excellent choice for many underground tanks:

- Easy top-mounting
- Can handle long narrow nozzles, and pipes
- Unaffected by dirty products with solids content

For more information on which model and antenna to use for the applications above, see "Transmitter and Antenna Overview" on page 8 and "Measuring Range" on page 11, or contact your local Emerson Process Management representative.

Reliable Measurements through Advanced Surface Tracking Capability

Different process conditions, such as the tank atmosphere, foam, turbulence and products with low dielectric constants, will all decrease the returned signal such that the radar transmitter may lose track of the surface. It is therefore important that the transmitter can detect very weak signals.
The Rosemount 5400 Series transmitter incorporates several new innovations to get the best possible surface tracking capability. These features contribute to more reliable measurements and better performance when compared with standard 2-wire transmitters.

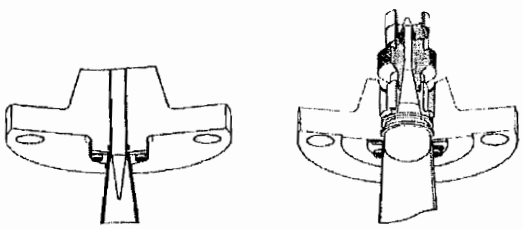
DUAL PORT TECHNOLOGY

Dual Port Technology means that there are two ports for transmitting and receiving signals, which reduces noise. Even if the returned signal is weak, the transmitter will still be able to reliably detect it.
A transmitter with Dual Port Technology can receive 75% less reflected energy than a standard 2-wire transmitter and still have equal or better surface tracking capability.
Standard 2-wire radar level transmitters only use one port on the microwave generation module for sending and receiving signals. This introduces significant losses in the microwave generation.

CONDENSATION RESISTANT ANTENNA

The tank seal is the part of the waveguide that protects the transmitter from the process atmosphere. Rosemount 5400 Series has a larger protective surface towards the tank, which makes the transmitter less sensitive to dirt and condensation.

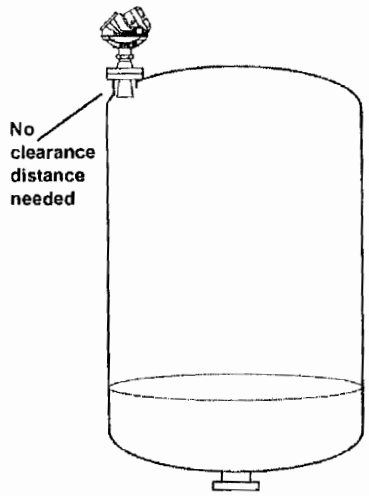
Standard Transmitter **Rosemount 5402**



Rosemount 5400 Series transmitters are equipped with an enlarged PTFE tank seal to protect the antenna from contamination and condensation, an especially important feature for high frequency antennas.

CIRCULAR POLARIZATION

Standard radar transmitters utilize linear polarization resulting in greater influence from disturbing objects. The 5400 Series transmitter has circular polarization, which reduces echoes from tank walls and disturbing objects. This means increased installallation flexibility and measurement reliability. The transmitter can be installed without any clearance distance to the tank wall.



Circular polarization enables the transmitter to be installed without any clearance distance to the tank wall.

System Integration

The Rosemount 5400 Series is a loop-powered device (it uses the same two wires for power supply and communication) that supports both FOUNDATION™ fieldbus, and the analog 4-20 mA with superimposed digital HART®.

EASY INTEGRATION

The 5400 Series supports the latest interoperability standards and can therefore easily be integrated into almost any host system.
For configuration, the enclosed software package Rosemount Radar Master can be used to configure the transmitter in five simple steps.
Any other DD- or enhanced EDDL-compatible configuration tool such as AMS, DeltaV or the Rosemount 375, can also be used.

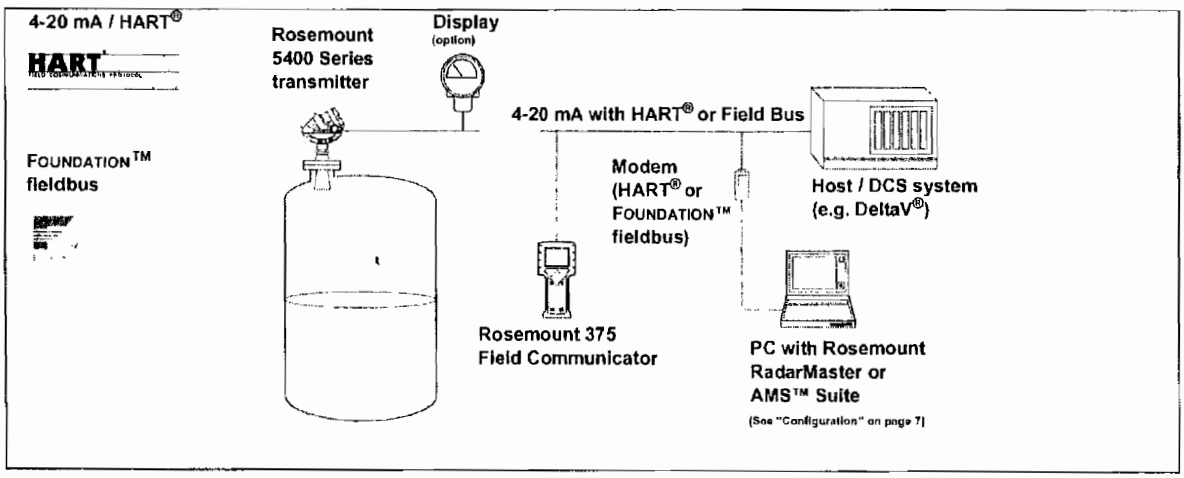
THE FOUNDATION FIELDBUS ADVANTAGE

No proprietary connections are required to perform a complete configuration – not even for the echo-curve! Instead this can be done remotely in the control room over the fieldbus segment using Rosemount Radar Master. Basic Configuration can also be performed using any DD-compatible configuration tool, such as DeltaV.

Additionally, with the strength of eleven function blocks and interoperability certificates from all major host system vendors, the 5400 Series will unleash the true benefits of FOUNDATION™ fieldbus.

INNOVATIVE PLANTWEB CAPABILITIES

If the performance of the microwave board starts to degrade, a PlantWeb Alert, categorized as a warning, can be displayed to the operator.
The same happens if the internal temperature sensor gets too hot.
Alerts will describe the problem and recommend actions. Precise diagnostics capabilities like this and many more will simplify troubleshooting and enable predictive maintenance.



The 5400 Series can be integrated into almost any new or existing plant. Configure it remotely in the control room over the 4-20 mA/Hart® or FOUNDATION™ fieldbus wires. No proprietary connections are needed.

DISPLAY

Data can be read from the optional integral display or remotely by using the Rosemount 751 Field Signal Indicator (see Product Data Sheet, document number 00813-0100-4378) for 4-20 mA / HART® or the Rosemount 752 Remote Indicator for FOUNDATION™ fieldbus (see Product Data Sheet, document number 00813-0100-4377).

The integral display is easily configured with Rosemount RadarMaster or the Rosemount 275/375 Handheld Communicator. The user can choose which variable to display or if toggling between different variables should be applied.

TRANSMITTER VARIABLES

From one Rosemount 5400 Series radar level transmitter it is possible to receive information about Level, Distance, Volume, Signal Strength, Level Rate, Analog Output Current, % of Range, and Internal Temperature.

CONFIGURATION

Basic configuration can easily be done either with Rosemount RadarMaster, a Rosemount 275/375 Handheld Communicator, the AMS™ Suite, DeltaV® or any other DD (Device Description) compatible host system. For advanced configuration features, RadarMaster is required.

RadarMaster is a user-friendly, Windows based software package that provides easy configuration and service. A wizard guides the user to enter the required parameters for a basic configuration. "Measure & Learn" functionality is accessed through RadarMaster. It enables automatic suggestion of threshold and disturbance echo settings, thereby making tough applications easy to configure. RadarMaster also includes waveform plots, off-line configuration, logging and extensive on-line help.

For 4-20 mA or HART®, a HART® modem is required for communication between the transmitter and RadarMaster (part number 03300-7004-0001 for RS232 and 03300-7004-0002 for USB interface).

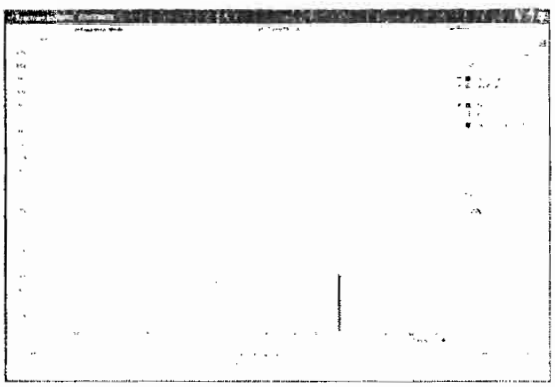
For FOUNDATION™ fieldbus devices, RadarMaster is connected to the fieldbus segment via the fieldbus modem (part number 03095-5108-0001 for PCMCIA). For more information, see the 5400 FOUNDATION™ fieldbus Reference Manual (document number 00809-0100-4032) or consult factory.

Rosemount 5400 transmitters support PlantWeb® Alerts.

By filling in the Configuration Data Sheet (CDS), it is possible to order a pre-configured transmitter.

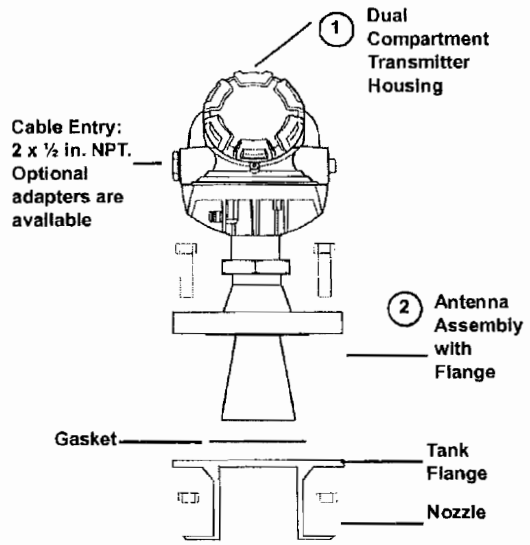
ADVANCED PLANTWEB® FUNCTIONALITY

The Rosemount 5400 Series transmitter powers PlantWeb® through innovative measurement technologies and advanced diagnostics that provide higher reliability, easier configuration, reduced process downtime, lower installation and operating costs for a better bottom line.



With Rosemount RadarMaster, a noise threshold curve and false echo registration can automatically be created by clicking the Learn button.

Transmitter and Antenna Overview



The Rosemount 5400 Series transmitter consists of the transmitter housing and an antenna assembly. The transmitter housing contains all electronics. The antenna assembly seals off the tank atmosphere from the transmitter housing and the surroundings.

The 5400 Series is delivered as a single assembly for easy out-of-box installation. No special tools are required.

The transmitter is available with Intrinsically Safe(1) / Non-Incendive or Explosionproof / Flameproof approvals.

For more information see "Product Certifications."

TRANSMITTER HOUSING (1)

There are two models available with different frequencies: the 5402 (~26 GHz, K-band) and the 5401 (~6 GHz, C-band). The models utilize different frequencies, and antennas, so transmitter housings are therefor not interchangeable.

The transmitter housing has two integral ½-in. NPT cable entries for conduit / cable connections. Adapters to other connection types are available. See "Ordering Information" on page 28 and 28.

The dual-compartment housing separates cabling from the electronics for increased moisture resistance.

The transmitter housing can easily be rotated and removed from the antenna assembly for service or replacement. It is done without opening the tank.

ANTENNA ASSEMBLY (2)

The antenna assembly is the only part in contact with the tank atmosphere.

The antenna assembly consists of an antenna, an O-ring, a tank seal, a flange (see "Standard Flanges" on page 26) or a thread (NPT).

The purpose of the antenna is to focus the radar beam. The Rosemount 5400 Series Radar Level transmitters are equipped with high performance cone, rod and process seal antennas in various sizes and materials.

A general recommendation is to use the largest possible antenna to achieve highest gain.

For information on temperature and pressure, see "Temperature and Pressure Ratings" on page 18.

(1) Fisco intrinsic safety is available for Foundation™ fieldbus. See "Ordering Information" on page 28 and 31 for more information on available approvals.

Model and Antenna Guide	5402		5401	
This table gives guidelines on which model and antenna to select, depending on application. **G=Good** **AD=Application Dependent** (consult your local Emerson representative) **NR=Not Recommended**	**Cone (preferred)** Best choice for a broad range of applications, free propagation and pipe installations.	**Process Seal** Ideal for small tanks and corrosive applications. Also good for heavy antenna condensation/build-up.	**Cone (preferred)** Suitable for some extreme process conditions.	**Rod** Suitable for small process connections, and corrosive environment.
Accuracy	± 0.1 in (3 mm)	± 0.1 in (3 mm)	± 0.4 in (10 mm)	± 0.4 in (10 mm)
Tank Considerations				
Installation close to smooth tank wall	G	G	G	G
Internal obstructions, directly in path	NR	NR	AD	AD
Internal obstructions, avoidance(1)	G	G	NR	NR
Antenna extends below nozzle	G	G	G	G
Antenna recessed in smooth nozzle up to 6 ft (2 m)	G	G	AD(2)	NR(3)
Antenna recessed in nozzle with irregularities, such as bad welds	AD(2)	AD	AD(2)	NR(3)
Still-pipe mounting	G	G	G	NR
Valves	G	G	NR	NR
Pressure/Temperature considerations	See pages 18, 21-22	See pages 18 and 24.	See pages 18, 21-22	See pages 18 and 23.
Measuring range considerations	See page 11.	See page 11.	See page 11.	See page 11.
Process Medium Characteristics				
Vapor (light, medium)	G	G	G	G
Vapor (heavy)	NR	AD	G	G
Condensing vapor/product build-up(4)	AD	G	G	AD
Boiling/Turbulent surface (low/medium)	G	G	G	G
Boiling/Turbulent surface (heavy)	AD	AD	G(5)	NR
Boiling/Turbulent surface (still-pipe)	G	G	G	NR
Foam(6)	NR	NR	AD	AD
Foam (still-pipe)(6)	G	G	G	NR
Corrosive products (options available)	G(7)	G(7)	G(7)	G(7)
Materials with very low dielectric	G	G	G	AD
Changing density/dielectric/pH/ pressure/temperature	G	G	G	G
Coating/viscous/crystallizing liquids	G	G	G	G
Cleanability of antenna	AD	G	AD	G

(1) The obstruction should not be within the radar beam. Preferred choices due to more narrow radar beam: Model 5402, and cone antenna.
(2) An extended cone antenna can be used.
(3) The active part must protrude beneath the nozzle.
(4) Build-up can often be avoided or reduced by using heat-tracing or cleaning arrangements.
(5) Use a 6 or 8 in. cone antenna.
(6) Foam can either reflect, be invisible or absorb the radar signal. Pipe mounting is advantageous since it reduces the foaming tendancy.
(7) See wetted material on page 10.

	5402 (~ 26 GHz)		5401 (~ 6 GHz)	
Transmitter model and antenna combination	**Cone**	**Process Seal**	**Cone**	**Rod**
Wetted Material	**Antenna options:** • 316 / 316 L SST (EN 1.4404) • Hastelloy® C-276 (UNS N10276) • Monel® 400 (UNS N04400 • NACE® **Tank Seal:** • PTFE **O-ring**(2)	**Antenna option:** • PTFE **O-ring**(2)	**Antenna options:** • 316 / 316 L SST (EN 1.4404) • Hastelloy® C-276 (UNS N10276) • Monel® • NACE® **Tank Seal:** • PTFE **O-ring**(2)	**Antenna options:** • PFA(1) • PFA(1) and 316 / 316 L SST (EN 1.4404)(2)
Process Connection	Flange or Bracket	Flange	Flange or Bracket	Flange, Thread or Bracket

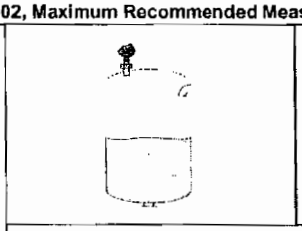
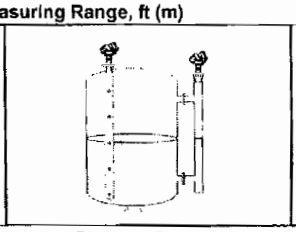
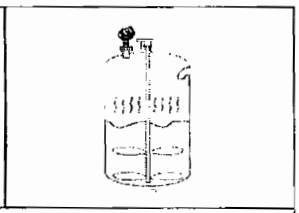
(1) PFA is a fluoropolymer with properties similar to PTFE.
(2) O-ring options: Viton®, Kalrez®, EPDM and Buna-N.

Measuring Range

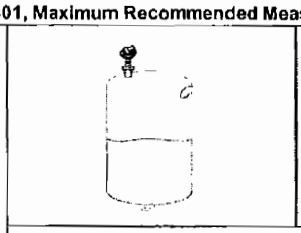
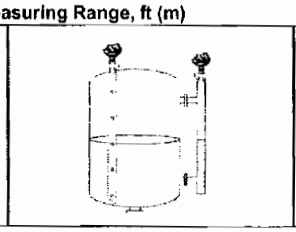
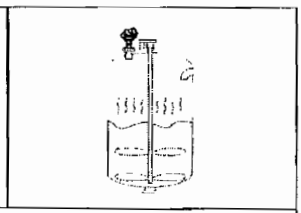
The measuring range depends on the microwave frequency, antenna size, the dielectric constant (ε_r) of the liquid, and process conditions. The higher the dielectric constant value, the stronger the reflection (see the following tables). The figures below are given as a guideline for optimum performance. Larger measuring ranges may be possible. For more information, contact your local Emerson Process Management office.

A. Oil, gasoline or other hydrocarbons, and petrochemicals (ε_r =1.9-4.0).
   In pipes or with ideal surface conditions, for some liquefied gases (ε_r =1.4-4.0)
B. Alcohols, concentrated acids, organic solvents, oil/water mixtures, and acetone (ε_r =4.0-10.0).
C. Conductive liquids, e.g. water based solutions, dilute acids, and alkalis (ε_r>10.0).

Rosemount 5402, Maximum Recommended Measuring Range, ft (m)

High Frequency Antennas									
	Dielectric Constant								
	A	B	C	A	B	C	A	B	C
2-in. Cone / Process Seal	33 (10)	49 (15)	66 (20)	82 (25)	115 (35)	115 (35)	9.8 (3)	20 (6)	33 (10)
3-in. Cone / Process Seal	49 (15)	66 (20)	98 (30)	82 (25)	115 (35)	115 (35)	13 (4)	30 (9)	39 (12)
4-in. Cone / Process Seal	66 (20)	82 (25)	115 (35)	82 (25)	115 (35)	115 (35)	23 (7)	39 (12)	49 (15)

Rosemount 5401, Maximum Recommended Measuring Range, ft (m)

Low Frequency Antennas									
	Dielectric Constant								
	A	B	C	A	B	C	A	B	C
3-in. Cone[1]	NA	NA	NA	82 (25)	115 (35)	115 (35)	NA	NA	NA
4-in. Cone / Rod[2]	23 (7)	39 (12)	49 (15)	82 (25)	115 (35)	115 (35)	13 (4)	26 (8)	39 (12)
6-in. Cone	43 (13)	66 (20)	82 (25)	82 (25)	115 (35)	115 (35)	20 (6)	33 (10)	46 (14)
8-in. Cone	66 (20)	82 (25)	115 (35)	82 (25)	115 (35)	115 (35)	26 (8)	39 (12)	52 (16)

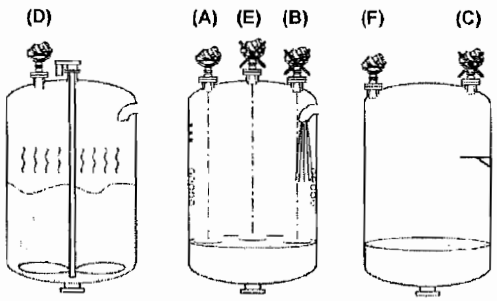
(1) Pipe installations only. NA=not applicable.
(2) Pipe installations are not allowed with rod antennas.

Mechanical Mounting Recommendations

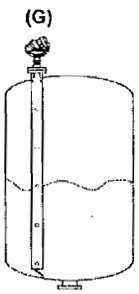
MOUNTING LOCATION

For optimal performance, the transmitter should be installed in locations where there is a clear and unobstructed view of the level surface (A):

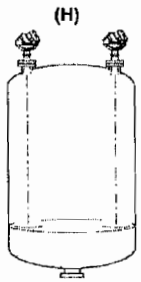
- Filling inlets creating turbulence (B), and stationary metallic objects with horizontal surfaces (C) should be kept at a distance, outside the signal beam – see tables on page 14 for beamwidth information.
- Agitators with large horizontal blades may reduce the performance of the transmitter. Install the transmitter in a location where this effect is minimized. Vertical or slanted blades are often invisible to radar, but they create turbulence (D).
- Do not install the transmitter in the center of the tank (E).
- Due to the circular polarization, there is no requirement on clearance distance from the tank wall if it is flat and free from obstructions such as heating coils and ladders (F). The optimal location is often 1/3 of the radius from the tank wall.



- The antenna is normally aligned vertically.
- A metal bridle / still-pipe can be used to avoid disturbing objects, turbulence, and foam (G).



- The walls in non-metallic tanks are invisible to the radar signal, so nearby objects outside the tank may be detected.
- Choose the largest possible antenna diameter for the installation. A larger antenna will concentrate the radar beam, and will be less susceptible to interference by obstructions. It also assures maximum antenna gain.
- Multiple 5400 transmitters can be used in the same tank without interferring with each other, independently of frequency and antenna choice (H).

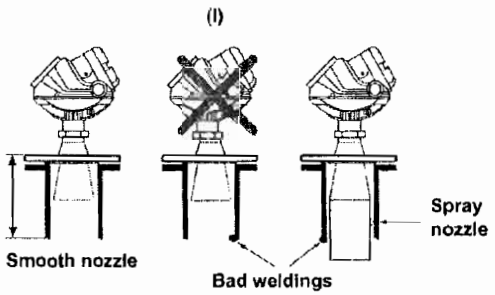


NOZZLE CONSIDERATIONS

Special considerations may have to be taken due to the nozzle, depending on the selection of transmitter model and antenna.

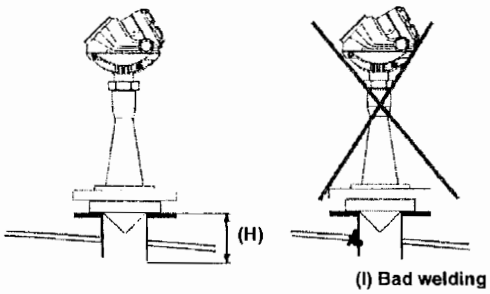
5402 with Cone Antenna

(F): The antenna can be recessed in smooth nozzles up to 6 ft (2 m). If the inside of the nozzle contains disturbing objects, use the extended cone (I).



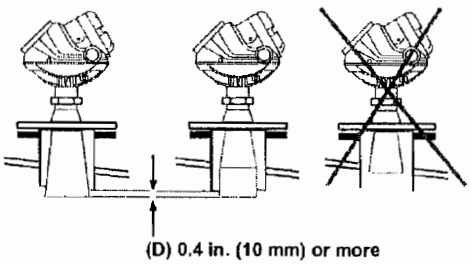
5402 with Process Seal Antenna

(H): The antenna can be used on nozzles up to 6 ft (2 m). Disturbing objects inside the nozzle may impair the measurement (I), and should therefor be avoided.
The flange on the tank should have a flat or raised face. Other tank flanges might also be possible, please consult your local Emerson representative for advice.



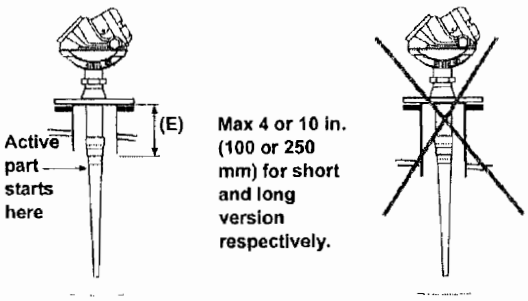
5401 with Cone Antenna

The antenna should extend 0.4 inches (10 mm) below the nozzle or more (D). If required, use the extended cone solution.



5401 with Rod Antenna

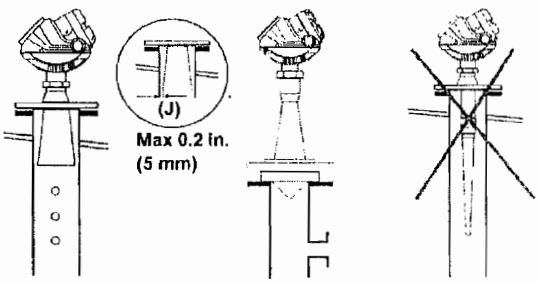
The active part of the rod antenna must stick beneath the nozzle (E).



Still-pipes and Bridles in Metallic Materials

Pipe measurement is advantageous in many applications if used correctly:

- Use cone or process seal antennas – not the rod antenna.
- The gap between the cone antenna and the still-pipe is limited to 0.2 in. (5 mm).
  If required, order an oversized antenna and cut on location (J).



Additional information is available in the Reference Manual (00809-0100-4026), or you can contact your local Emerson representative.

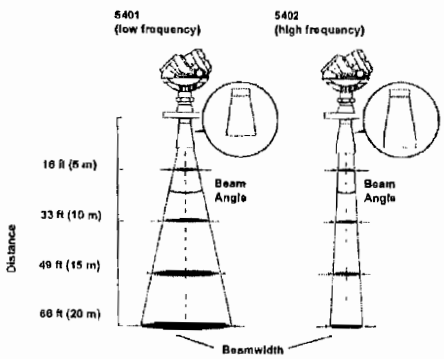
Valves

The 5400 Series transmitter can be isolated from the process by using a valve:

- Use a full-port ball valve.
- 5402 is required. The Process Seal Antenna is the preferred choice, since it does not require a spool piece, although the cone antenna can also be used.
- Ensure there is no edge between the ball valve and the nozzle / pipe. The inside should be smooth.

Valves can be combined with pipes.

Beam Angle and Beamwidth



Comparison between the beam angle and beamwidth for the Rosemount 5401 (~6 GHz) and 5402 (~26 GHz) transmitters with antennas of the same size and type.

Beam Angle for Rosemount 5400 Series

Antenna Size	Beam Angle 5402	Beam Angle 5401
2-in. Cone / Process Seal(1)	19°	–
3-in. Cone / Process Seal(1)	14°	(Pipe only)
4-in. Cone / Process Seal(1), Rod(2)	9°	37°
6-in. Cone	–	23°
8-in. Cone	–	17°

(1) Only with 5402.
(2) Only with 5401.

Beamwidth at different distances from flange for 5402

	Antenna		
	2-in. Cone / Process Seal	3-in. Cone / Process Seal	4-in. Cone / Process Seal
Distance	Beamwidth, ft (m)		
16 ft (5 m)	4.9 (1.5)	3.3 (1.0)	3.3 (1.0)
33 ft (10 m)	9.8 (3.0)	6.6 (2.0)	4.9 (1.5)
49 ft (15 m)	14.8 (4.5)	9.8 (3.0)	8.2 (2.5)
66 ft (20 m)	19.7 (6.0)	13.1 (4.0)	9.8 (3.0)

Beamwidth at different distances from flange for 5401

	Antenna		
	4-in. Cone / Rod	6-in. Cone	8-in. Cone
Distance	Beamwidth, ft (m)		
16 ft (5 m)	11.5 (3.5)	6.6 (2.0)	4.9 (1.5)
33 ft (10 m)	23.0 (7.0)	13.1 (4.0)	9.8 (3.0)
49 ft (15 m)	32.8 (10)	19.7 (6.0)	14.8 (4.5)
66 ft (20 m)	42.7 (13)	26.2 (8.0)	19.7 (6.0)

For more information, see the Reference Manual (document number 00809-0100-4026).

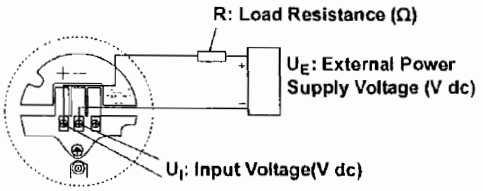
Specifications

General	
Product	Rosemount 5400 Series Radar Level Transmitter
Measurement Principle	Pulsed, free propagating radar 5402: ~26 GHz 5401: ~6 GHz
Microwave Output Power	< 1 mW
Beam Angle	See table on page 12
Re-calibration	Not required due to self-adjusting electronics.
Measuring Performance	
Maximum Measuring Range	115 ft (35 m) from flange
Instrument Accuracy at reference conditions(1)	5402: ± 0.1 in. (± 3 mm) 5401: ± 0.4 in. (± 10 mm)
Repeatability	± 0.04 in. (± 1 mm) at 16.4 ft (5 m) distance
Resolution	0.04 in. (1 mm)
Near Zone Distance	1.3 ft (0.4 m)
Near Zone Accuracy	5402: ± 0.6 in. (± 15 mm) 5401: ± 1.2 in. (± 30 mm)
Transition Zone(2)	6 in. (150 mm) from antenna aperture
Minimum Dielectric Constant	$\varepsilon_r = 1.4$
Temperature Drift	0.05 %/10 K in temperature range -40°F to 176°F (-40°C to 80°C)
Update Interval	1 second
Max Level Rate	1.6 in./s (40 mm/s) as default, adjustable to 7.1 in./s (180 mm/s)
Display / Configuration / Communication	
Integral Display	5-digit integral display. The process variables listed below can be presented. If more than one variable is chosen, carousel toggling of data is used. The display also shows diagnostics and error information.
Output Variables	Level, Distance, Volume, Level Rate, Signal Strength, Internal Temperature, Analog Output Current(3), and % of Range(3)
Output Units	Level and Distance: ft, inch, m, cm or mm Volume: ft^3, $inch^3$, US gals, Imp gals, barrels, yd^3, m^3, or liters Level Rate: ft/s, m/s Temperature: °F, °C
Configuration Tools	HART®: Rosemount RadarMaster, Rosemount 275/375 Handheld Communicator, AMS Suite or any other EDDL or enhanced-EDDL host FOUNDATION™ fieldbus: Rosemount RadarMaster, 375 Handheld Communicator, DeltaV® or any other DD (Device Description) compatible host system. Certificates of interoperability are available from all major host system vendors.
FOUNDATION™ fieldbus Blocks	Resource block, 3 Transducer blocks, 6 Analog Input (AI) blocks, Proportional /Integral/Derivate (PID) block, Input Selector (ISEL) block, Signal Characterizer (SGCR) block, Arithmetic (ARTH) block, and Output Splitter (OS) block
FOUNDATION™ fieldbus Class (Basic or Link Master)	Link Master (LAS)
FOUNDATION™ fieldbus Block Execution Time	AI-block: 30 ms. PID-block: 40 ms. ARTH-, ISEL-, OSPL-block: 65 ms. CHAR-block: 75 ms
Conforming FOUNDATION™ fieldbus	ITK 4.6
FOUNDATION™ fieldbus PlantWeb® Alert Support	Yes
Electric	
Terminal Supply Voltage	See "Power Supply" on page 16
Internal Power Consumption	< 50 mW in normal operation
Output	HART® 4-20 mA current loop or FOUNDATION™ fieldbus
Signal on Alarm (configurable), HART®	High=21.75 mA (standard setting) Low=3.75 mA (option, model code C8) Namur NE43: High=22.5 mA (option, model code C4)

Electric, continued	
Saturation Levels, HART®	Standard: Low=3.9 mA, High=20.8 mA Namur NE43: Low=3.8 mA, High=20.5 mA
IS Parameters	See "Product Certifications" on page 19
Cable Entry	Two integrated ½-in. NPT threads. Adapters are available, see "Ordering Information". One metal plug to seal any unused ports is enclosed with the transmitter delivery.
Output Cabling	24-12 AWG, twisted shielded pairs
Quiescent Current Draw (FOUNDATION™ fieldbus)	21 mA
Mechanical	
Antennas	See pages 8, 21, 28 and 28
Material Exposed to Tank Atmosphere	**Cone Antenna** • 316 / 316 L SST (EN 1.4404) or Monel® 400 (UNS NO4400) or Hastelloy® C-276 (UNS N10276). Monel® and Hastelloy® antennas have a plate design. • PTFE fluoropolymer • O-ring material. **Rod Antenna, Two versions** • All-PFA(4) fluoropolymer • PFA(4) fluoropolymer, 316 / 316 L SST (EN 1.4404) and O-ring material. **Process Seal Antenna** • PTFE fluoropolymer • O-ring material For more information, see pages 10, 29 and 32.
Housing / Enclosure	Polyurethane-covered Aluminum
Dimensions and Weights	See "Dimensional Drawings and Mechanical Properties" on page 21
Environment	
Ambient Temperature(5)	-40°F to 176°F (-40°C to 80°C). LCD readable in: -4°F to 158°F (-20°C to 70°C).
Storage Temperature	-58°F to 194°F (-50°C to 90°C). LCD: -40°F to 185°F (-40°C to 85°C)
Flange Temperature	See "Temperature and Pressure Ratings" on page 18
Process Pressure	See "Temperature and Pressure Ratings" on page 18
Humidity	0 - 100% Relative Humidity, non condensating
Factory Sealed	Yes
Ingress Protection	Type 4X, IP66, IP67
EU Directive compliance	CE mark, 93/68/EEC
Radio Approvals(6)(7)	FCC part 15C (1998)(8), R&TTE (EU directive 1999/5/EC), and IC (RSS210-5)
Electromagnetic Compatibility(9)	Emission and Immunity: EMC directive 89/336/EEC. EN61326-1:1997 incl. A1:1998 and A2:2001. NAMUR recommendations NE21.
Transient / Built-in Lightning Protection(9)	EN61326, IEC 801-5, level 1 kV. T1 option: Additionally, the transmitter complies with IEEE 587 Category B transient protection and IEEE 472 surge protection. The protection includes gas-filled discharge tubes and semiconductor components.
Pressure Equipment Directive (PED)	97/23/EC
Vibration Resistance(9)	IEC 60770-1 level 1

(1) Ideal metal plate with no disturbing objects.
Temperature: + 68 °F (20 °C).
Pressure: 14-15 psi (960-1060 mbar).
Humidity: 25-75 % RH.
(2) Transition Zones are areas where measurements are not recommended.
(3) Not applicable for FOUNDATION™ fieldbus.
(4) PFA is a fluoropolymer with properties similar to PTFE.
(5) Temperature may be limited by the selected product certificate, see "Product Certifications" on page 19.
(6) Only a limited selection is presented. Contact your local Emerson representative for more information.
(7) For Japan: "Install device on tanks or pipes made of metal"
(8) For 5402: "This device is authorized for use in tank-mounted applications, including metal tanks as well as concrete, plastic, glass and other non-conductive tanks." No specific restrictions are stated for the 5401.
(9) The device may also comply with other standards. Consult your local Emerson representative.

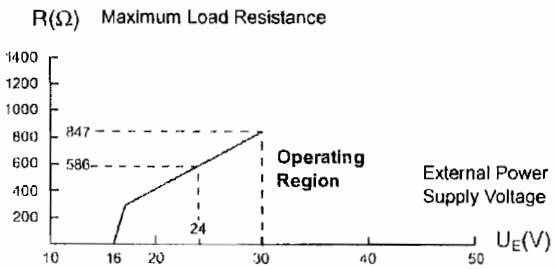
POWER SUPPLY



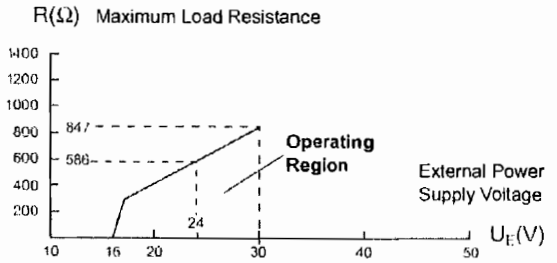
4-20 mA with HART® communication

The input voltage U_I for HART® is 16-42.4 V dc (16-30 V dc in IS applications, and 20-42.4 V dc in Explosionproof / Flameproof applications). Maximum load resistance and power supply limitations for typical operating conditions are given in the diagrams and table below.

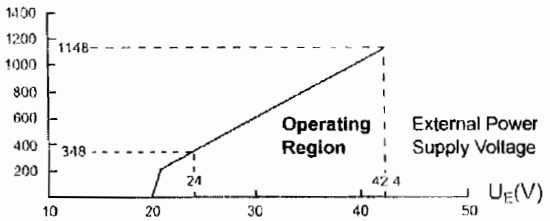
Non-Hazardous Installations



Intrinsically Safe Installations



Explosionproof / Flameproof Installations



NOTE
The diagram is only valid if the HART® load resistance is at the + side and if the - side is grounded, otherwise the load resistance value is limited to 435 Ohm.

Minimum input voltage (U_I) at different currents

Hazardous approval	Current	
	3.75 mA	21.75 mA
	Minimum input voltage (U_I)	
Non-Hazardous Installations and Intrinsically Safe Installations	16 V dc	11 V dc
Explosionproof / Flameproof Installations	20 V dc	15.5 V dc

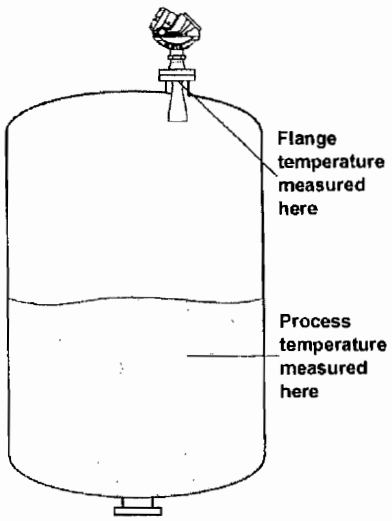
FOUNDATION™ fieldbus

The input voltage U_I for FOUNDATION™ fieldbus is 9-32 V dc (9-30 V dc in IS applications, 9-17.5 V dc in FISCO applications , and 16-32 V dc in Explosionproof / Flameproof applications). The quiescent current draw is 21 mA.

TEMPERATURE AND PRESSURE RATINGS

Flange Temperature

The temperature at the flange is limited by the antenna in combination with the tank seal, and O-rings (if applicable). The continuous flange temperature range is presented for each antenna in section "Dimensional Drawings and Mechanical Properties" on page 21.



Temperature rating considerations.

NOTE
Flange temperature depends on process and ambient temperature, and mounting conditions such as nozzle position, distance to max product level, nozzle height, presence of insulation, etc.

Operating Pressure

The pressure in the tank is limited by a combination of the antenna and the process connection.

The following 5400 Series flanges have the same p/T rating as the corresponding blind flanges:

ANSI: according to ANSI B16.5 Table 2-2.3.

EN: according to EN 1092-1 Table 18, material group 13E0.

The continuous operating pressure range is presented for each antenna in section "Dimensional Drawings and Mechanical Properties" on page 21.

Electronics Temperature

There are restrictions on the ambient temperature (see "Specifications" on page 16). The ambient temperature may also be limited by the selected product certificate (see "Product Certifications" on page 19).

Product Certifications

SAFETY NOTE AND SPECIAL CONDITIONS FOR SAFE USE (X-MARKING IN ATEX, IECEX, AND NEPSI CERTIFICATES)

The intrinsically safe circuits do not withstand the 500 V ac test as specified in EN 50020 clause 6.4.12.

Parts of the rod antenna and the process seal antenna are non-conducting and the area of the non-conducting part exceeds the maximum permissible areas for Group IIC according to EN 50014, clause 7.3 (20 cm^2) and Category II 1G according to EN 50284, clause 4.4.3 (4 cm^2) (20 cm^2 for zone 1 and 4 cm^2 for zone 0 according to IEC 60079-0, clause 7.3). Therefore, when the antenna is used in a potentionally explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

Impact and friction hazards need to be considered according to EN 50284, clause 4.3.1 (IEC 60079-0, clause 8.1.2) when the transmitter and part of antennas exposed to the exterior atmosphere of the tank is made of light metal alloys, and used in Category II 1 G (zone 0).

ATEX Approvals CE

Nemko 04ATEX1073X

E1[1] Flameproof:
II 1/2 GD T73°C[2].
EEx iad IIC T4 (-40°C<T_a<+70°C[3]).
U_m=250 V

I1[1] Intrinsically Safe:
II 1 GD T73°C[2].
EEx ia IIC T4 (-50°C<T_a<+70°C[3]).
4-20 mA / HART® model: U_i=30 V dc, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0 H.
FOUNDATION™ fieldbus model: U_i=30 V dc, I_i=300 mA, P_i=1.5 W, C_i=0 nF, L_i=0 H.
FISCO model: U_i=17.5 V dc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
Installation Drawing: 9150079-907

(1) Ordering Information code for Product Certificates, see page 31.
(2) +63°C with FOUNDATION™ fieldbus or FISCO option.
(3) +60°C with FOUNDATION™ fieldbus or FISCO option.

National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) Approvals

GYJ06242X, GYJ06458X

E3[1] Flameproof:
Ex iad IIC T4 (-40°C<T_a<+70°C[3]).
U_m=250 V

I3[1] Intrinsically Safe:
Ex ia IIC T4 (-40°C<T_a<+70°C[3]).
4-20 mA / HART® model: U_i=30 V dc, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0 H.
FOUNDATION™ fieldbus model: U_i=30 V dc, I_i=300 mA, P_i=1.5 W, C_i=0 nF, L_i=0 H.
FISCO model: U_i=17.5 V dc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
Installation Drawing: 9150079-907.

Technology Institution of Industrial Safety (TIIS) Approval

E4[1] Flameproof:
Transmitter: Ex d [ia] IIC T4
Antenna: Ex ia IIC T4
Installation Drawing: 05400-00375A.

Factory Mutual (FM) Approvals

Project ID: 3020497

E5[1] Explosion Proof for Class I, Div. 1, Groups B, C and D;
Dust Ignition Proof for Class II/III, Div. 1, Groups E, F and G;
With Intrinsically Safe connections to Class I, II, III, Div. 1, Groups B, C, D, E, F and G.
Temp. Code T4
Ambient temperature limits: -40°C to +70°C[3].
Seal not required.

I5[1] Intrinsically Safe for Class I, II, III, Div. 1, Groups A, B, C, D, E, F and G,
Class I, Zone 0, AEx ia IIC T4 when installed per Control Drawing: 9150079-905.
Non-Incendive Class I, Div. 2, Groups A, B, C and D;
Suitable for Class II, III, Div. 2, Groups F and G.
4-20 mA / HART® model: U_i=30 V dc, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0 H.
FOUNDATION™ fieldbus model: U_i=30 V dc, I_i=300 mA, P_i=1.3 W, C_i=0 nF, L_i=0 H.
FISCO model: U_i=17.5 V dc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
Max operation:
4-20 mA / HART® model: 42.4 V, 25 mA,
FOUNDATION™ fieldbus model: 32 V, 25 mA.
Temp. Code T4
Ambient temperature limits: -40°C to +70°C[3].

Canadian Standards Association (CSA) Approvals

Project ID: 1514653

E6[1] Explosionproof with internal Intrinsically Safe Circuits [Exia]
Class I, Div. 1, Groups B, C and D;
Temp Code T4.
Class II, Div. 1 and 2, Groups E, F and G;
Class III, Div. 1
Ambient temperature limits -40°C to +70°[2]
Factory sealed.

I6[1] Intrinsically Safe Exia:
Class I, Div. 1, Groups A, B, C and D.
Temp Code T4.
4-20 mA / HART® model: U_i=30 V dc, I_i=130 mA, P_i=1.0 W, C_i=7.3 nF, L_i=0 H.
FOUNDATION™ fieldbus model: U_i=30 V dc, I_i=300 mA, P_i=1.3 W, C_i=0 nF, L_i=0 H.
FISCO model: U_i=17.5 V dc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
Installation Drawing: 9150079-906
Ambient temperature limits -40°C to +70°[2].

IECEx Approval

IECEx NEM 06.0001x

E7[1] Flameproof:
Ex iad IIC T4 (-40°C<T_a<+70°C[2]).
U_m=250 V

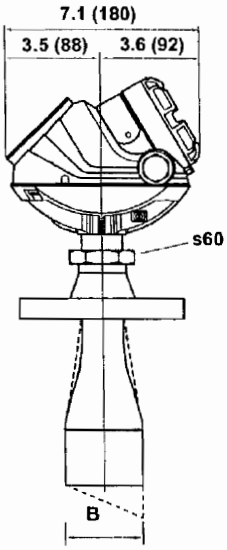
I7[1] Intrinsically Safe:
Ex ia IIC T4 (-50°C<T_a<+70°C[2]).
4-20 mA / HART® model: U_i=30 V dc, I_i=130 mA, P_i=1.0 W, C_i=7.26 nF, L_i=0 H.
FOUNDATION™ fieldbus model: U_i=30 V dc, I_i=300 mA, P_i=1.5 W, C_i=0 nF, L_i=0 H.
FISCO model: U_i=17.5 V dc, I_i=380 mA, P_i=5.32 W, L_i=C_i=0.
Installation Drawing: 9150079-907.

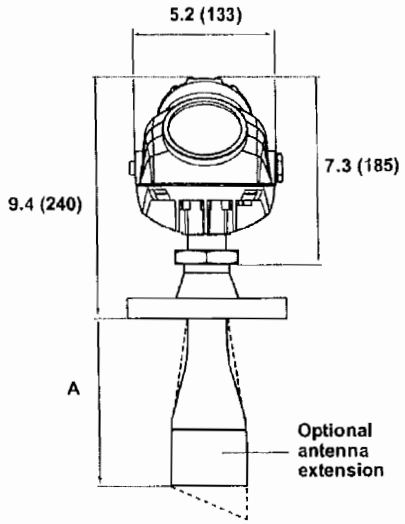
For more information on product certificates, refer to the Reference Manual (document number 00809-0100-4026).

(1) Ordering Information code for Product Certificates, see page 31.
(2) +60°C with FOUNDATION™ fieldbus or FISCO option.

Dimensional Drawings and Mechanical Properties

ROSEMOUNT 5402 AND 5401 WITH SST CONE ANTENNA (MODEL CODE 2S-8S)





All dimensions are in inches (mm).

Process Connection Availability
- **● Available as standard**
- **○ Available as special, consult factory**
- **– Not available**

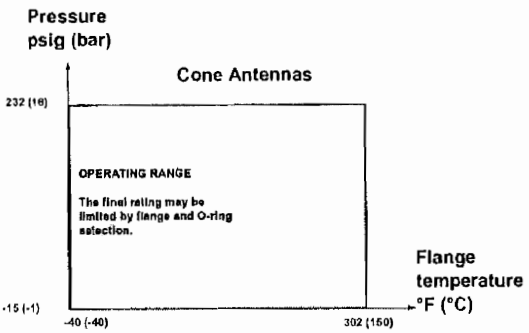
Process Connection	Antenna Code 2S	3S, 4S, 6S, 8S
2 in. / DN 50 / 50A	●	○
3 in. / DN 80 / 80A	●	●
4 in. / DN 100 / 100A	●	●
6 in. / DN 150 / 150A	●	●
8 in. / DN 200 / 200A	●	●
Threaded Connection	–	–
Bracket Mounting	●	●

5402 Standard SST Cone

Cone size (inches)	A	B	Antenna Code
2	6.5 (165)	2.0 (50)	2S
3	5.9 (150)	2.6 (67)	3S
4	8.8 (225)	3.6 (92)	4S

5401 Standard SST Cone

Cone size (inches)	A	B	Antenna Code
3	3.3 (84)	2.6 (67)	3S
4	5.9 (150)	3.6 (92)	4S
6	7.3 (185)	5.5 (140)	6S
8	10.6 (270)	7.4 (188)	8S



Process temperature and pressure diagram.

5402 and 5401 Extended SST Cone[1]

Max. nozzle height	A	Option Code
20 (500)	20.4 (518)	S3

(1) The extended cone antennas are available in 5-inch step increments from 10 to 50 inches. Consult your local Emerson Process Management representative for more information. Expect long lead times for other sizes than the 20 in. (500 mm) version.

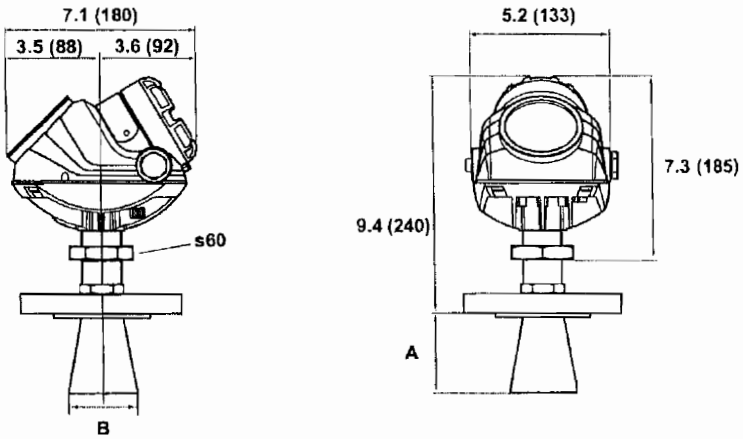
Temperature restrictions due to O-ring selection.

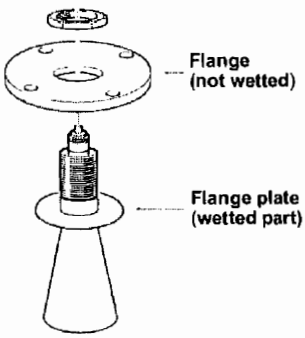
Tank seal with different O-ring materials	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton®	-4 (-20)	302 (150)
Ethylene Propylene (EPDM)	-40 (-40)	302 (150)
Kalrez® 6375	5 (-15)	302 (150)
Buna-N	-40 (-40)	230 (110)

Drawing: 9240030-970 (www.rosemount.com)

ROSEMOUNT 5402 AND 5401 WITH WETTED FLANGE PLATE CONE ANTENNA (MODEL CODE: 2H-8H, 2M-8M AND 2N-8N)

All dimensions are in inches (mm).



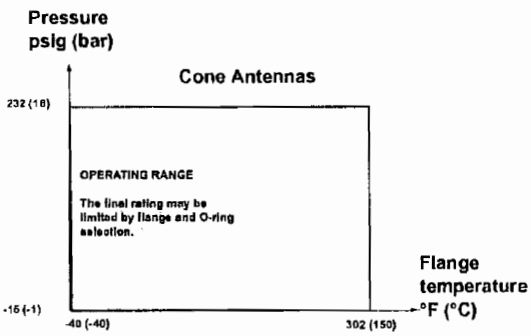


5402 Cone Antenna With Wetted Flange Plate

Cone size (inches)	A	B	Antenna Code
2	5.9 (150)	2.0 (50)	2H, 2M, 2N
3	6.9 (175)	2.6 (67)	3H, 3M, 3N
4	9.8 (250)	3.6 (92)	4H, 4M, 4N

5401 Cone Antenna With Wetted Flange Plate

Cone size (inches)	A	B	Antenna Code
3	3.3 (84)	2.6 (67)	3H, 3M, 3N
4	5.9 (150)	3.6 (92)	4H, 4M, 4N
6	7.3 (185)	5.5 (140)	6H, 6M, 6N
8	10.6 (270)	7.4 (188)	8H, 8M, 8N



Process temperature and pressure diagram.

Process Connection Availability
- **● Available as standard**
- **ↄ Available as special, consult factory**
- **– Not available**

Process Connection	Antenna Code				
	2H, 2M, 2N	3H, 3M, 3N	4H, 4M, 4N	6H, 6M, 6N	8H, 8M, 8N
2 in. / DN 50 / 50A	●	ↄ	ↄ	ↄ	ↄ
3 in. / DN 80 / 80A	ↄ	●	ↄ	ↄ	ↄ
4 in. / DN 100 / 100A	ↄ	ↄ	●	ↄ	ↄ
6 in. / DN 150 / 150A	ↄ	ↄ	ↄ	●	ↄ
8 in. / DN 200 / 200A	ↄ	ↄ	ↄ	ↄ	●
Threaded Connection	-	-	-	-	-
Bracket Mounting	-	-	-	-	-

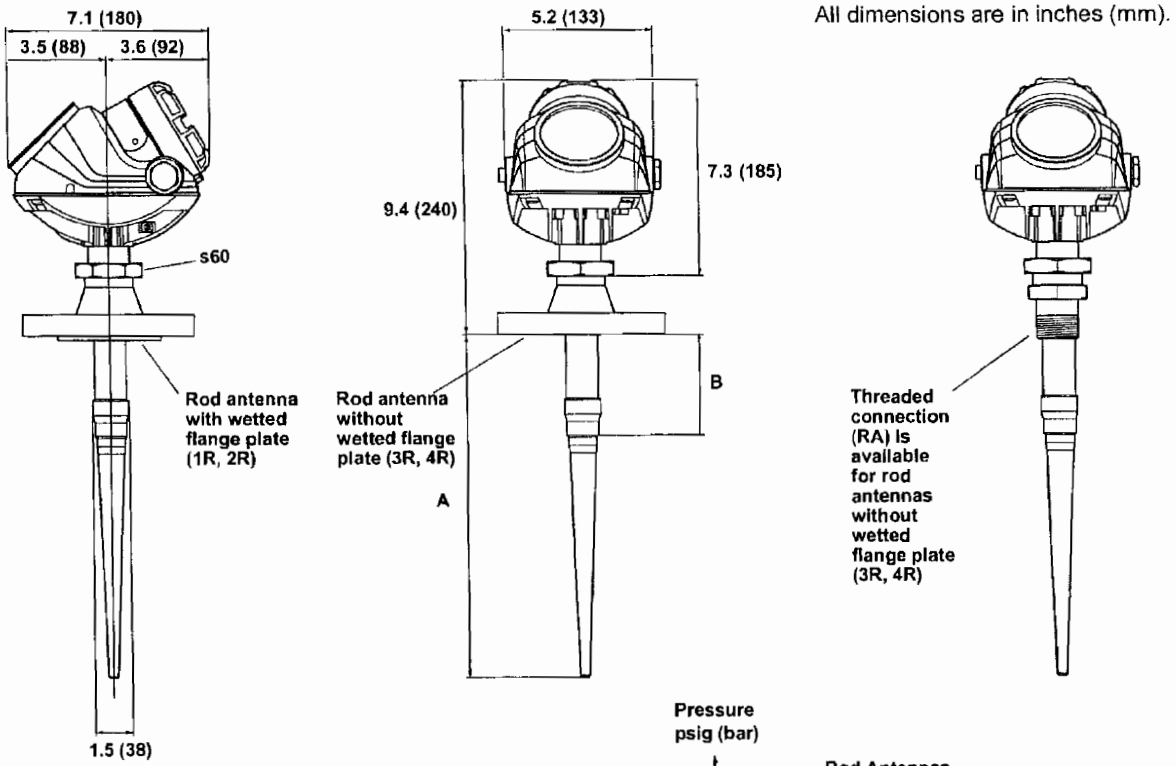
Temperature restrictions due to O-ring selection.

Tank seal with different O-ring materials	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton®	-4 (-20)	302 (150)
Ethylene Propylene (EPDM)	-40 (-40)	302 (150)
Kalrez® 6375	5 (-15)	302 (150)
Buna-N	-40 (-40)	230 (110)

Drawing: 9240030-973 (www.rosemount.com)

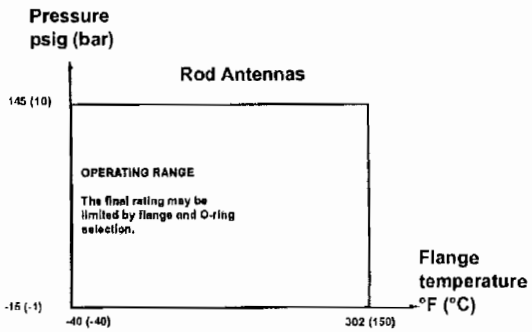
ROSEMOUNT 5401 WITH ROD ANTENNA (MODEL CODE 1R-4R)

All dimensions are in inches (mm).



Rod	A	B(1)	Antenna Code
Short	14.4 (365)	4 (100)	1R, 3R
Long	20.3 (515)	10 (250)	2R, 4R

(1) The active part of the antenna must protrude into the tank. B is the maximum nozzle height.



Process temperature and pressure diagram.

Process Connection Availability
- **Available as standard**
- **Available as special, consult factory**
- **Not available**

Process Connection	Antenna Code 1R, 2R	Antenna Code 3R, 4R
2 in. / DN 50 / 50A	●	●
3 in. / DN 80 / 80A	●	●
4 in. / DN 100 / 100A	●	●
6 in. / DN 150 / 150A	○	●
8 in. / DN 200 / 200A	○	●
Threaded Connection	-	●
Bracket Mounting	-	●

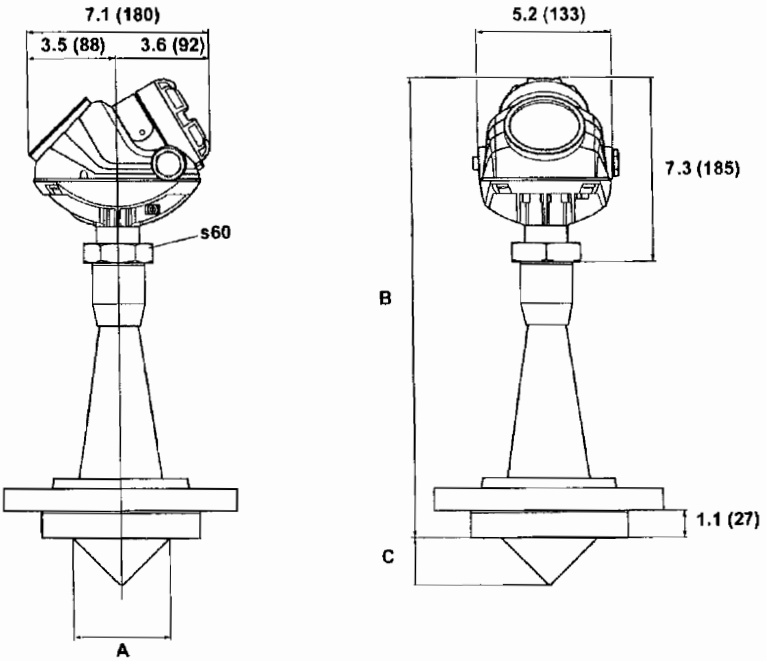
Drawing: 9240030-977 (www.rosemount.com)

Temperature restrictions due to O-ring selection (not applicable for 1R and 2R where no process O-ring is present).

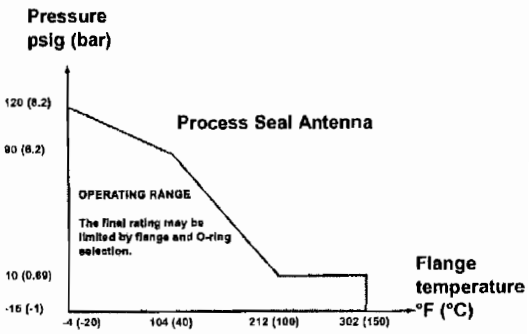
Tank seal with different O-ring materials	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton®	-4 (-20)	302 (150)
Ethylene Propylene (EPDM)	-40 (-40)	302 (150)
Kalrez® 6375	5 (-15)	302 (150)
Buna-N	-40 (-40)	230 (110)

ROSEMOUNT 5402 WITH PROCESS SEAL ANTENNA (MODEL CODE 2P-4P)

All dimensions are in inches (mm).



Process Seal size (inches)	A	B	C	Antenna Code
2	1.8 (46)	14.2 (360)	0.9 (22)	2P
3	2.8 (72)	17.3 (440)	1.4 (35)	3P
4	3.8 (97)	18.9 (480)	1.9 (48)	4P



Process temperature and pressure diagram.

Process Connection Availability
- **● Available as standard**
- **○ Available as special, consult factory**
- **– Not available**

Process Connection	Antenna Code 2P	3P	4P
2 in. / DN 50 / 50A	●	-	-
3 in. / DN 80 / 80A	-	●	-
4 in. / DN 100 / 100A	-	-	●
6 in. / DN 150 / 150A	-	-	-
8 in. / DN 200 / 200A	-	-	-
Threaded Connection	-	-	-
Bracket Mounting	-	-	-

Temperature restrictions due to O-ring selection.

Tank seal with different O-ring materials	Min. Temperature °F (°C) in air	Max. Temperature °F (°C) in air
Viton®	-4 (-20)	302 (150)
Ethylene Propylene (EPDM)	-4 (-20)	275 (135)
Kalrez® 6375	23 (-5)	302 (150)
Buna-N	-4 (-20)	257 (125)

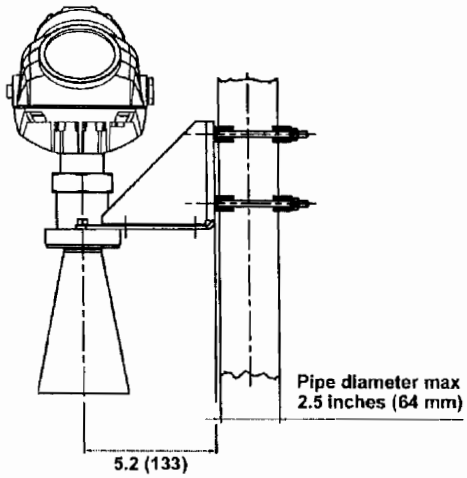
Drawing: 9240030-976 (www.rosemount.com)

PROCESS CONNECTIONS

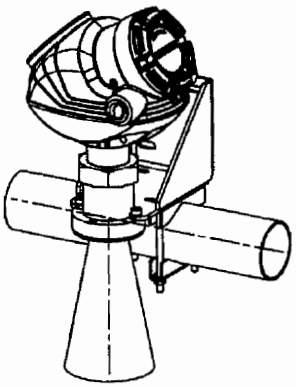
Bracket Mounting (model code BR)

Bracket mounting is available for Rosemount 5401 and 5402 with SST Cone Antenna (2S-8S) and Rosemount 5401 with Rod Antenna (3R-4R)

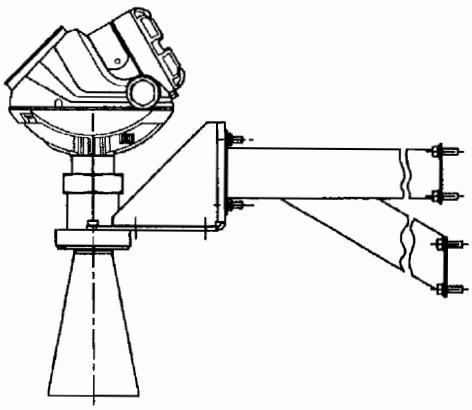
All dimensions are in inches (mm).



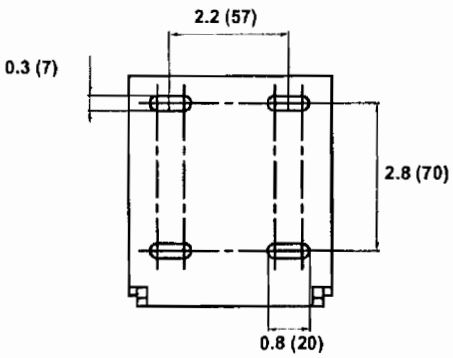
Pipe mounting
(vertical pipe)



Pipe mounting
(horizontal pipe)



Wall mounting

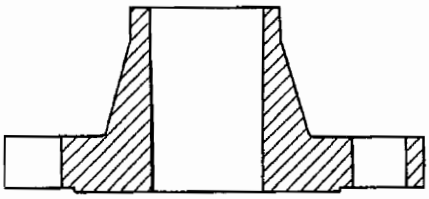


Hole pattern
wall mounting

Drawing: 9240030-989 (www.rosemount.com)

Standard Flanges

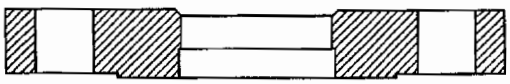
Cone and Rod Antennas (model code: 2S-8S and 1R-4R)



Designation	Mating Standard	Face Style(1)	Face Surface Finish	Material
ANSI	ASME B16.5	0.06 in. Raised Face	R_a = 125-250 µin.	316 / 316L
EN (DIN)	EN 1092-1	2 mm Raised Face (Type B1)	R_a = 3.2-12.5 µm.	EN 1.4404
JIS	JIS B2220	2 mm Raised Face	R_a = 3.2-6.3 µm	EN 1.4404

(1) Face gasket surface is serrated per mating standard.

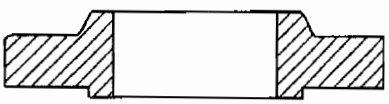
Cone Antennas with Wetted Flange Plate (model code: 2H-8H, 2M-8M, and 2N-8N)



Designation	Mating Standard	Face Style(1)	Face Surface Finish	Material
ANSI	ASME B16.5	0.06 in. Raised Face	R_a = 125-250 µin.	316 / 316L
EN (DIN)	EN 1092-1	Flat Face (Type A)	R_a = 3.2-12.5 µm.	EN 1.4404
JIS	JIS B2220	2 mm Raised Face	R_a = 3.2-6.3 µm	EN 1.4404

(1) Face gasket surface is serrated per mating standard.

Process Seal Antennas



Designation	Standard	Style	Material
ANSI	ASME B16.5	Slip-on	316 / 316L
EN (DIN)	EN 1092-1	Slip-on (Type 01)	EN 1.4404
JIS	JIS B2220	Slip-on plate (SOP)	EN 1.4404

APPROXIMATE WEIGHTS

Transmitter	Weight lbs (kg)
Aluminium housing	4.4 lbs (2.0 kg)
Antenna (Model Code)	**Add max lbs (kg)**
Cone Antenna (2S-8S, 2H-8H, 2M-8M, 2N-8N)	2.2 lbs (1.0 kg)
Process Seal Antenna (2P-4P)	4.4 lbs (2.0 kg)
Rod Antenna (1R-4R)	2.2 lbs (1.0 kg)
Process Connection (Model Code)(1)	**Add max lbs (kg)**
ANSI Flange, 2 in. 150 lbs SST (AA)	6.6 lbs (3.0 kg)
EN (DIN) Flange, DN50 PN40 SST (HB)	8.8 lbs (4.0 kg)
JIS Flange 50A 10K SST (UA)	6.6 lbs (3.0 kg)
Bracket Mounting (BR)	4.4 lbs (2.0 kg)
Thread Adapter (RA)	1.1 lbs (0.5 kg)

(1) Approximate weights for other 5400 Series process connection sizes than those in this table can be estimated:
First of all, find out the weight of the SST blind flange (slip-on for process seal antennas) that corresponds to the type and size shown in this table.
Find out the weight for the SST blind flange that corresponds to the specific 5400 Series flange size which is not represented in this table.
The 5400 Series flange weight can be estimated by adding the relative weight difference of these SST blind flanges.

Ordering Information

Model Code for Rosemount 5402 Radar Level Transmitter

Model	Product Description
5402	High frequency version (~26 GHz)
Code	**Housing Material**
A	Polyurethane-covered Aluminum
Code	**Signal Output**
H	4-20 mA with HART® communication
F	FOUNDATION™ fieldbus
Code	**Conduit / Cable Threads**
1	1/2 inch - 14 NPT
2	M20 x 1.5 adapter
E	M12, 4-pin, Male Connector (eurofast®)(1)
M	A size Mini, 4-pin, Male Connector (minifast®)(1)
Code	**Product Certifications**
NA	No Product Certificates
E1	ATEX Flameproof(1)
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(2)
E3	NEPSI Flameproof(1)
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety
E4	TIIS Flameproof(3)
E5	FM Explosionproof(1)
I5	FM Intrinsic Safety and Non-incendive
IE	FM FISCO Intrinsic Safety(2)
E6	CSA Explosionproof(1)
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety(2)
E7	IECEx Flameproof(1)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(2)

Code	Antenna - Size and Material (for process connection availability, refer to "Dimensional Drawings and Mechanical Properties" on page 21
	Cone Antennas
2S	2 in. DN 50, 316L SST (EN 1.4404)
3S	3 in. DN 80, 316L SST (EN 1.4404)
4S	4 in. DN 100, 316L SST (EN 1.4404)
2H	2 in. DN 50, Hastelloy® C-276 (UNS N10276) with wetted flange plate
3H	3 in. DN 80, Hastelloy® C-276 (UNS N10276) with wetted flange plate
4H	4 in. DN 100, Hastelloy® C-276 (UNS N10276) with wetted flange plate
2M	2 in. DN 50, Monel® 400 (UNS N04400) with wetted flange plate
3M	3 in. DN 80, Monel® 400 (UNS N04400) with wetted flange plate
4M	4 in. DN 100, Monel® 400 (UNS N04400) with wetted flange plate
2N	2 in. DN 50, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
3N	3 in. DN 80, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
4N	4 in. DN 100, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
	Process Seal Antennas
2P	2 in. DN 50, PTFE
3P	3 in. DN 80, PTFE
4P	4 in. DN 100, PTFE
	Other Antennas
XX	Customer specific
Code	**Tank Sealing**
PV	PTFE with Viton® fluoroelastomer o-rings
PK	PTFE with Kalrez® 6375 perfluoroelastomer o-rings
PE	PTFE with EPDM o-rings
PB	PTFE with Buna-N o-rings
Code	**Process Connection and Material (for antenna availability, refer to "Dimensional Drawings and Mechanical Properties" on page 21**
	ANSI Flanges (316 / 316L SST)
AA	2 inch, 150 lbs
AB	2 inch, 300 lbs
BA	3 inch, 150 lbs
BB	3 inch, 300 lbs
CA	4 inch, 150 lbs
CB	4 inch, 300 lbs
DA	6 inch, 150 lbs
EA	8 inch, 150 lbs
	EN (DIN) Flanges (EN 1.4404 SST)
HB	DN 50 PN 40
IB	DN 80 PN 40
JA	DN 100 PN 16
JB	DN 100 PN 40
KA	DN 150 PN 16
LA	DN 200 PN 16
	JIS Flanges (EN 1.4404 SST)
UA	50A 10K
VA	80A 10K
XA	100A 10K
YA	150A 10K
ZA	200A 10K
	Other Flanges
BR	Bracket Mounting, 316L / EN 1.4404 SST(4)
XX	Customer specific

Code	Options
M1	Integral digital display
GC	Transparent meter glass protection cover made of PTFE / FEP
T1	Transient Protection Terminal Block (standard with FISCO options)
	Software Configuration
C1	Factory configuration (CDS required with order)
	Alarm Limit Configuration
C4	NAMUR alarm and saturation levels, high alarm
C8	Low alarm(5) (standard Rosemount alarm and saturation levels)
	Special Certificates
N2	Certificate of compliance with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103(6)
Q4	Calibration Data Certificate
Q8	Material Traceability Certification per EN 10204 3.1(7)
	Special Procedures
P1	Hydrostatic testing(4)
	Antenna Modification
S3 (pending)	Cone antenna extension in 316 / 316L / EN 1.4404 SST. To be used if there are irregularities in the nozzle. Fits nozzles up to 20 in. (500 mm)(8).
Typical Model Number: 5402 A H 1 E5 4S PV CA - M1 C1	

(1) Options E (eurofast®) and M (minifast®) are not available with Explosionproof or Flameproof approvals.
(2) Requires Foundation™ fieldbus signal output (U_i parameter listed in "Product Certifications" on page 19).
(3) G ½ in. SST cable gland is included in delivery.
(4) Bracket mounting (BR) is not available with hydrostatic testing (P1).
(5) The standard alarm setting is high.
(6) Requires wetted flange plate cone antennas (2H-4H, 2M-4M, 2N-4N) or process seal antennas (2P-4P).
(7) Certificate includes all pressure retaining wetted parts.
(8) Requires a SST cone antenna (2S-4S).

Model Code for Rosemount 5401 Radar Level Transmitter

Model	Product Description
5401	Low frequency version (~6 GHz)
Code	**Housing Material**
A	Polyurethane-covered Aluminum
Code	**Signal Output**
H	4-20 mA with HART® communication
F	FOUNDATION™ fieldbus
Code	**Conduit / Cable Threads**
1	1/2 inch - 14 NPT
2	M20 x 1.5 adapter
E	M12, 4-pin, Male Connector (eurofast®)(1)
M	A size Mini, 4-pin, Male Connector (minifast®)(1)
Code	**Product Certifications**
NA	No Product Certificates
E1	ATEX Flameproof(1)
I1	ATEX Intrinsic Safety
IA	ATEX FISCO Intrinsic Safety(2)
E3	NEPSI Flameproof(1)
I3	NEPSI Intrinsic Safety
IC	NEPSI FISCO Intrinsic Safety
E4	TIIS Flameproof(3)
E5	FM Explosionproof(1)
I5	FM Intrinsic Safety and Non-incendive
IE	FM FISCO Intrinsic Safety(2)
E6	CSA Explosionproof(1)
I6	CSA Intrinsic Safety
IF	CSA FISCO Intrinsic Safety(2)
E7	IECEx Flameproof(1)
I7	IECEx Intrinsic Safety
IG	IECEx FISCO Intrinsic Safety(2)

Code	Antenna - Size and Material (for process connection availability, refer to "Dimensional Drawings and Mechanical Properties" on page 21
	Cone Antennas
3S	3 in. DN 80, 316L SST (EN 1.4404), pipe installations only
4S	4 in. DN 100, 316L SST (EN 1.4404)
6S	6 in. DN 150, 316L SST (EN 1.4404)
8S	8 in. DN 200, 316L SST (EN 1.4404)
3H	3 in. DN 80, Hastelloy® C-276 (UNS N10276) with wetted flange plate, pipe installations only
4H	4 in. DN 100, Hastelloy® C-276 (UNS N10276) with wetted flange plate
6H	6 in. DN 150, Hastelloy® C-276 (UNS N10276) with wetted flange plate
8H	8 in. DN 200, Hastelloy® C-276 (UNS N10276) with wetted flange plate
3M	3 in. DN 80, Monel® 400 (UNS N04400) with wetted flange plate, pipe installations only
4M	4 in. DN 100, Monel® 400 (UNS N04400) with wetted flange plate
6M	6 in. DN 150, Monel® 400 (UNS N04400) with wetted flange plate
8M	8 in. DN 200, Monel® 400 (UNS N04400) with wetted flange plate
3N	3 in. DN 80, 316L SST (EN 1.4404), with wetted flange plate, pipe installations only. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
4N	4 in. DN 100, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
6N	6 in. DN 150, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
8N	8 in. DN 200, 316L SST (EN 1.4404), with wetted flange plate. Complies with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103.
	Rod Antennas
1R	Short version, all-PFA(4)(5), with wetted flange plate, max. nozzle height 4 in. (100 mm), free propagation only
2R	Long version, all-PFA(4)(5), with wetted flange plate, max. nozzle height 10 in. (250 mm), free propagation only
3R	Short version, SST+PFA(4), max. nozzle height 4 in. (100 mm), free propagation only
4R	Long version, SST+PFA(4), max. nozzle height 10 in. (250 mm), free propagation only
	Other Antennas
XX	Customer specific
Code	**Tank Sealing**
PV	PTFE with Viton® fluoroelastomer o-rings
PK	PTFE with Kalrez® 6375 perfluoroelastomer o-rings
PE	PTFE with EPDM o-rings
PB	PTFE with Buna-N o-rings
PD	All-PFA(4) rod antennas (O-rings are not wetted)
Code	**Process Connection and Material (for antenna availability, refer to "Dimensional Drawings and Mechanical Properties" on page 21**
	ANSI Flanges (316 / 316L SST)
AA	2 in. 150 lbs
AB	2 in. 300 lbs
BA	3 in. 150lbs
BB	3 in. 300 lbs
CA	4 in. 150 lbs
CB	4 in. 300 lbs
DA	6 in. 150 lbs
EA	8 in. 150 lbs
	EN (DIN) Flanges (EN 1.4404 SST)
HB	DN 50 PN 40
IB	DN 80 PN 40
JA	DN 100 PN 16
JB	DN 100 PN 40
KA	DN 150 PN 16
LA	DN 200 PN 16

Code	Process Connection and Material (continued)
	JIS Flanges (EN 1.4404 SST)
UA	50A 10K
VA	80A 10K
XA	100A 10K
YA	150A 10K
ZA	200A 10K
	Threaded (316L / EN 1.4404 SST)
RA	1.5-in. NPT(6)
	Other
BR	Bracket Mounting, 316L / EN 1.4404 SST(5)
XX	Customer specific
Code	**Options**
M1	Integral digital display
GC	Transparent meter glass protection cover made of PTFE / FEP
T1	Transient Protection Terminal Block (standard with FISCO options)
	Software Configuration
C1	Factory configuration (CDS required with order)
	Alarm Limit Configuration
C4	NAMUR alarm and saturation levels, high alarm
C8	Low alarm(7) (standard Rosemount alarm and saturation levels)
	Special Certificates
N2	Certificate of compliance with guidelines in NACE® MR0175/ISO 15156 and NACE® MR0103(8)
Q4	Calibration Data Certificate
Q8	Material Traceability Certification per EN 10204 3.1(9)
	Special Procedures
P1	Hydrostatic testing(6)
	Antenna Modification
S3	Extended Cone Antenna in 316 / 316L / EN 1.4404 SST. Maximum recommended nozzle height is 20 in. (500 mm).(10)
Typical Model Number: 5401 A H 1 NA 4S PV CA - M1 C1	

(1) Options E (eurofast®) and M (minifast®) are not available with Explosionproof or Flameproof approvals.
(2) Requires Foundation™ fieldbus signal output (U, parameter listed in "Product Certifications" on page 19).
(3) G ½ in. SST cable gland is included in delivery.
(4) PFA is a fluoropolymer with properties similar to PTFE.
(5) All-PFA Rod antennas (1R or 2R) require all-PFA tank seal (PD).
(6) Certain process connections are not available with hydrostatic testing (P1).
(7) The standard alarm setting is high.
(8) Requires wetted flange plate cone antennas (3H-8H, 3M-8M, 3N-8N) or rod antennas (1R-4R).
(9) Certificate includes all pressure retaining wetted parts.
(10) Requires a SST cone antenna (3S-8S).

Application & Configuration Data Sheet

*=Indicates default factory configuration.

Customer Information, Model Number and Tagging Information - Information is required if C1 is ordered

Customer / End User _____ **Customer Contact** _____
Sales Person _____ **Customer Phone/E-mail** _____
P.O. Number _____ **Line Item** _____ **Ultimate Destination** _____

Model Number ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Options ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐ ☐☐

Hardware Tag (max 21 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
Software Tag (max 8 characters) ☐☐☐☐☐☐☐☐

Process Information

Process Name _____ **Product Type** _____

Process Description _____

Dielectric Constant	☐ 1.9-2.5	☐ 2.5-4.0	☐ 4.0-10	☐ >10 (water based)	☐ Unknown
Process Temperature	**Min:** _____	**Max:** _____	☐ °F	☐ °C	
Process Pressure	**Min:** _____	**Max:** _____	☐ psig	☐ Bar	

Is the process turbulent?	☐ No	☐ Slightly	☐ Aggressive	
If turbulent, due to	☐ Agitation	☐ Vortex	☐ Flowing	☐ Splash Loading

Foam	☐ None	☐ Light, airy	☐ Heavy, dense
If foam, it is present	☐ Constantly	☐ Occasionally	
If foam, thickness _____	☐ inch	☐ mm	

Condensation / Dirt	☐ None	☐ Light	☐ Heavy

Variable Units (choose only one of each group)

Use this unit when filling in values in the Application & Configuration Data Sheet.

If Level	☐ ft	☐ in	☐ m	☐ cm	☐ **mm***	
If Volume(1)	☐ ft^3	☐ in^3	☐ US gals	☐ Barrels	☐ **m^3***	☐ liters

LCD Meter Configuration - Only if M1 and C1 is ordered

Variables	☐ Level	☐ Distance	☐ Volume	☐ % of Level Range(2)	☐ Level Rate

Variable units are displayed according to the above. If more than one variable is chosen, Carousel Toggling of data is used.

Security Information - Information is required if C1 is ordered

Write Protect	☐ On	☐ **Off***

(1) If volume calculation is required, fill in Application and Configuration Data Sheet, Volume Configuration.
(2) Not applicable for FOUNDATION™ fieldbus.

Application & Configuration Data Sheet, continued

*=Indicates default factory configuration.

Analog Output (4-20 mA analog output), not applicable for FOUNDATION™ fieldbus devices - Information is required if C1 is ordered

Primary Variable (PV) ☐ **Level*** ☐ Distance ☐ Volume ☐ Level Rate(1) ☐ Signal Strength(2)

Lower Range Value (4 mA) _____ (use the selected variable unit on previous page)

Upper Range Value (20 mA) _____ (use the selected variable unit on previous page)

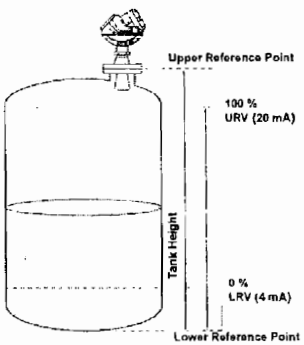
Alarm Mode ☐ **High*** ☐ Low ☐ Freeze

Tank Geometry - Information is required if C1 is ordered

Tank Shape

Select a tank type corresponding to the actual tank on which the device is mounted. If the device is mounted on a tank type that is not available as an individual selection choose Unknown.

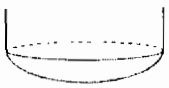
☐ **Unknown*** ☐ Vertical Cylinder ☐ Horizontal Cylinder
☐ Spherical ☐ Cubical(3)



Tank Bottom(4)

Select a Tank Bottom Type that corresponds to the actual shape of the tank bottom.

☐ **Unknown*** ☐ Flat(5) ☐ Dome/Dish/Bullet



☐ Cone Other (e.g. inclined) ☐

Tank Height _____ (use variable unit chosen on previous page)

(1) Always in selected level unit per second.

(2) Always in mV.

(3) A cubical tank type is defined as a box shaped tank with right angles.

(4) Tank Bottom Type is only applicable for Vertical Cylinder and Cubical tanks.

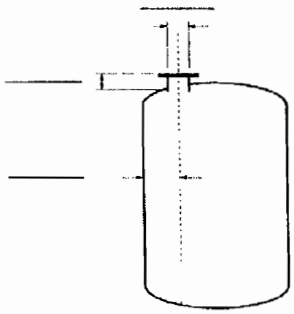
(5) Bottom of the tank is < 5°.

Application & Configuration Data Sheet, continued

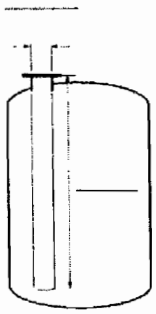
Fitting Dimensions - Information is required if C1 is ordered

Please fill in the dimensions (according to selected variable unit)

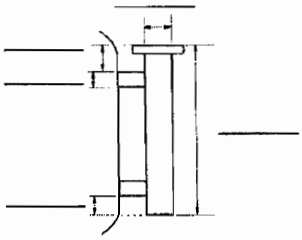
☐ Nozzle



☐ Stilling Well



☐ Bypass Pipe



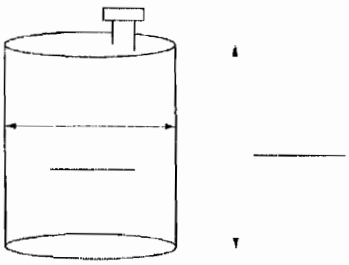
Application & Configuration Data Sheet, continued

VOLUME CONFIGURATION

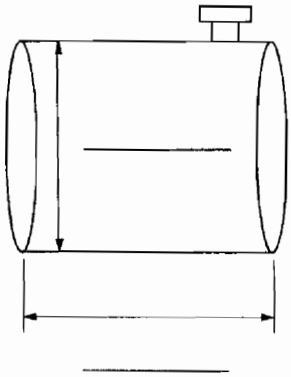
Volume Configuration Information (total volume calculation only) - Required if C1 is ordered and Volume is chosen variable

Volume is calculated based on ideal tank types or a strapping table. Please mark the box that corresponds to your tank type and fill in dimensions on the lines according to the previously selected variable unit.

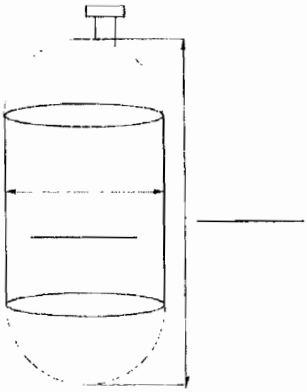
☐ **Vertical Cylinder**



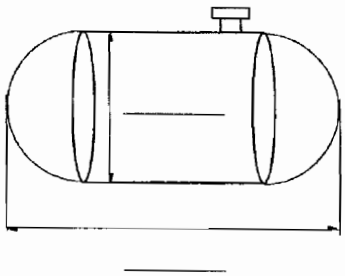
☐ **Horizontal Cylinder**



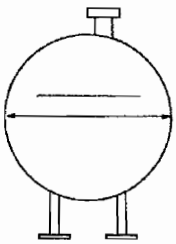
☐ **Vertical Cylinder with Bullet Ends**



☐ **Horizontal Cylinder with Bullet Ends**



☐ **Sphere**



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Waste Programs Div.
Permits Section

Rosemount Level Solutions

Emerson provides a complete range of Rosemount products for level measurement applications.

Pressure – Level or Interface Measurement

Emerson has a complete line of Rosemount pressure transmitters and remote seals for measuring level or interfaces in liquid applications. Optimize performance with direct mount, Tuned Seal systems:

- Rosemount 3051S_L, 3051L, and 1151LT Liquid Level Transmitters
- Rosemount 1199 Remote Diaphragm Seals with direct mount or capillary connections

Vibrating Fork Switches – Point Level Detection

The Rosemount 2100 Series is developed for reliable point level detection of liquids and consists of:

- Rosemount 2110 Compact Vibrating Fork Liquid Level Switch
- Rosemount 2120 Full-featured Vibrating Fork Liquid Level Switch

Guided Wave Radar – Level and Interface Measurement

Multivariable, loop-powered Guided Wave Radar transmitters with a wide range of probe styles to fit different liquids and solids applications. The product line consists of:

- Rosemount 3300 Series – Versatile and easy-to-use transmitter with proven reliability
- Rosemount 5300 Series – Accurate, high performance transmitter with FOUNDATION™ fieldbus support

Non-contacting Radar – Level Measurement

The Rosemount non-contacting radar family consists of:

- Rosemount 5400 Series Transmitters – Loop-powered transmitter with a wide range of antennas, for liquid level measurement in most applications and process conditions
- Rosemount 5600 Series Transmitters – Transmitters with ultra-high sensitivity for measurement of level in liquids and solids, even for the most challenging applications

Non-contacting Ultrasonic – Level Measurement

The Rosemount 3100 Series ultrasonic level transmitters provide continuous non-contacting level measurement of liquids. The range consisits of:

- Rosemount 3101 for simple continuous level measurement
- Rosemount 3102 for continuous measurement with two integral relays for local control functionality
- Rosemount 3105 Intrinsically safe certified version for hazardous areas

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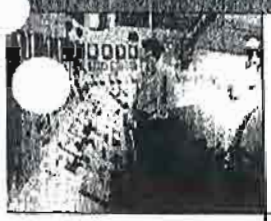

AN-3100D Annunciator

FOR POWER GENERATION, TRANSMISSION & DISTRIBUTION, PETROLEUM, PETROCHEMICAL, AND OTHER PROCESS INDUSTRIES

ROCHESTER

INNOVATIVE ANNUNCIATOR

Continuing with the widely successful AN-3100 series of annunciators, AMETEK's new AN-3100D brings alarm monitoring to new levels. Time stamped alarms and more communication options are now available. Installation and setup have been simplified making this an ideal fit for new projects or system replacements. The unique software configuration provides more features and functions a mouse click away.

Time Stamped Alarms (SER)

All of your alarms can include a time stamp, synchronized by IRIG-B or our internal clock. This can be presented through Modbus, DNP, OPC or to a local printer or terminal for viewing.

Communications

Transmit or receive alarms using our RS-232/485 serial or Ethernet port. The AN-3100D supports Modbus and DNP protocols. Communicate via OPC using our OPC Server Software.

Software Configuration

While all systems are pre-configured to your specifications, the software configuration tool unleashes the true power of the AN-3100D.

You can select any operational sequence, sort alarms by group, configure your relay outputs and more. There is never any reason to pull out the front accessible input cards as changes can be made via software.

Compact Size

The annunciator and all electronics including the communication options are self contained within a compact frame less than seven inches deep. In most cases, the power supply is included inside the system simplifying installation and wiring.

Reliability

Every AN-3100D annunciator is equipped with low power, long life LEDs. The brightness exceeds standard incandescent bulbs and they last years longer. If a LED needs replacement, our automatic detector provides notice so critical alarms are not missed. A built-in ground fault detector is available for indicating ground faults in your field wiring.

Flexible Design

The window legends are printed on standard transparency film, making it easy to change legends at any time. The annunciator capacity can be increased with built-in expansion. All features and options are field selectable and upgradeable.

FEATURES AND BENEFITS

- Timed Stamped Alarms (SER)
- LED Illumination (Standard)
- Serial and Ethernet Communications: Modbus, DNP, OPC Protocols
- Software Configurable
- Laser Printed Legends
- Internal Self Diagnostics
- Compact Size

AMETEK®
POWER INSTRUMENTS

EXPERIENCE THE POWER

SPECIFICATIONS

INPUT

Field Contacts
- Normally Open (N.O.) or Normally Closed (N.C.) input selection through software or hardware
- Wetted (voltage supplied) or dry (voltage free) contacts

Field Contact Voltage
- 12, 24, 48, 125 VDC, 120 VAC jumper selectable (.0018mA per input)

Input Isolation
- Each input is optically isolated

Input Response
- 50 milliseconds (standard)
- 1 millisecond fast response (opt)
- 50 milliseconds to 250 seconds software adjustable

DISPLAY

LED
- White LED, minimum 2 per window

Window Sizes (h x w)
- Quad: 1.5 x 1.5 inch (38 x 38 mm)
- Third: 1.0 x 3.0 inch (25 x 76 mm)
- Half: 1.5 x 3.0 inch (38 x 76 mm)
- Full: 3.0 x 3.0 inch (76 x 76 mm)

Window Color
- White, red, yellow, amber, green, blue

Legends
- Laser printed on transparency film or engraved windows

ALARM SEQUENCE

Sequence Selections
- A, A4, M, R, R12, F1A, F3A, F2M1, FFAM2, F3C and R12C
- Software configurable
  - Dual color sequences
  - Customized flash rates
  - Up to 4 first out groups

CONTROLS

- Integral test, acknowledge, silence and reset with LED status lights
- External push button inputs
- Configurable switch inputs (inhibit LEDs, horns, relays)

OUTPUTS

Auxiliary Relay Option
- Individual or dual relay per point
- Follows field contact or alarm sequence
- Software configurable
- Energized/de-energized operation
- Form A or form B (N.O. or N.C.)
- Form C (SPDT)

Common Relays
- 2 relays included for: critical and non-critical horn; ringback audible
- 2 relays available for: critical and non-critical reflash, common alarm: watchdog, power fail, ground fault
- Software configurable
- Energized or de-energized operation
- Form A or form B (N.O. or N.C.)

Relay Ratings
- 24 VDC @ 3.0 amps
- 110 VDC @ 0.1 amps
- 120 VAC @ 3.0 amps

Audible
- Internal 80db @ 30cm audible device external horns available

COMMUNICATION

Serial Modbus
- Master or slave
- Transmit or receive alarms
- RS-232/485 or Ethernet
- Pushbutton controls

DNP 3.0
- Slave mode
- Transmit alarms
- RS-232/485 or Ethernet
- Pushbutton controls

OPC Server Software
- Ver. 2.0 OPC DA

Serial ASCII
- RS-232/485 or Ethernet
- For local terminal/printer

TIME STAMPED ALARMS

- 1 or 4 msec time stamp resolution
- IRIG-B time sync input or internal clock
- Point #, alarm status, time and date
- Modbus, DNP, ASCII outputs
- 500 event storage

CONNECTIONS

Input/Output Terminals
- Fixed barrier terminal block, 12 GA (2.5mm) maximum, ring, spade or bare wire termination.

Communication Ports
- Serial: 9 pin female D connector
- Ethernet: RJ45 connector
- IRIG-B: BNC connector

POWER REQUIREMENTS

Internal or External Power Supplies
- 230 VAC (176-264 VAC 50 Hz)
- 120 VAC (88-132 VAC 60 Hz)
- 125 VDC (100-250 VDC)
- 48 VDC (38-58 VDC)
- 24 VDC (19-29 VDC)

Max. 1.7 watts/input @ power input

MECHANICAL

Mounting
- Semi-flush panel mounting
- 19 inch rack mounting
- Wall (surface) mounting
- NEMA enclosures

Weight
- 1.2 lbs per cell (0.34 kg per cell)

ENVIRONMENT

Operating Temperature Range:
- -4 to 122°F (-20 to 50°C)

Humidity:
- 20-95% RH

Surge Withstand:
- ANSI C37.90.1 (oscillatory)

Fast Transient:
- IEC-61000-4-4

Surge Immunity:
- IEC-61000-4-5

EMI/RFI/ESD:
- IEC-61000-4-3, 4-6, 6-3, 4-8, 4-2

Isolation:
- 1950 VDC or 1400 VAC input to output, logic, case

CERTIFICATIONS

UL, ULC, CE
FM Class 1, Div 2, FMC

Semi-flush Mounting Details inches (mm)

Cells H or W	Overall H or W	Panel Cut-Out H or W
1	5.0 (127)	4.06 (103)
2	8.47 (215)	7.53 (191)
3	11.94 (303)	11.00 (279)
4	15.40 (391)	14.47 (368)
5	18.88 (479)	17.94 (456)
6	22.34 (568)	21.41 (544)
7	25.81 (656)	24.88 (632)
8	29.28 (744)	28.34 (720)
9	32.75 (832)	31.81 (808)
10	36.22 (920)	35.29 (896)
11	39.69 (1008)	38.75 (984)
12	43.16 (1096)	42.22 (1072)
13	46.63 (1184)	45.69 (1160)
Depth behind panel: 6.75", 8" with rear cover		

Example: 2 H x 3 W has a cut-out height of 7.53 (191) and a cut-out width of 11.0 (279)

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Echotel®
Model 910

Installation and Operating Manual

Ultrasonic

Level

Switch

Magnetrol®

STI

Read this Manual Before Installing

This manual provides information on the Echotel Model 910 Ultrasonic Liquid Level Switches. It is important that all instructions are read carefully and followed in sequence. Detailed instructions are included in the Installation section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

Notes

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Warnings

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages

The Echotel Model 910 is designed for use in Category II, Pollution Degree 2 installations. Follow all standard industry procedures for servicing electrical and computer equipment when working with or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe safety procedures when working with electrostatic sensitive components.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

WARNING! Explosion hazard. Do not connect or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Low Voltage Directive

For use in Category II installations. If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

Notice of Trademark, Copyright, and Limitations

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Magnetrol/STI reserves the right to make changes to the product described in this manual at any time without notice. Magnetrol/STI makes no warranty with respect to the accuracy of the information in this manual.

Warranty

All Magnetrol/STI Model 910 Level Switches are warranted free of defects in materials or workmanship for two full years from the date of original factory shipment.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol/STI shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol/STI products.

Quality Assurance

The quality assurance system in place at Magnetrol/STI guarantees the highest level of quality throughout the company. Magnetrol/STI is committed to providing full customer satisfaction both in quality products and quality service.

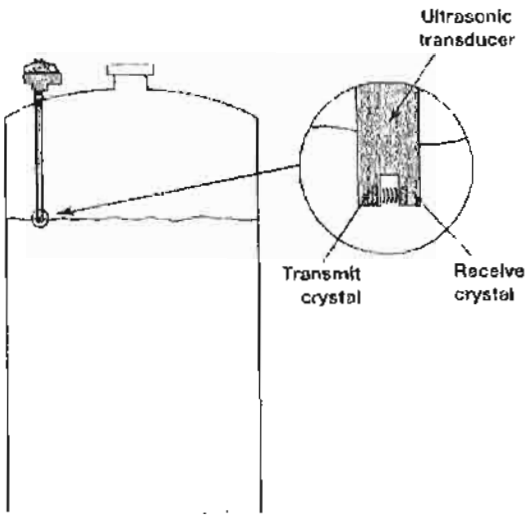
Magnetrol's quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

1.0 Introduction

Echotel Model 910 Level Switches utilize ultrasonic contact technology for measuring level in clean liquid applications.

1.1 Principle of Operation

The Model 910 Level Switch uses ultrasonic energy to detect the presence or absence of liquid in a transducer gap. The basic principle behind ultrasonic contact technology is that high-frequency sound waves are easily transmitted across a transducer gap in the presence of a liquid medium, but are severely attenuated when the gap is dry. The Model 910 uses an ultrasonic frequency of 3 MHz to perform this liquid level measurement in a wide variety of process media and application conditions.



Ultrasonic signal transmission across transducer gap

Figure 1

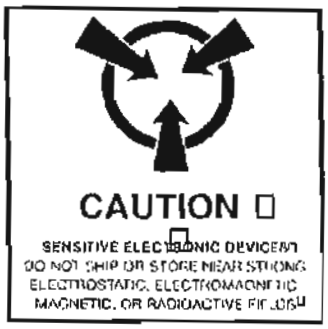
The transducer uses a pair of piezoelectric crystals that are encapsulated in epoxy at the tip of the 316 stainless steel transducer. The crystals are made of a ceramic material, that vibrates at a given frequency when subjected to an applied voltage. The transmit crystal converts an electrical signal from the Model 910 electronics into an ultrasonic signal. When liquid is present in the gap, the receive crystal is able to sense the ultrasonic signal from the transmit crystal and convert it back to an electrical signal. This signal is sent to the electronics to indicate the presence of liquid in the transducer gap. When there is no liquid present, the ultrasonic signal is attenuated, and is not detected by the receive crystal.

2.0 Installation

2.1 Unpacking

Unpack the instrument carefully. Inspect all units for damage. Report any concealed damage to carrier within 24 hours. Check the contents of the packing slip and purchase order. Check and record the serial number for future reference when ordering parts.

2.2 Electrostatic Discharge (ESD) Handling Procedure



Magnetrol/STI's electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that may be damaged by static electricity present in most work environments.

The following steps are recommended to reduce the risk of component failure due to electrostatic discharge.

- Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap the board in aluminum foil. Do not place boards on foam packing materials.
- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle circuit boards only by the edges. Do not touch components or connector pins.
- Make sure that all electrical connections are completely made and none are partial or floating. Ground all equipment to a good, earth ground.

2.3 Preliminary Operational Check

After unpacking and before installation, perform the following operational check on the unit in a non-hazardous area:

1. Apply proper operating voltage to terminals L1 and L2/N. Power supply ground should be connected to the green ground screw in housing base.
2. Fill a suitable container with liquid.
3. Place transducer gap in the liquid. The relay output should actuate.
4. Remove transducer from the liquid. The relay output should de-actuate. In case of malfunction, consult *Section 3.1, Troubleshooting* on page 6.

Caution: This unit contains CMOS electronics which may become damaged by static electricity. Do not touch any semiconductor devices unless you are properly grounded.

2.4 Mounting

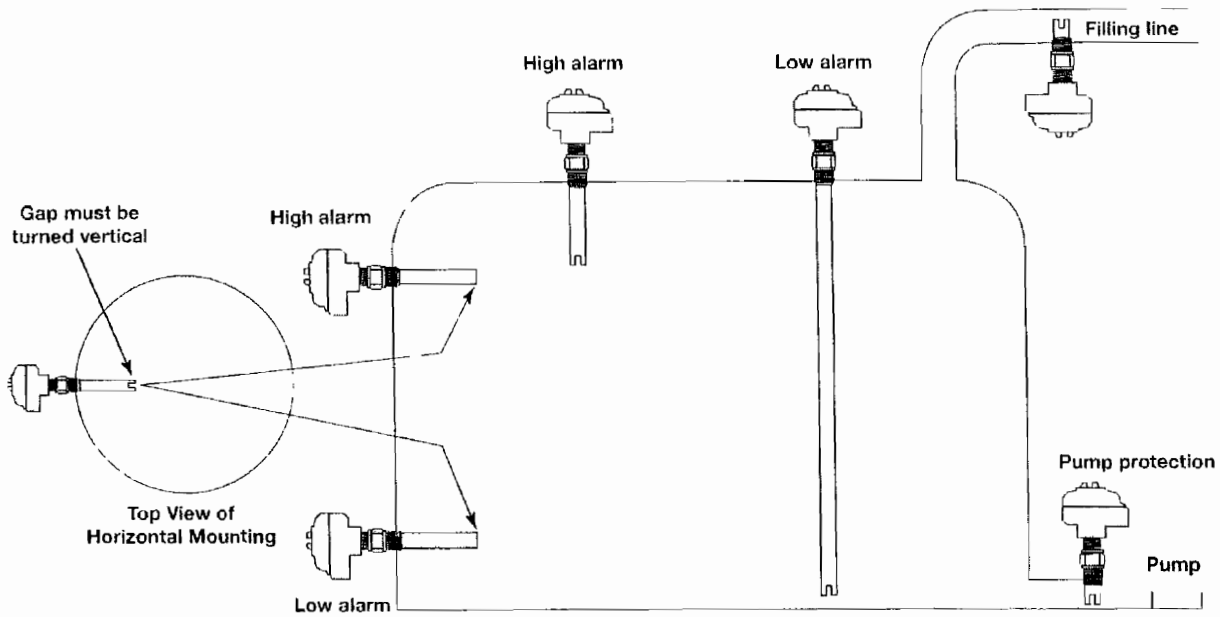


Figure 2
Typical Mounting Orientations

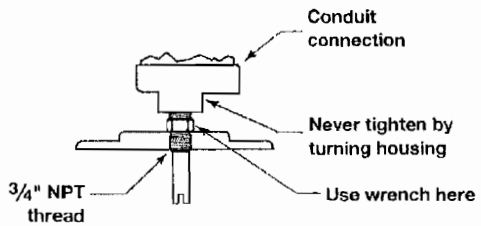


Figure 3
Vertical Mounting

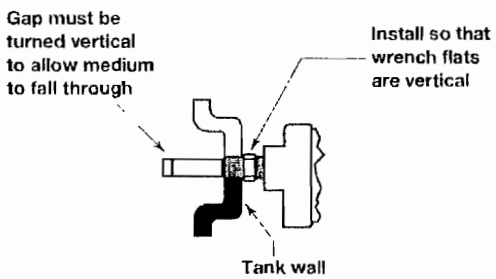


Figure 4
Horizontal Mounting

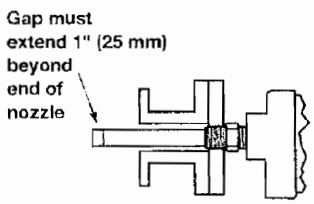


Figure 5
Nozzle Mounting

Model 910 level switches are shipped as integral units with the electronics assembled to the transducer. They may be mounted in a variety of positions as shown in Figures 2 through 5.

Proper orientation of the transducer gap will provide maximum performance in difficult applications. When the switch is mounted horizontally, the transducer gap must be turned vertical to allow proper drainage of the liquid media. See Figures 2 and 4.

Screw transducer into the opening using pipe compound or thread tape. If flanged, bolt unit to mating flange with proper gasket.

Caution: Never tighten unit on the tank connection by turning the housing. Use a wrench on the transducer mounting nut flats. Use thread tape or suitable pipe compound on the threads. Do not overtighten.

When installed in a nozzle or pipe, the transducer gap must extend into the tank at least one inch beyond the inside tank wall. Refer to Figure 5.

2.5 Wiring

2.5.1 Power

Power connections are made at the two-position terminal block labeled TB1 within the electronics enclosure. Use of 14–22 AWG twisted shielded pair wire is recommended.

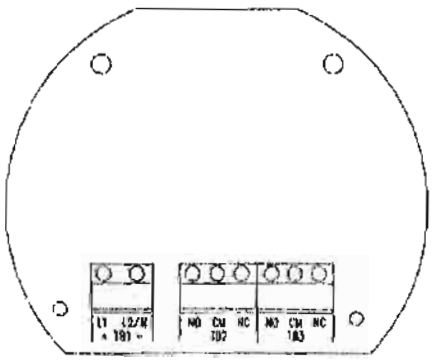
NOTE: Observe all applicable electrical codes and proper wiring procedures.

1. Make sure the power is turned off.
2. Unscrew and remove the housing cover.
3. Prevent moisture seepage into housing by installing an approved seal-drain fitting in the conduit run leading to the unit.
4. Route wires into housing.
5. Connect ground wire to green ground screw located in the base of the housing. DO NOT proceed until ground connection is made.
6. After grounding is complete, connect the power leads to proper terminals as follows:

VAC Units	VDC Units
L1, L2/N	+, −

Caution: In hazardous areas, do not power the unit until the conduit is sealed and the enclosure cover is screwed down securely.

7. Dress wiring to ensure no interference or contact with cover or circuit board components.

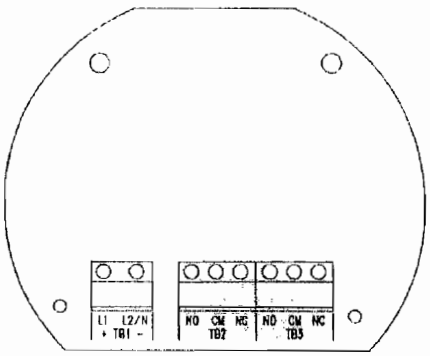


TB1 Power Wiring

2.5.2 Relay

Model 910 switches have a number of possible relay wiring options. The table below lists the relay contact positions for all possible combinations of power failure, condition of the transducer gap, and fail-safe jumper position. The user must decide which combinations constitute fail-safe and alarm conditions, and then select the appropriate relay wiring and fail-safe position.

1. Run relay output wiring to the terminal blocks labeled TB2 and TB3. Ensure that the load to be controlled is within the relay's rated capacity as shown in *Section 3.3.2, Electrical* on page 6.



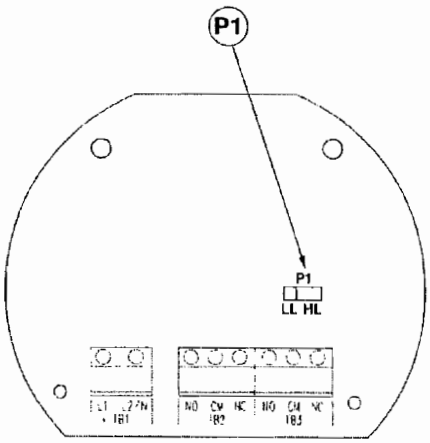
Relay Output Wiring

2. Select high or low fail-safe using the P1 jumper.

P1 Fail-safe Jumper Position	Line Power	Transducer Gap	Relay Terminals	
			CM to NC	CM to NO
Low level	On	Dry	Closed	Open
		Wet	Open	Closed
	Failure	Dry	Closed	Open
		Wet	Closed	Open
High level	On	Dry	Open	Closed
		Wet	Closed	Open
	Failure	Dry	Closed	Open
		Wet	Closed	Open

3. Replace housing cover. Installation is complete.

Caution: Never tighten unit to the tank connection by turning the housing. Use a wrench on the transducer mounting nut flats. Use thread tape or suitable pipe compound on threads. Do not over tighten.



P1 Fail-safe Jumper

3.0 Reference Information

3.1 Troubleshooting

Caution: In hazardous areas, do not remove housing cover until power is disconnected and atmosphere is determined to be safe.

3.1.1 No signal with level change

a. Verify power and control circuit wiring.
b. Make sure liquid is filling the transducer gap.
c. Check for dense foam on surface or dried product in the gap. Unit will not function properly if either condition exists.
d. Check transducer phone plugs for proper insertion in J1 and J2.
e. If control circuit does not actuate, consult factory.

3.1.2 Calibration

Model 910 switches do not require field calibration. The set point is not adjustable.

3.1.3 Switch chatter

a. Check voltage to make sure it is within tolerances shown in Section 3.3.2.
b. Check for turbulence. Relocate control or isolate from turbulence.
c. Check for excessive aeration.
d. Consult factory.

3.1.4 Control output will not de-actuate

a. Check transducer for plugged gap.
b. Check for dense foam or liquid in gap.
c. If control circuit does not de-actuate, consult factory.

3.2 Agency Approvals

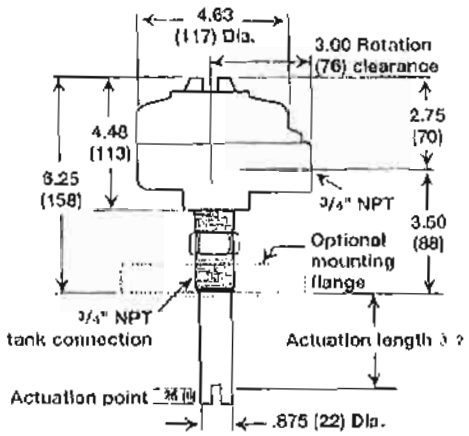
FM	910-XXXX-XXX	Explosion Proof	Class I, Div. 1; Groups C & D Class II, Div. 1; Groups E, F, & G Class III, NEMA Type 4X
FM APPROVED	910-XXXX-XXX	Non-Incendive	Class I, Div. 2; Groups A, B, C, & D Class II, Div. 2; Groups F & G Class III, NEMA Type 4X
CSA	910-XXXX-XXX	Explosion Proof	Class I, Div. 1; Groups C & D Class II, Div. 1; Group E, F, & G Class III, Type 4X
	910-XXXX-XXX	Non-Incendive	Class I, Div. 2; Groups A, B, C, & D Class II, Div. 2; Groups E, F, & G Class III, Type 4X
ATEX	910-5XXX-XXX 910-PXXX-XXX		Ⓔx II 1/2 G EEx d II C T6/EEx e II T6

These units have been tested to EN 50081-2 and EN 50082-2 and are in compliance with the EMC Directive 89/336/EEC.

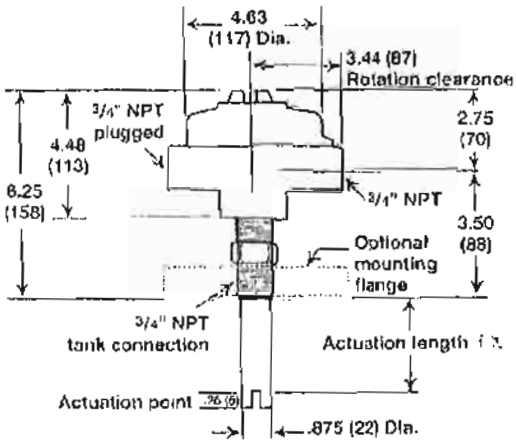
3.3 Specifications

3.3.1 Physical

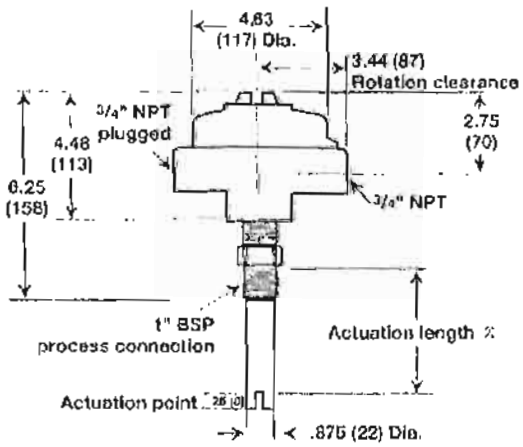
Inches (mm)



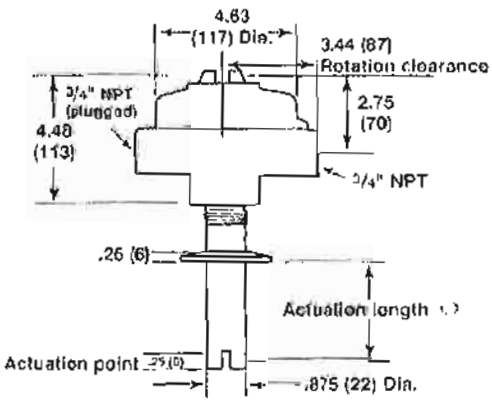
316 stainless steel housing
(Single ¾" NPT conduit)



Aluminum sand cast housing
(Dual ¾" NPT conduits)



Aluminum sand cast housing
(Dual ¾" NPT conduit w/1" BSP process connection)



Aluminum sand cast housing
(Dual ¾" NPT conduit with sanitary flange)

(1) 1" (Code 001) minimum with NPT threaded process connections.
2" (Code 002) minimum with sanitary or ANSI flanged process connections.

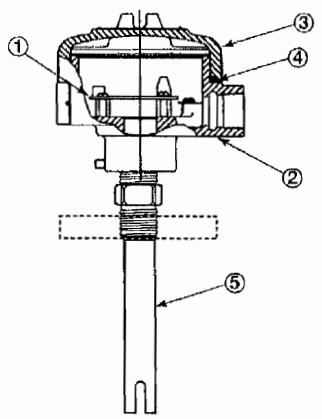
(2) 25 (Code 003) mm minimum with NPT threaded process connections.
50 (Code 005) mm minimum with 1" BSP, and sanitary or ANSI flanged process connections.

3.3.2 Electrical

Power Supply:	120 VAC (+10%/-15%), 50/60 Hz 240 VAC (+10%/-15%), 50/60 Hz 24 VDC (±10%)
Power Consumption:	2.5 VA nominal
Relay Output:	Gold flash DPDT relay: 10 amps @ 120 VAC, 240 VAC, 24 VDC ① Hermetically sealed DPDT relay: 5 amps @ 120 VAC, 24 VDC, and 3 amps @ 240 VAC
Repeatability:	0.078" (2 mm)
Fail-safe Configuration:	Field selectable high or low
Calibration:	None required
Ambient Temperature:	Electronics: -40° to +160° F (-40° to +71° C)
Process Temperature:	Transducer: -40° to +250° F (-40° to +121° C)
Operating/Non-Operating Pressure:	800/1500 psig (55/103 bar)
Shock	ANSI/ISA-S71.03 Class SA1
Vibration	ANSI/ISA-S71.03 Class VC2

① Gold flash DPDT relay is rated at 8 amps when used with Housing codes 5 or P

3.4 Replacement Parts



No.		Description	Part Number
1	PC Board	120 VAC w/10 amp relay	Z30-2043-003
		240 VAC w/10 amp relay	Z30-2043-004
		24 VDC w/10 amp relay	Z30-2043-002
		120 VAC w/5 amp HS relay	Z30-2043-011
		240 VAC w/3 amp HS relay	Z30-2043-012
		24 VDC w/5 amp HS relay	Z30-2043-010
2	Housing Base	Aluminum w/FM and CSA	004-9182-002
		Aluminum w/all 3 approvals	004-9182-008
		316 SS w/FM and CSA	004-9140-001
		316 SS w/CENELEC	004-9140-001
3	Housing Cover	Aluminum w/FM and CSA	004-9105-001
		Aluminum w/all 3 approvals	004-9105-005
		316 SS w/FM and CSA	004-9142-001
		316 SS w/CENELEC	004-9142-001
4	O-Ring		012-2101-345
5	Transducer		Consult factory

WARNING! Explosion hazard — Substitution of components may impair suitability for Class 1, Division 2 rating.

WARNING! Explosion hazard — Do not disconnect equipment unless power has been switched off, or the area is known to be non-hazardous.

3.5 Model Numbers

3.5.1 Model 910

HOUSING

A	Aluminum sand cast with ¾" NPT dual conduit, FM and CSA approvals
Y	316 stainless steel with ¾" NPT single conduit, FM and CSA approvals
P	Aluminum sand cast with ¾" NPT dual conduit, FM, CSA and ATEX approvals
5	316 stainless steel with ¾" NPT single conduit, ATEX approval

TRANSDUCER UNIT OF LENGTH

1	English (actuation length in inches)
M	Metric (actuation length in centimeters)

PROCESS CONNECTION

A	¾" NPT
2	1" NPT
9	1" BSP
3	1½" sanitary flange, 16 amp (Compatible with Tri-Clover Tri-Clamp® fittings)
4	2" sanitary flange, 16 amp (Compatible with Tri-Clover Tri-Clamp® fittings)
1	1" 150 lb. ANSI raised face flange
C	1½" 150 lb. ANSI raised face flange
D	2" 150 lb. ANSI raised face flange
E	1" 300 lb. ANSI raised face flange
F	1½" 300 lb. ANSI raised face flange
G	2" 300 lb. ANSI raised face flange

INPUT POWER

0	120 VAC with 10 amp DPDT gold flash relay
1	240 VAC with 10 amp DPDT gold flash relay
2	24 VDC with 10 amp DPDT gold flash relay
H	120 VAC with 5 amp DPDT hermetically sealed relay
J	240 VAC with 3 amp DPDT hermetically sealed relay
K	24 VDC with 5 amp DPDT hermetically sealed relay

ACTUATION LENGTH

1" to 96" in 1" increments (with Transducer Unit of Length code 1) Example: 4 inches = 004 ① ②
3 cm to 244 cm in 1 cm increments (with Transducer Unit of Length code M) Examples: 6 centimeters = 006 ② ③

9	1	0	—					—				

① 1" (code 001) minimum with NPT process connections, 2" (code 002) minimum with sanitary or ANSI flanged process connections.

② 2.5 cm (code 003) minimum with NPT process connections, 5 cm (code 005) minimum with 1" BSP, or sanitary or ANSI flanged process connections.

③ Consult factory for longer lengths.

Service Policy

Owners of Magnetrol/STI controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through Magnetrol/STI's local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

NOTE: See Electrostatic Discharge Handling Procedure on page 2.

Magnetrol

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4000 • Fax 630-969-9489 • www.magnetrol.com
145 Jardin Drive, Units 1 & 2 • Concord, Ontario Canada L4K 1X7 • 905-738-9600 • Fax 905-738-1306
Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317

STI

5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4028 • Fax 630-969-9489 • www.sticontrols.com

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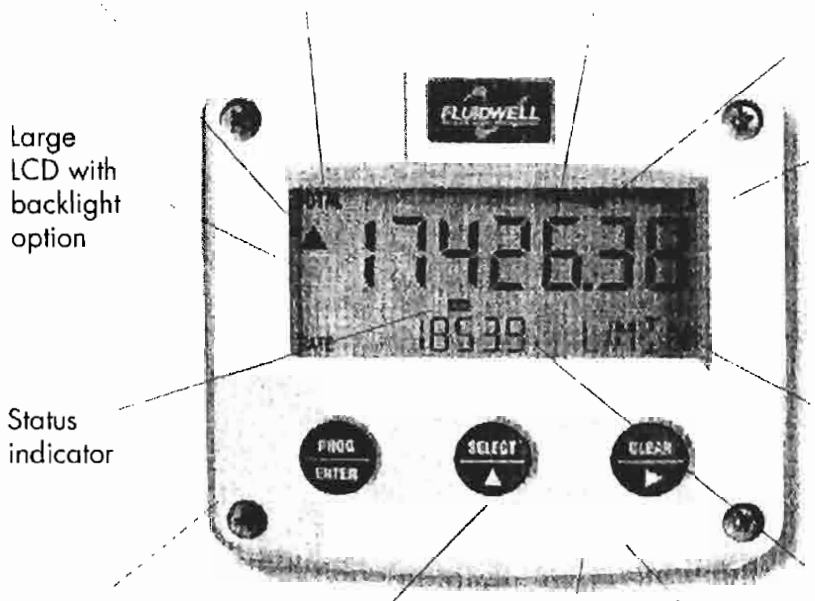
BULLETIN: 51-604.14
EFFECTIVE: January 2005
SUPERSEDES: July 2004

Fluidwell F-Series

Flow • Level • Pressure • Temperature



- 4-20 mA, 0-10 V, pulse, or RTD inputs
- AC, DC, loop, or battery power
- Rugged NEMA 4X enclosures
- Field & panel mount enclosures
- Intrinsically safe or explosion-proof
- Operates from -40 to 80°C
- Serial Modbus communications
- Backlighting

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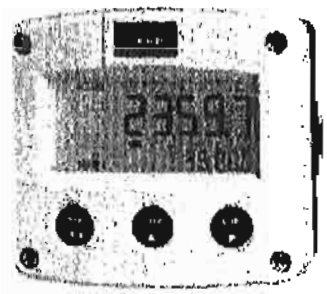
Fluidwell F-Series Product Offerings

for more details see the individual Quick Select Guides beginning on the next page

Rate/Totalizers

- Analog or pulse input
- Multi-point linearization
- 7 digit flow rate display
- 7 digit total display
- 11 digit non-resettable total
- Bi-directional measurement
- High & low alarms
- Analog & pulse outputs

Batch Controllers

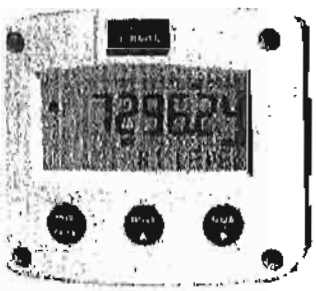


- Analog or pulse input
- 1 or 2 stage batch control
- Start, stop, & pause buttons
  Overrun correction
- Count up or count down
- Flow rate, preset value, & total display
- 11 digit non-resettable total

Flow Computers

- Analog or pulse Input
- Temperature compensation for liquids
- Temperature & pressure compensation for gas
- Ratio calculation & monitoring
- Fuel consumption calculation
- 11 digit non-resettable total

Level, Pressure, & Temperature Indicators



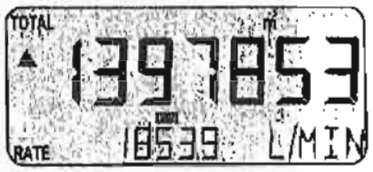
Battery-powered RTD temperature meter

- Analog or RTD input
- Multi-point linearization
- Displays volume, height & %
- Dual pressure inputs
- High & low alarms
- Analog output

Fluidwell F-Series Quick Select Guide

Flow Rate/Totalizers

F011 with backlight on



F012, F014, F110, F115, F016, F112

F111 with backlight off

F013 & F113 in alarm condition

Flow Rate/Totalizers								Linearization			High/low alarms	
	F010	F011	F012	F014	F110	F111	F115	F016	F112	F118	F013	F113
	Flow rate indicator	Flow totalizer	Flow rate/totalizer	with pulse output	with pulse & analog outputs	with two inputs & two pulse outputs	with bi-directional measurement	with pulse output	with pulse & analog outputs	with pulse & analog output & two flow rate alarms	Flow rate monitoring with one alarm output	Flow rate monitoring max four alarm outputs
Pulse, NAMUR, coil input	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0-20 mA, 4-20 mA input	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
0-10 V input	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Actual flow rate	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Actual total (resettable)		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Accumulated total (non-resettable)		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Multi-point linearization								✔	✔	✔		
Analog output (flow rate)					✔		✔		✔	✔		✔
Pulse output assigned to total				✔	✔	✔	✔	✔	✔	✔		✔
High & low alarms										✔	✔	✔
Flow direction detection							✔					
Dual input						✔	✔					
External reset total					✔				✔			✔
RS-232, RS-485, TTL					✔	✔	✔		✔	✔		✔
Intrinsically safe or exp-proof	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Backlight	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

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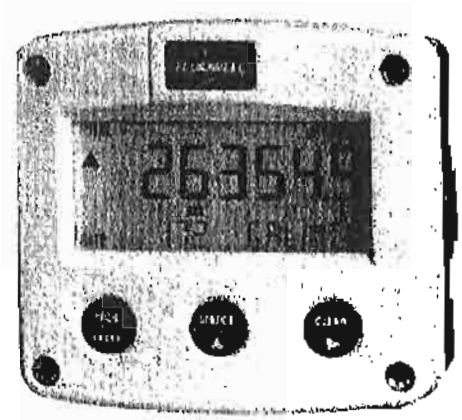
Fluidwell F-Series Quick Select Guide

Flow Computers



F126-EL with backlight off

F126-EG with backlight on

F114 with ratio in alarm condition

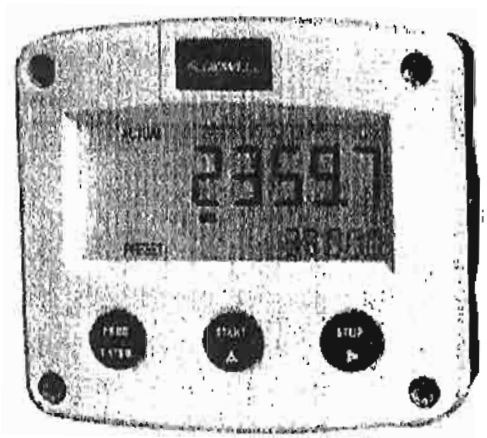
F116 & F127-EL with sum/differential

Flow Computers			Ratio	Differential/sum	
	F126-EL	F126-EG	F114	F116	F127-EL
	Flow & temperature for liquid volume calc.	Flow, temp, & press. for gas volume calc.	Ratio calculation & monitoring	Consumption/sum calculation	Consumption calc. with temp correction
Pulse, NAMUR, coil input	✔	✔	✔	✔	✔
0-20 mA, 4-20 mA input	✔	✔	✔	✔	
0-10 V input	✔	✔	✔	✔	
Actual flow rate	✔	✔	✔	✔	✔
Actual total (resettable)	✔	✔	✔	✔	✔
Accumulated total (non-resettable)	✔	✔		✔	✔
Actual temperature	✔	✔			✔
Actual pressure		✔			
Analog output (flow rate)	✔	✔	✔	✔	✔
Pulse output assigned to total				✔	
High & low alarms			✔		
Temperature compensation	✔	✔			✔
Pressure compensation		✔			
Dual input			✔	✔	✔
Fuel consumption calculation				✔	✔
Sum calculation (add on)				✔	
Ratio calculation			✔		
RS-232, RS-485, TTL	✔	✔	✔	✔	✔
Intrinsically safe or explosion-proof	✔	✔	✔	✔	✔
Backlight	✔	✔	✔	✔	✔

[illegible] Selector / Configurator at www.predig.com/configurator

Fluidwell F-Series Quick Select Guide

Batch Controllers



F030, F130 & F136 with batch paused & backlight off

F131 & F133 with backlight on

Batch Controllers/Dispensers	F030	F130	F131	F133	F136
	with one stage control output	with two stage control or pulse outputs	with two control/pulse & analog output	Delivery controller with batch counter	with two control/pulse & analog output
Pulse, NAMUR, coil input	✔	✔	✔	✔	✔
0-20 mA, 4-20 mA input	✔	✔	✔		✔
0-10 V input	✔	✔	✔		✔
Actual flow rate			✔	✔	✔
Actual total (resettable)	✔	✔	✔	✔	✔
Accumulated total (non-resettable)	✔	✔	✔	✔	✔
Batch counter				✔	
Preset and actual value	✔	✔	✔		✔
Analog output assigned to rate			✔		
Analog output assigned to batch process					✔
Pulse output assigned to total		✔	✔		✔
1 stage control output	✔	✔	✔	✔	✔
2 stage control output		✔	✔		✔
Ticket printing				✔	
Overrun correction	✔	✔	✔		✔
External start/stop		✔	✔	✔	✔
RS-232, RS-485, TTL		✔	✔	✔	✔
Intrinsically safe or explosion-proof	✔	✔	✔	✔	✔
Backlight	✔	✔	✔	✔	✔

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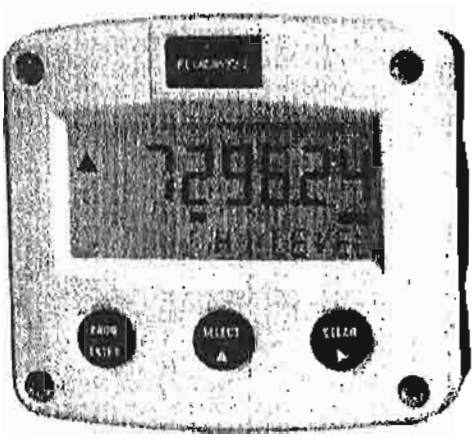
Fluidwell F-Series Quick Select Guide

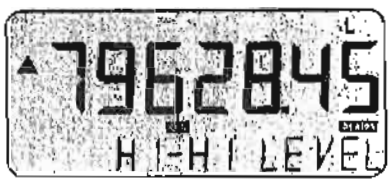
Level Indicators



F073 in alarm condition

F170 with high/low alarms & backlight on

F070 with 1" high display & backlight on



F173 with linearization & backlight off

Level Indicators		High/low alarms		Linearization	
	F070	F073	F170	F077	F173
	Level indicator	with one alarm output	with analog & max four alarm outputs	with one alarm output	with analog & max four alarm outputs
0-20 mA, 4-20 mA input	✔	✔	✔	✔	✔
0-10 V input	✔	✔	✔	✔	✔
Displays volume, height, and percentage	✔	✔	✔	✔	✔
Multi-point linearization				✔	✔
Analog output			✔		✔
High & low alarms		✔	✔	✔	✔
RS-232, RS-485, TTL			✔		✔
Intrinsically safe or explosion-proof	✔	✔	✔	✔	✔
Backlight	✔	✔	✔	✔	✔

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Fluidwell F-Series Quick Select Guide

Pressure Indicators

Pressure Indicators			High/low alarms	
	F050	F151	F053	F153
	Pressure indicator	Dual pressure indicator	with one alarm output	with analog & max four alarm outputs
0-20 mA, 4-20 mA input	✔	✔	✔	✔
0-10 V input	✔	✔	✔	✔
Actual pressure & engineering units	✔	✔	✔	✔
Analog output				✔
High & low alarms			✔	✔
Dual input		✔		
RS-232, RS-485, TTL		✔		✔
Intrinsically safe or explosion-proof	✔	✔	✔	✔
Backlight	✔	✔	✔	✔

F151 with backlight on

F143 with high/low alarms in alarm condition

Temperature Indicators

Temperature Indicators			High/low alarms	
	F040	F141	F043	F143
	Temperature indicator	Dual temperature indicator	with one alarm output	with analog & max four alarm outputs
0-20 mA, 4-20 mA input	✔	✔	✔	✔
0-10 V input	✔	✔	✔	✔
100 Ω RTD (Pt100)	✔	✔	✔	✔
Actual temperature & engineering units	✔	✔	✔	✔
Analog output				✔
High & low alarms			✔	✔
Dual input		✔		
RS-232, RS-485, TTL		✔		✔
Intrinsically safe or explosion-proof	✔	✔	✔	✔
Backlight	✔	✔	✔	✔

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- Fuel Consumption Computers
- Setpoint Generators
- Modbus Display
- Loop-Powered Displays
- Level Indicators

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APPENDIX D-5

GRAINGER CODE ANALYSIS

Grainger Consulting, Inc.
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REPORT OF FINDINGS – CODE ANALYSIS

PROJECT: - CLEAN HARBOR TANK FARM GC # 2371

DATE: 29 July 2009

Brian Parker
Facility General Manager
Clean Harbors Environmental Services
1340 West Lincoln St
Phoenix, AZ 85007
602-462-2300 Office
602-721-7238 Mobile
602-462-2390 Fax
Parker.brian@cleanharbors.com

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 10031 SCOTT C. GRAINGER Date Signed 07/29/09 ARIZONA U.S.A.

Exp 03/31/2011

PURPOSE:
Prepare code and standard analysis of the tank farm. Codes to include the current building, electrical and fire codes as adopted by City of Phoenix, and other NFPA Standards that may apply as requested by Client. Deliverables include a written report unless otherwise directed by Client.

STATEMENT:
This Report of Findings is very limited in scope. It applies ONLY to the specific conditions noted for this project and at the location below. The information contained here-in may not be used for any other project or location without the expressed written approval of this Engineer. Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report and as the applicable codes and standards apply to the instant condition.

PROJECT LOCATION:
1340 West Lincoln St
Phoenix, AZ 85007

REFERENCES:
Applicable Codes & Standards
International Code Council (ICC)

- International Building Code (IBC) 2006 as adopted by City of Phoenix
- International Fire Code (IFC) 2006 as adopted by City of Phoenix

National Fire Protection Association (NFPA) Standards

- NFPA 10, 2007, Standard for Portable Fire Extinguishers
- NFPA 30, 2008, Flammable and Combustible Liquid Code
- NFPA 70, 2008, National Electric Code

- NFPA 77, 2007, Recommended Practice on Static Electricity
- NFPA 497, 2004, Recommended Practice for Classification of Flammable Liquids or Vapors and of Hazardous, (classified) Locations for Electrical Installations in Chemical Process Areas

Grainger Consulting, Inc. Reports of Findings (RoF) These reports & drawing are, by reference, a part of this Report of Findings

- Electrical Classification
- Lighting
- Electrostatic Discharge
- Containment
- Sht EC-1, Electrical Classification for CSA I & CSA II

Augspurger Komm Engineering Inc. Reports

- Tank Farm Containment, Calculations Report, 10 Jan. 2008

TANK TABLE

The table is attached. It provides many details for each tank located within the tank farm. See attached sketch, Tank Farm Plan, for a layout of the tank farm and immediate surroundings including the transport vehicle loading area.

SITE CONDITIONS

- There are fifteen tanks located within a single contained area referred to as the Tank Farm. Fourteen of the tanks are Above Ground Steel Tanks (AGST), see the attached Sketch, Tank Farm Plan. Each AGST is identified by a 3 digit number.
- There is one vertical poly tank which is used for retaining rainwater. The rainwater is used to rinse truck tanks after they are unloaded.
- A catwalk system provides access to the top of all AGST. It is described on the Tank Farm Plan[1]
- There is no fire suppression system or alarm system for either the tank farm or vehicle transfer area. There is an alert siren and lamp that provides notification of a fire alarm within the hazmat storage and office building located to the west.[2]
- Transport vehicle transfer area is located on the Tank Farm Sketch attached
- There is a containment area for the tank farm.
- Clean Harbor treats all combustible C2 liquids stored in the tank farm as a flammable liquid Class I B
- The liquids are stored in the tank farm. There is no process activity
- Certain AGST vents are piped to a vapor recovery system, see Tank Table, use column footnotes for detail. The remaining tanks have atmospheric vents. These tanks either contain rainwater or combustible C3A or C3B liquids (ambient temperatures of liquid are below liquid flash points)

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[1] See photos 6163, 6364
[2] See photo 6367

- All AGST operate at < 2.5 psi

ANALYSIS

This analysis is based upon current code and standard requirements as referenced. It is possible that various current requirements that are referenced here-in were not requirements at the time the tank farm and transfer areas were originally designed and permitted.

The following analysis applies to the tank farm and transfer area
All references, { } refer to the IFC unless otherwise noted. Chapter 27 of the IFC contains the general provisions for the handling, transfer and storage of all hazardous materials. Chapter 34 contains specific requirements for flammable and combustible liquids

- Tank piping, valves fittings – {2703.2.2} materials are to be compatible with the material stored / conveyed, manual valves shall be accessible and located at each tank
  - Manual shut off – valves are located at the inlet / outlet of each AGST.[3]
- Empty tanks {2703.2.5} shall be free of residual material and vapor.
  - Clean Harbor has cleaned the empty tanks. No Qualitative data on the extent of cleaning was requested.
- Tanks out of service for > 90 days shall be safe guarded as approved by City or removed. Fill line and other openings are to be secured against tampering. The use of Tag seals may be acceptable to the Fire Department.
  - Tags and locks have been installed on the outlet / inlet valves of all Out-of Service tanks[3] , except as noted here-in
    - No tag or lock on valves for these tanks 101, 102, 103, 104, 201, 301, 401, 601, 702
    - NFPA diamond does not have "0" in each quadrant, 201, 401, 701, 702
- Tank liquid level control to prevent over filling is required {2703.2.7, 3404.2.7, 3404.2.9.6.6 and NFPA 30} on all tanks containing flammable / combustible II liquids. See Tank Table attached.
  - . Level control is required for tanks containing Flammable Liquids (FL) or Combustible Class 2 (CL2) liquids that are in service or that have not been cleaned, see Tank Table
  - Clean Harbor has installed electronic level sensing devices on the AGST that level sensors due to planned or current use for storage of FL or CL2 liquids,[4] see Sketch #4, GCi Report of Findings – Electrical Classification.
  - Installation of the Level Monitor Control Panel is not complete. The system is not operational.
  - Data sheets for the proposed monitoring equipment have been reviewed. Regardless of voltage selected for the system, a backup power supply will be required {604.2.10, 2704.7} unless the system is designed, installed and tested to demonstrate a fail-safe system. The stated intent, by Clean Harbors, is to have the

[3] See Photo 7033

upper limit monitor sound an alarm and shut off the air supply to the pneumatic transfer pump. Schematic drawings were reviewed with Clean Harbor's engineer. The following comments were made:

- Provide a detailed sequence of operation , a matrix would be preferred
- Show all connections including the warning horn
- Label all devices on drawing such as 90% sensors, 95% sensor, the annunciator and all other equipment
- Provide a detailed equipment list
- Provide details on the backup power for the system (see notes above)
- Provide wiring diagram for the shutdown
- Provide information on the pneumatic system shut down
- Provide detail located in electrically classified areas conduit passing through these areas

- Tests of equipment and devices {2703.2.9.1} are required on a routine basis.

SYSTEM	FREQUENCY OF TEST
Liquid Level Control	Annual or more frequent based upon manufacturer recommendations
Upper level monitor, alarm & emergency shut-down	
Pressure Control – (Jayco Valve)	

  - No Test records of pressure relief valves were provided.
  - The liquid level control equipment installation is not complete, system is not operational at this time

- Signage – Each tank is to have an NFPA diamond that properly identifies the contents {2703.5 & .7.1 and 3404.2.23}. No smoking signs are required within 25' of the tank farm and transfer areas.
  - Not all NFPA diamond tank signage meets the requirement
  - No Smoking signs are posted at facility entrances
- Industrial Trucks used in electrically classified[4] areas must be suitably protected {2703.7.3}.
  - The four trucks were noted to be designated as LPS, an acceptable designation for C1D2 operation. These trucks may not be used in C1D1 areas. See Report of Findings – Electrical Classification and Drawing Sht. EC-1.
    - There are no C1D1 areas in the tank farm where an industrial truck would or could be used.
    - The C1D1 areas located in CSA II, Sht EC-1, are only active as C1D1 when a drum is open for sampling.
    - The C1D1 areas located in the Work Stations are only active as C1D1 when a drum is open.

[4] See GCi Report of Findings – Electrical Classification for details.

- Safety Precautions {2703.9}, Clean Harbor personnel are required to be familiar with the material stored. A liaison is assigned to aid the Fire Department in pre-planning emergency responses. Mr. Bob Winters is the Fire Department liaison. Mr. Brian Parker is the Clean Harbor liaison. The area is to be secure against unauthorized entry.
    - The area is secure, all gates are locked. Only certain personnel have keys to gates.
    - The Clean Harbor SOP for Bulk Flammable Liquid transfer does refer to employee training requirements.
- Spill control and secondary containment are required {2704.2.1}; see GCi Report of Findings – Containment for details
- Emergency Alarm, an approved manual alarm system is not required for outdoor storage. The IFC lists areas required to have this type of alarm system. Outside storage is not specified {2704.9}. There is no emergency alarm system at the containment area.
- Clearance from combustibles – an area of 25' around each tank and the tank area (containment) is required to be maintained clear of all combustibles {2704.11}; see attached Tank Farm Plan for an outline of this area.
    - The Work stations to the west are within that area but are separated by a fire rated wall assembly. This separation is sufficient, in my opinion, to provide an equivalent separation
- Electrical Classification - Certain areas in and around the tank farm and transfer area require classification {3403.3.1.1}, see GCi Report of Findings-Electrical Classification for details
    - The existing electrical equipment generally complies with the requirements for classification
    - There is on-going construction / modification to electrical equipment in classified areas that appears to be being constructed with recognition of the classified areas. A detailed analysis is not possible until the work is complete. Clean Harbors stated intent is to comply with the classification requirements.
- Stairs, Walkways & Catwalks – These portions of exiting systems are required {3404.2.9.3} to comply with applicable provisions of IBC and NFPA 30. Catwalks are not specifically addressed in the IFC however, the reference to IBC is so general in nature it is reasonable to include it in this discussion, particularly when IBC includes modest requirements for catwalks.
    - Minimum width 22" {IBC 1015.6.1 x1 & 4}
        - Actual width of the catwalks on site are approximately 36" wide[5]
        - Exit / access stair into the tank containment is approximately 36" wide[6]
    - Ladders are permitted as a second means of egress {IBC 1015.6.1 x4}
        - Caged ladders are provided at the extreme ends of the two catwalks [5]
    - The exit travel distance from any point on either catwalk to grade is less than 100'. The allowable distance is 300' {IBC Tbl. 1016.1}

[5] See attached photos 6364
[6] See attached photo 7021

- Static Protection is required prevent the accumulation of static charges during transfer operations {IFC 3406.5.1.7}, see GCi Report of Findings -Electrostatic Discharge for details
- Fire extinguishers, portable – {3403.2.1} Extinguishers are required and are to be provided in accordance with IFC and NFPA 10; see the attached Tank farm Plan for existing locations[7]
  - One required on each industrial truck
    - Each truck has one with a current inspection tag {309.4} minimum 4-A: 20-B: C rating.
  - NFPA 10 will require a maximum travel distance of 30' to a 4-A:40B:C extinguisher
    - The existing 40 B:C locations meet this requirement.
- Fire suppression {3404.2.9.1}
  - IFC does not require fire suppression for the tank farm as presently configured.
  - NFPA 30 does not require fire suppression for Class 2 or 3 Combustibles regardless of tank size and does not require fire suppression for Flammable liquids in tanks less than 50,000 gal. {NFPA 30 22.8.1 & 22.8.2} for AGST located as the tanks are on site.
- Fire protection of tank supports {3404.2.9.1.3}
  - legs for AGST containing FL or CL2 or CL3A liquids over 12" above grade shall have a fire resistance rating $\geq$ 2 hrs
    - Tanks 601 and 104 are supported by legs > 12" long. A minimum of 2" thick concrete has been placed around the legs of Tank 104. This is equivalent to 2 hr fire resistive protection. Tank 601 may not be used to store the flammable or combustible liquids noted above until the legs are protected[8]

END OF REPORT

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

ATTACHMENTS:
Tank Table
Sketch – Tank Farm Plan
Photos of site, 7 pages
Drawing EC-1

[7] See attached photo, 6205 for typical installation
[8] See photos 6213

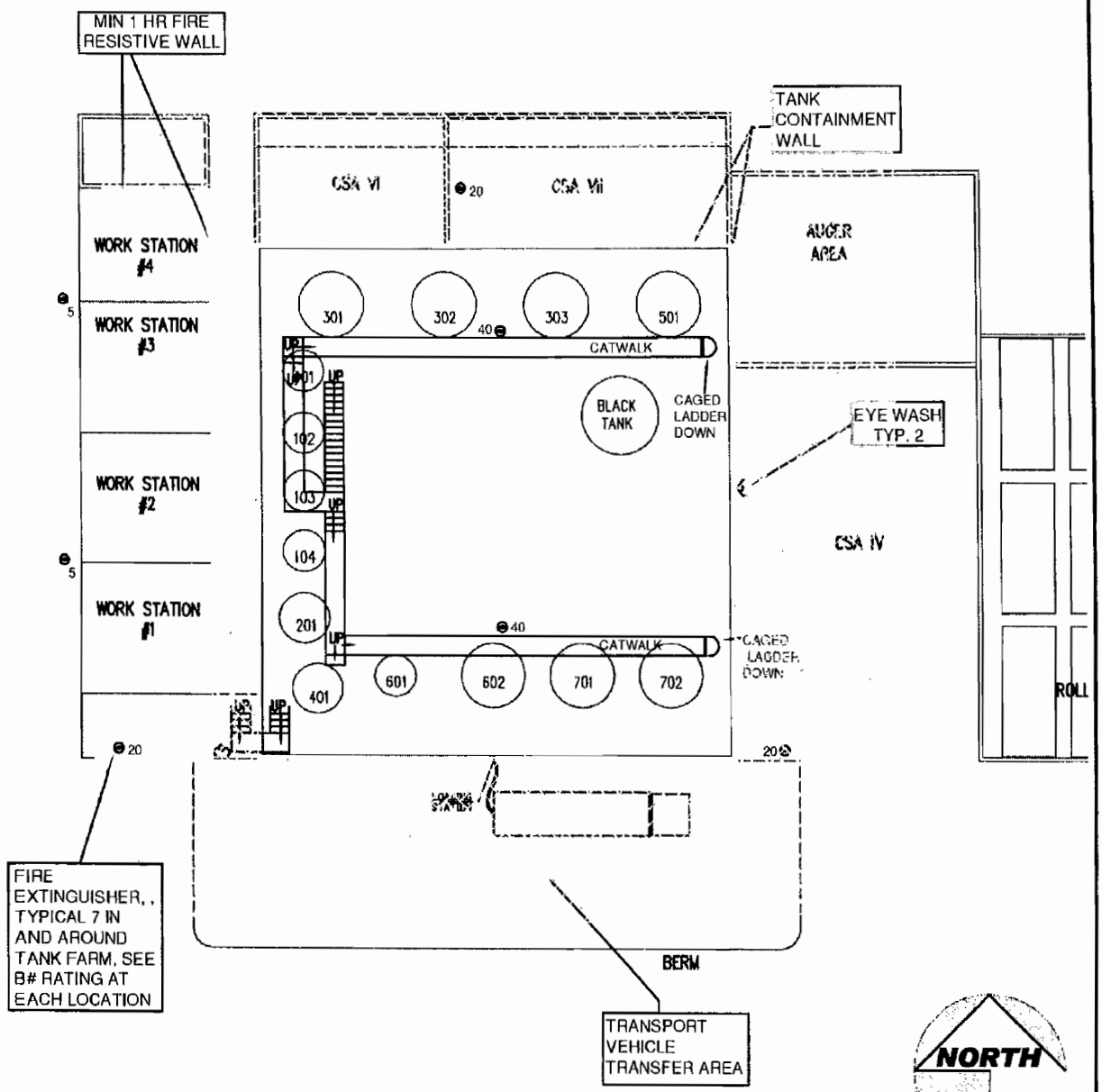
CLEAN HARBORS

GC # 2371
29 JULY 2009

TANK TABLE[1]

ID	Mfgr Tag	Vol. (gal) Full tank	Diam (Ft)	Height (Ft)	Liquid Surface Area[2] (SF)	In Use	Use	Liquid Level Monitor/upper limit[3] shut-off	Electrical Bond	Pressure Relief		
										Make/Model	+ oz	- oz
101	No tag	2,750	7	9.6'	211	N[4]	FL / C2[5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
102	No tag	2,750	7	9.6'	211	N[4]	FL / C2[5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
103	No tag	2,750	7	9.6'	211	N[4]	EVAL[5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
104	No tag	5,000	7.6	14.7	350	Y[9]	FL/C2[5,10,6,7]	Y[8]/ Y[8]	Y	Jayco / JT-20	12[11]	0.4
201	No tag	7,500	9	15.8	446	N[4]	C3A[5] or C3B[7]	N / N	Y	Jayco / JT-20	12[11]	0.4
301	No tag	10,000	11	14'	484	Y[9]	FL / C2[6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
302	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Jayco / JT-20	16	0.4
303	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Clay & Bailey T 56	8	0.4
401	No tag	7,500	9	15.8	446	N[4]	C3A or B[5]	Y[8]/Y[8]	Y	Jayco / JT-20	16	0.4
501	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Clay & Bailey T 56	0.4	0.4
601	No tag	5,000	7.6	14.7	350	N[4]	C3A or B[5,13]	N / N	Y	None		
602	Unknown, UL AGT[14]	10,000	11	14'	484	N[4]	C3A or B[5]	N / N	Y	Jayco / JT-20	16	0.4
701	FC Lowe, UL AGT	10,000	11	14'	484	N[4]	Rainwater[5]	N / N	Y	Jayco / JT-20	16	0.4
702	FC Lowe, UL AGT	10,000	11	14'	484	Y	Rainwater[7]	Y[8]/Y[8]	Y	Jayco / JT-20	16	0.4
Black		4,500	8.5	10.6	N/A	Y	Rainwater	N / N	N	None		

[1] All tanks are steel AGST except for Black which is a plastic material.
[2] Liquid surface area calculated using tank diameter shown (from AKE report) and tank total height which will provide a conservatively high total area. The maximum fill level for all AGST is ≤ 90% of total capacity.
[3] Clean Harbor has begun to install an upper limit alarm and shut down & level monitor on all AGST planned for use with FL and C2 liquids, see Code Analysis discussion.
[4] Tagged as OUT OF SERVICE, Tank has been cleaned.
[5] Contents is planned future use, Tank is presently not in use, see In Use Column
[6] Tank vent is designed for vapor recovery system, referred to as a Regulated Tank , by Clean Harbor
[7] Upper limit and level monitor devices are installed on these tanks. The monitor panel construction is not complete, see Code Analysis, Analysis –Tank liquid level discussion for detail.
[8] Electronic Device installed, not connected to monitor system.
[9] Tank is ready for service.
[10] The legs of this tank have been protected with an equivalent fire resistance of 2 hr using concrete, see Code Analysis, Fire Protection of Tank Legs Section for detail
[11] Pressure relief determined based upon spring color, white. 12oz per manufacture data
[12] Tank is under evaluation to determine if repair or replacement is warranted.
[13] The legs of this tank must be protected with an equivalent fire resistance of 2 hr before it may be used to store flammable or combustible C2 or C3A liquids, see Code Analysis, Fire Protection of Tank Legs Section for detail
[14] AGT (Above Ground Tank) same as Above Ground Steel Tank (AGST) in this report.



TANK FARM PLAN

N.T.S.

COMBUSTIBLE CLEAR AREA

TRANSPORT VEHICLES LOADING / UNLOADING PRODUCT ARE EXCLUDED

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

Grainger Consulting
Fire Protection Engineering • Code Consulting
4135 E. FAIRVIEW CIR., MESA, AZ 85206 (480) 833-2100

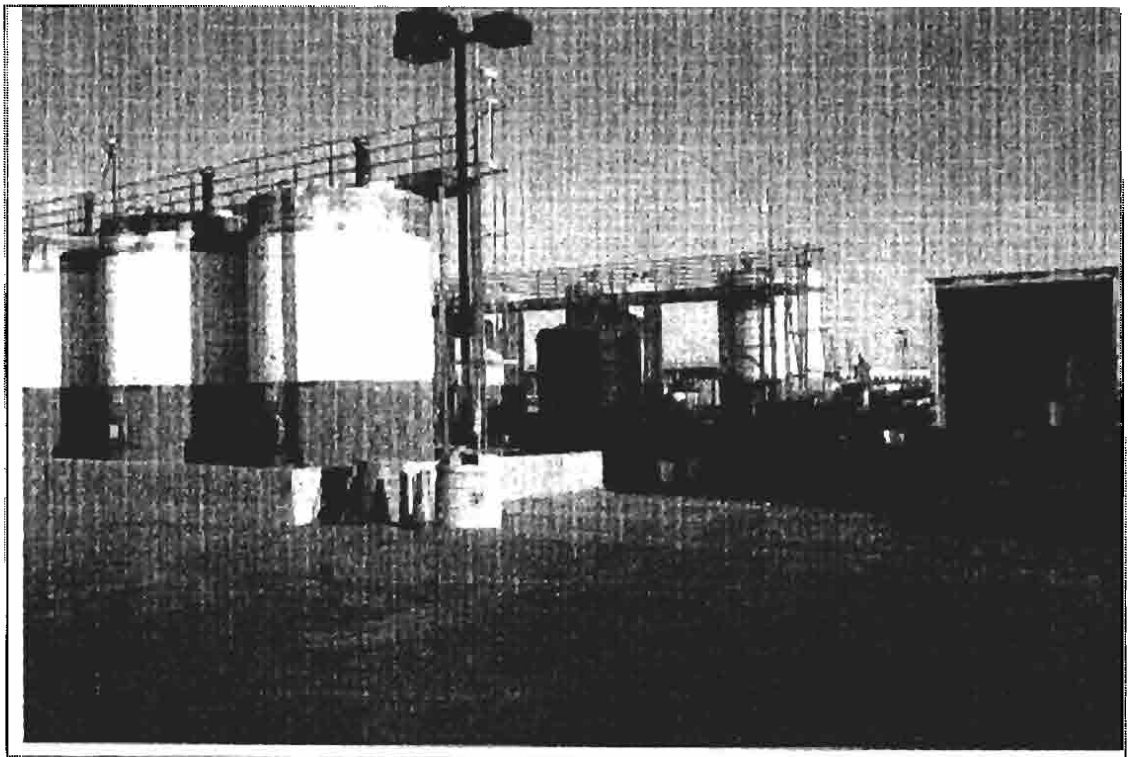
PROJECT · CLEAN HARBOR TANK FARM
TANK FARM PLAN

GC #: 2371 | DRAWN BY: TABII | REVIEWED BY: SG | DATE: 07/27/09

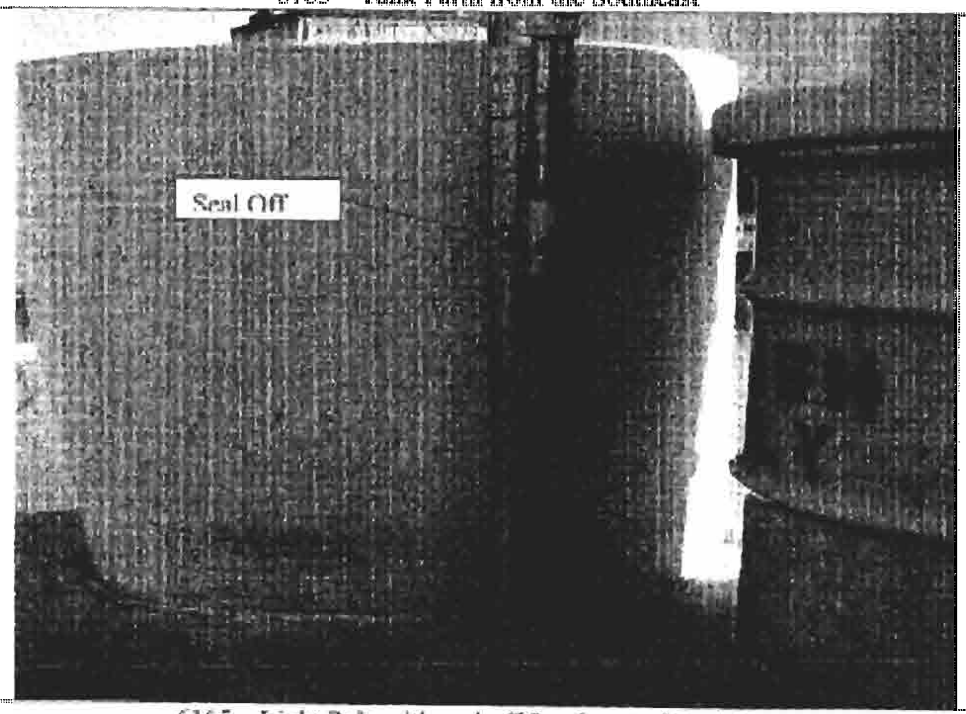
CODE ANALYSIS

TANK FARM & COMPACTOR PHOTOS
CLEAN HARBORS

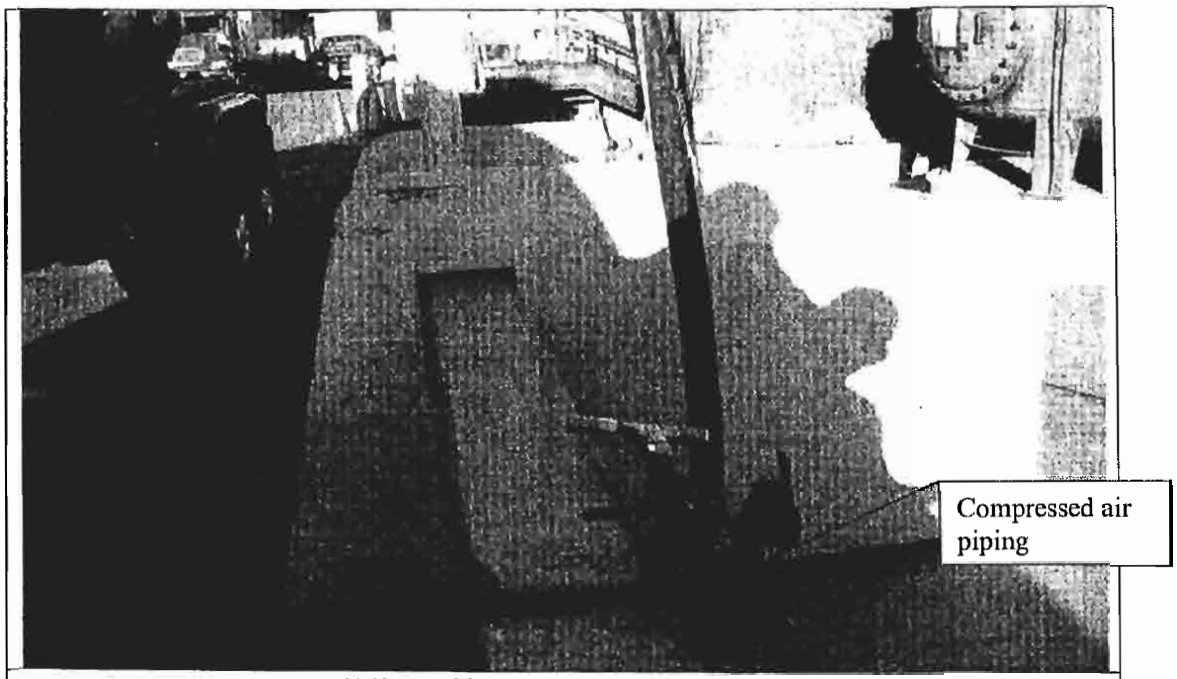
28 JULY 2009
GC# 2371



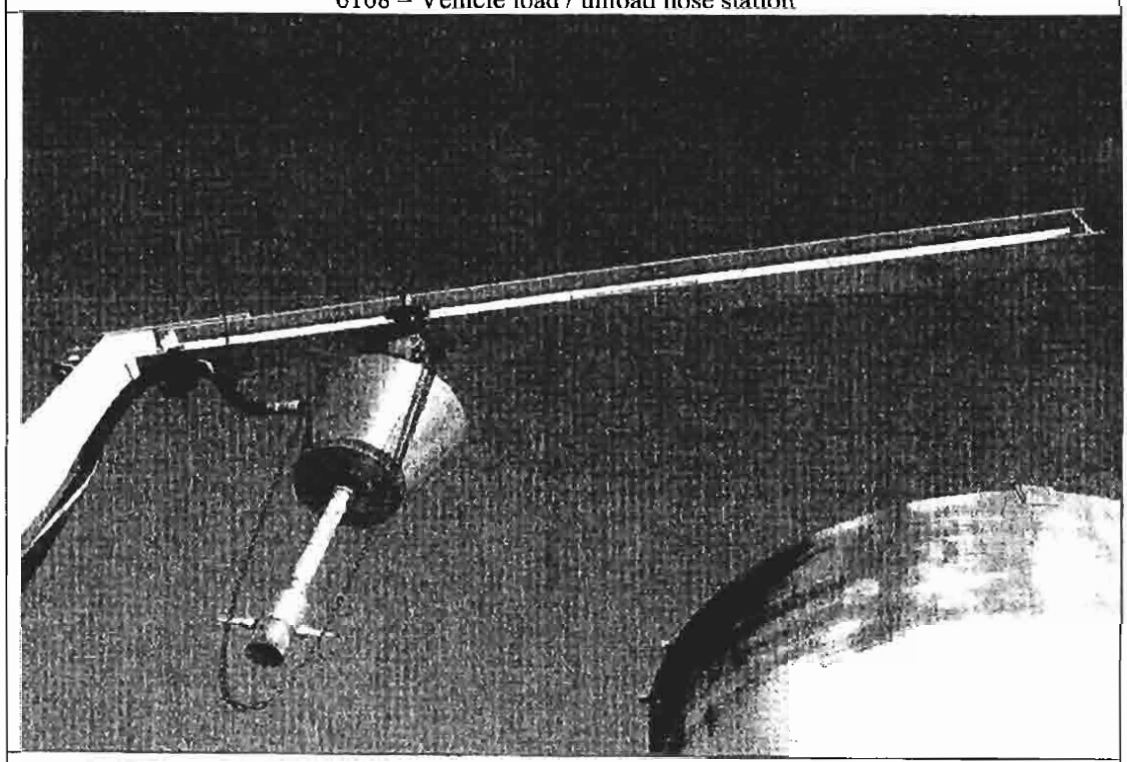
6163 – Tank Farm from the Southeast



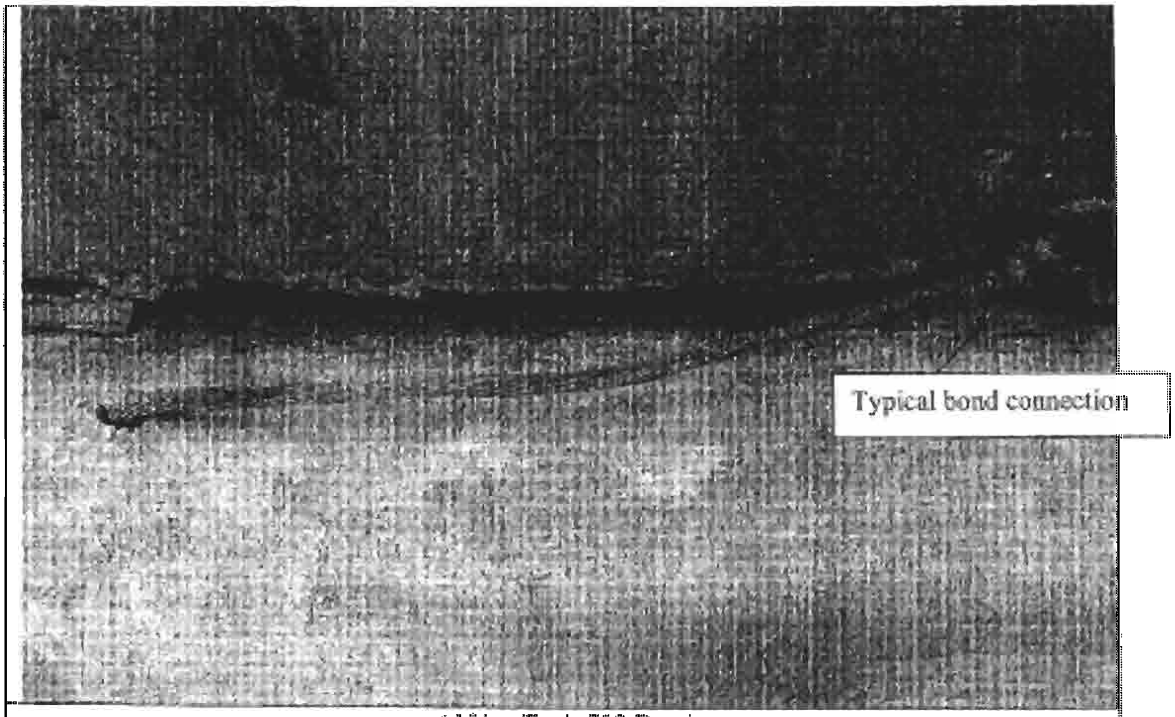
6165 – Light Pole with seal off Southeast of Tank Farm



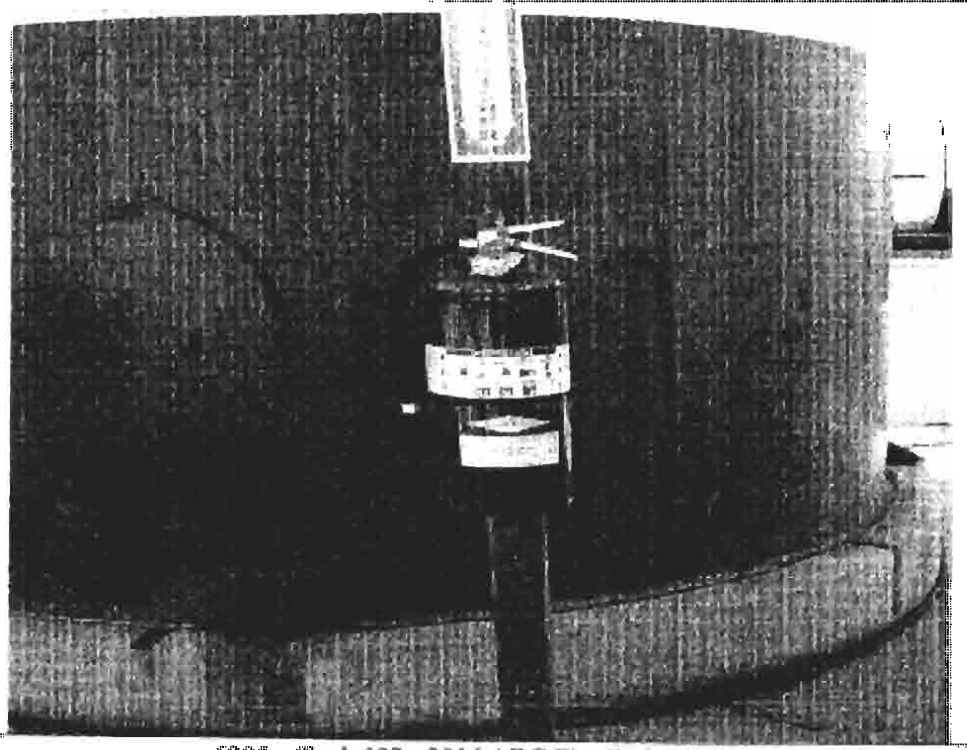
6168 – Vehicle load / unload hose station



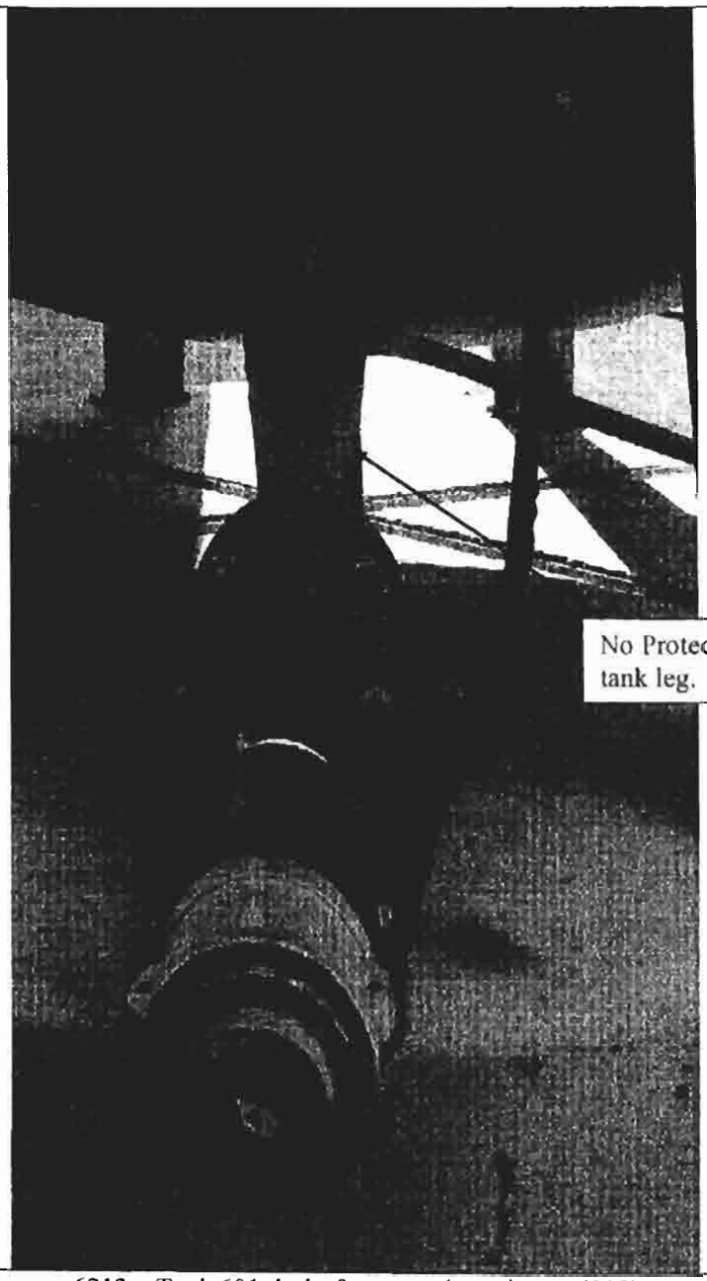
6169 – Vehicle tank wash / gantry crane



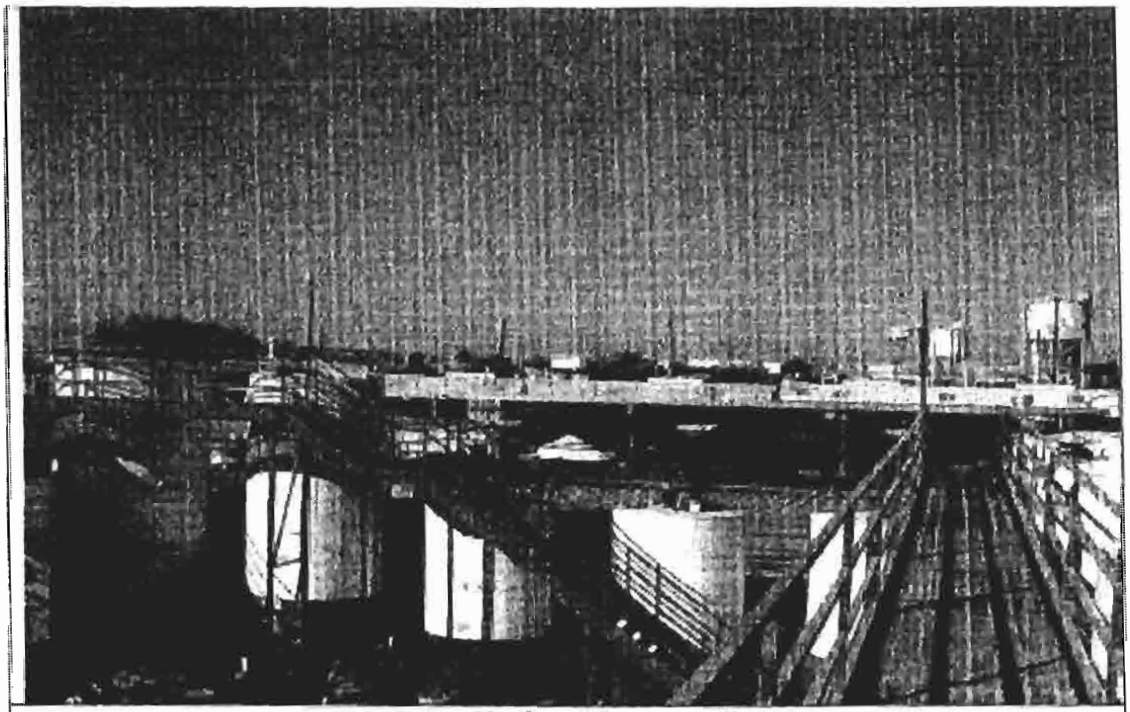
6191 – Tank 702 Bond



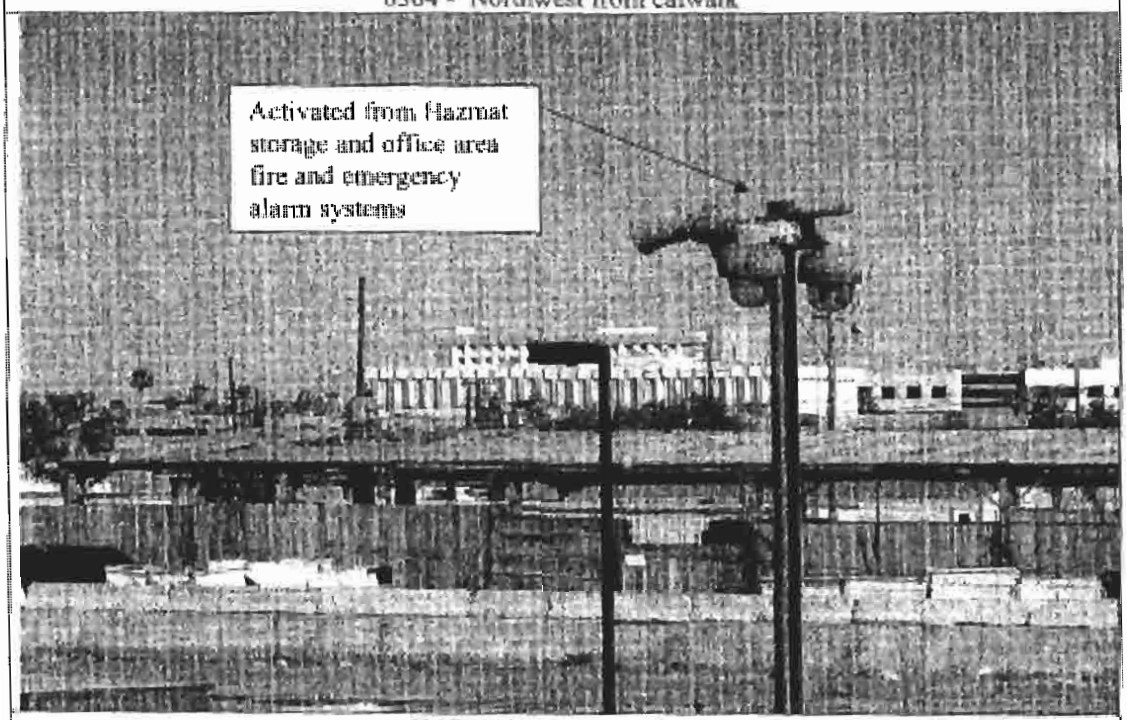
6205 – Tank 602 - 2016 ABC Fire Extinguisher



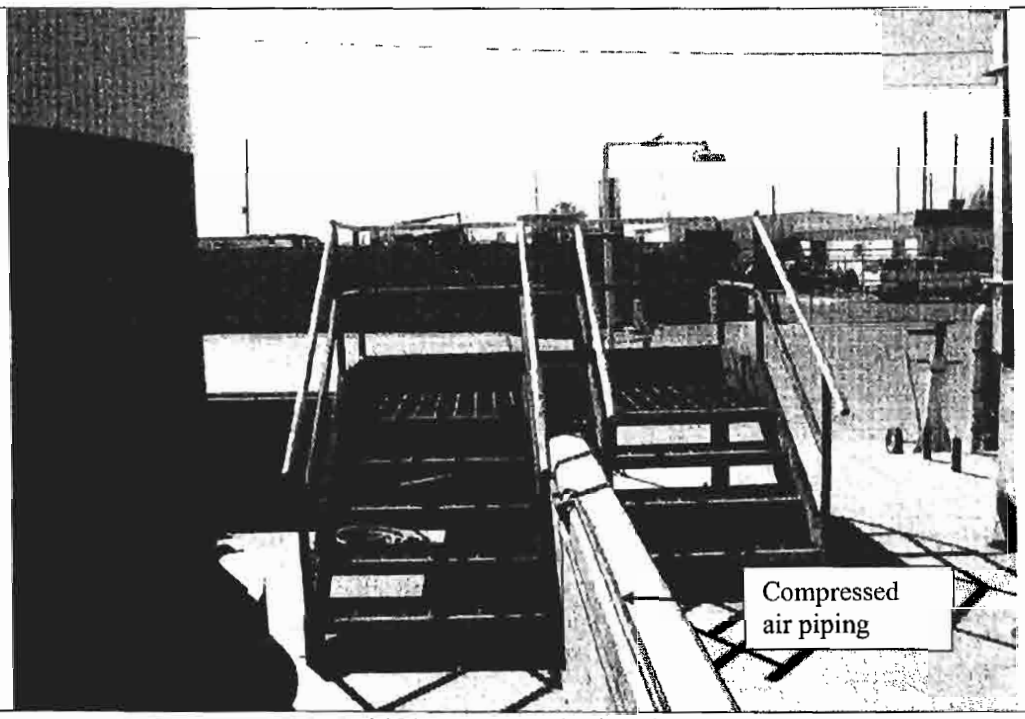
6213 – Tank 601 drain & gauge (see picture 6309)



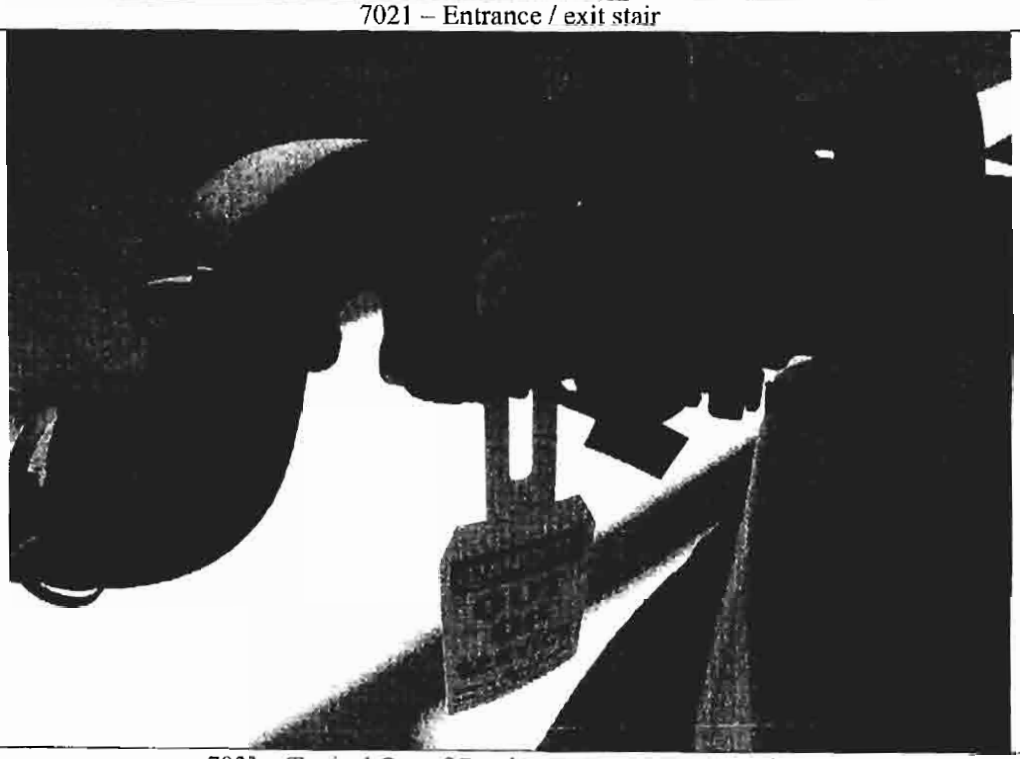
6364 - Northwest from catwalk



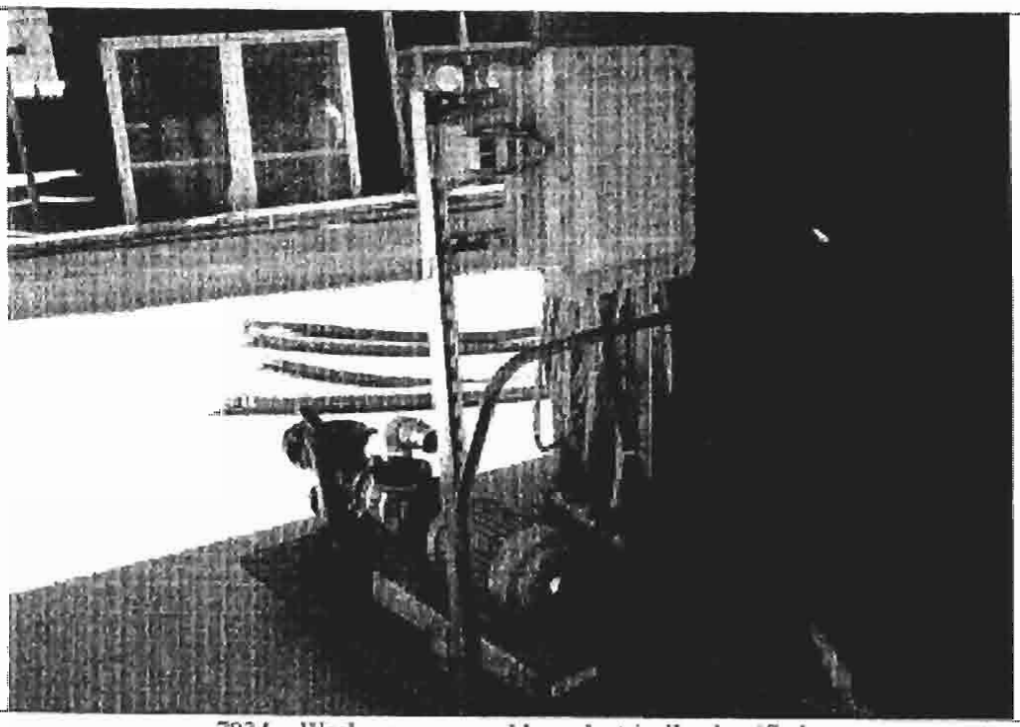
6367 – Alert horn and lamps



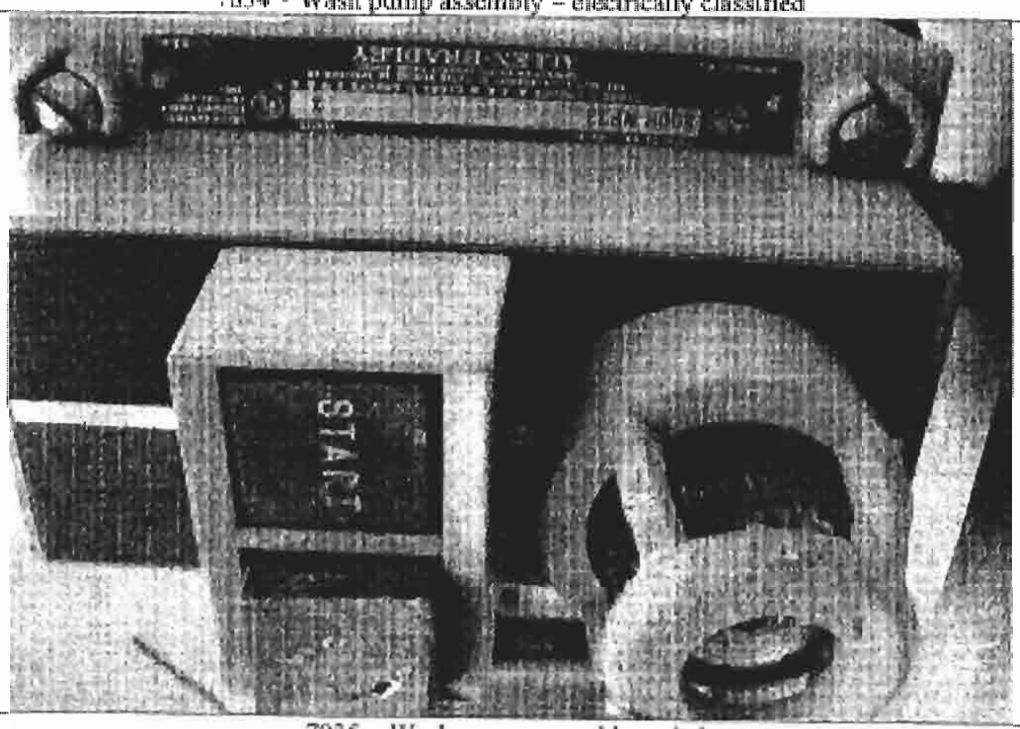
7021 – Entrance / exit stair



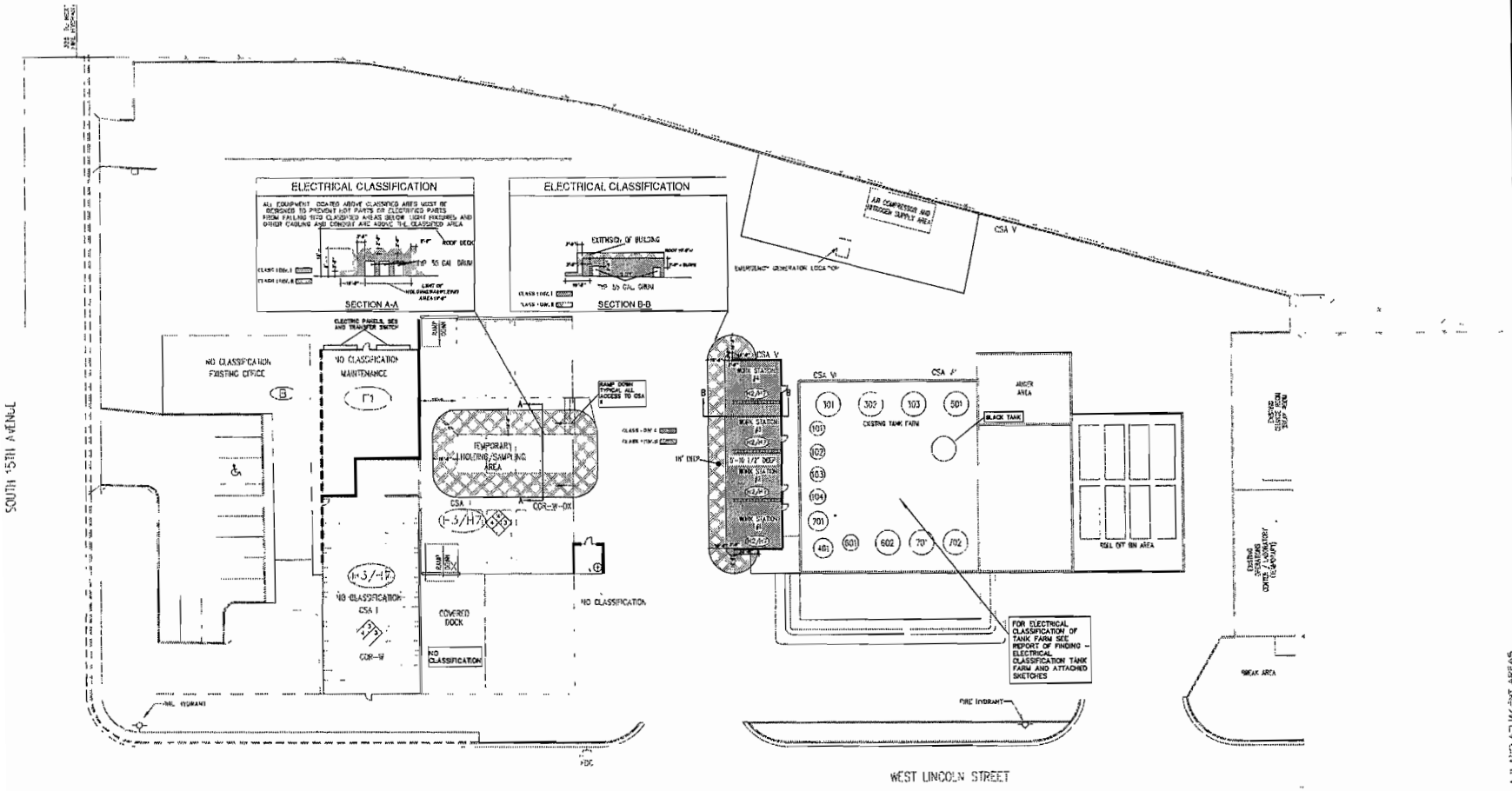
7033 – Typical Out of Service Tank valve lock and tag



7034 - Wash pump assembly – electrically classified



7035 - Wash pump assembly switch



NOTE: CONSTRUCTION TYPE AND OCCUPANCY REFERENCES ARE IN ACCORDANCE WITH THE 1994 UBC WHICH WAS IN EFFECT WHEN THE ORIGINAL CLASSIFICATION WORK WAS PERFORMED AT THE SITE.

STRUCTURE	AREA (SF)	OCCUPANCY / USE	CONST. TYPE
OFFICE	2860	B	5N
MAINTENANCE	2400	F1	2N
CSA I	3900	H3/H7	2N
CSA II	8510	H3/H7	USE 2N
COVERED DOCK	1575		
TOTAL	14,990		
WORK STATION #1	380	H3/H7	2N
WORK STATION #2	380	H3/H7	2N
WORK STATION #3	380	H3/H7	2N
WORK STATION #4	380	H3/H7	2N
TOTAL	1520		

ASSUMPTIONS:

1. AEROSALS ARE CONTAINED WITHIN STEEL DRUMS.
2. THE EXIST. B (OFFICE) STRUCTURE WAS CONSTRUCTED AT 5N AND MEETS ALL REQUIREMENTS FOR 3' DISTANCE FROM EXIST. H7, TYPE 2N LOCATED TO THE EAST.
3. WORK STATIONS CAN BE EXPECTED TO HAVE MATERIAL QUANTITIES IN EXCESS OF EXEMPT AMOUNTS & MONITORING OF QUANTITIES TO MAINTAIN QUANTITY BELOW EXEMPT AMOUNT IS NOT FEASIBLE.
4. VERTICAL EXTERIOR STORAGE TANKS ARE EQUIPPED W/ EMERGENCY RELIEF VENTS & ARE ATMOSPHERIC TANKS < 2.5 PSI.

WASTE TYPE	BUILDING
LIQUID CN–	CSA II
SOLID/SLUDGE CN–	CSA II
WATER/METAL SOLUTIONS	CSA I, III, WORKSTATIONS
AEROSOLS	CSA II
FUELS	CSA II,WORKSTATIONS
INCINERABLE SOLIDS	CSA II,IV,V
GAS CYLINDERS	
PROPANE	CSA IV
OXYGEN	CSA IV
IGNITABLE LIQUIDS	CSA II,WORKSTATIONS
LABPACK SOLVENTS	CSA II,IV,V,VI,VII,WORKSTATIONS
LABPACK CONTAINERABLE SOLIDS	CSA II,IV,V,VI,VII,WORKSTATIONS
LABPACK REACTIVES	CSA II,IV,V,VI,VII,WORKSTATIONS
LABPACK OXIDIZERS	CSA II,IV,V,VI,VII,WORKSTATIONS
OXIDIZER SOLIDS	WORKSTATIONS
OXIDIZER LIQUIDS	WORKSTATIONS
METALLIC WASTE	CSA II,IV,V,VI,VII
ACID SOLUTIONS	
NITRIC ACID (OX)	CSA WORKSTATIONS
NON–OXIDIZERS	CSA I
CAUSTIC SOLUTIONS	CSA II,WORKSTATIONS
LATEX PAINTS	CSA II,IV,VI
OIL BASED PAINTS LOOSEPACKED	CSA II,IV,V
SOLVENTS BASED STAINS LOOSEPACKED	CSA II,IV,V
CHLORINATED SOLVENTS	CSA II,WORKSTATIONS

NOTE: WASTE IN THE WORKSTATIONS ARE RELATED BY COMPATIBILITY FOR EACH UNIT. OIL, SOLVENTS AND OXIDIZERS WILL NOT BE STORED IN THE SAME WORKSTATION.

LEGEND:

WALLS

- NO RATING, NON–COMBUSTIBLE
- STRUCTURAL FRAME ONLY. NO NON–STRUCTURAL ELEMENTS.
- 1 HOUR RATED OCCUPANCY SEPERATION
- 1 HOUR RATING TO 10' ABOVE COURT FLOOR OR TO ROOF, WHICHEVER COMES FIRST.
- NONCOMBUSTIBLE WALL FULL HEIGHT EQUIVALENT TO MINIMUM 1 HR RATING.
- X–X–X CHAIN LINK FENCE

PROPERTY–OUTLINES

- PROPERTY LINE, EITHER LEGAL OR FOR BUILDING SEPARATION
- OUTLINE OF WEST BUILDING FOR SETBACK AND ACCESS PURPOSES.

N

DRAWING SCALE 1"=20'

10 0 10 20 40 60

REVISION

OCT 7 2009

PROJECT

CLEAN HARBOR

CLIENT

CLEAN HARBOR
1340 W LINCOLN ST
PHOENIX, AZ 85005

CITY OF PHOENIX DEPARTMENT OF ENVIRONMENTAL QUALITY

DESIGNED BY GHP DATE 12/1/03

CALCULATED BY DATE 12/1/03

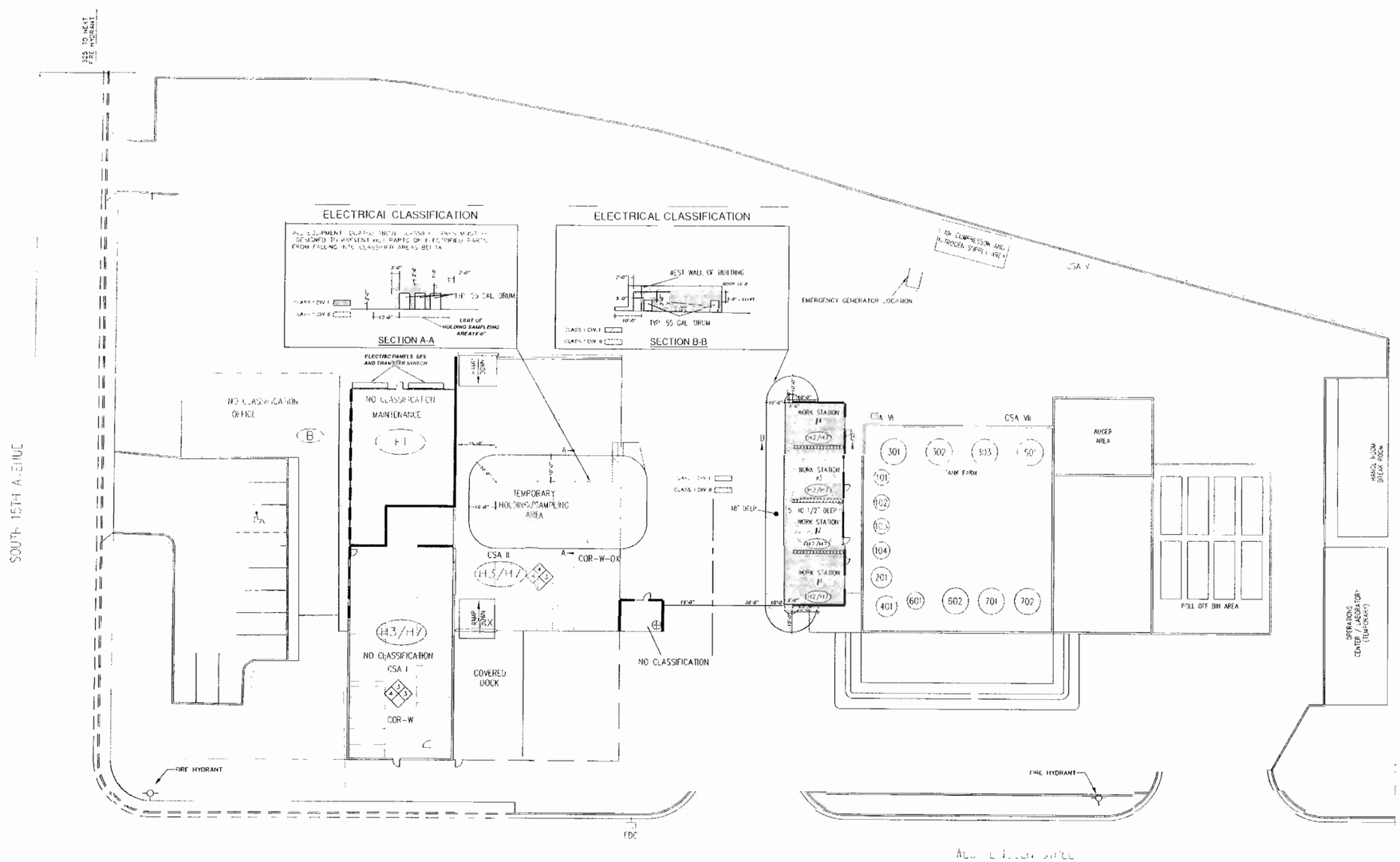
DRAWN BY GHP DATE 12/1/03

CHECKED BY SG DATE 12/1/03

EXPIRES 6/30/2011

SHEET EC-1 OF 1

864 2368 & 2371 ELECTRICAL CLASSIFICATION FOR CSA I, & II AND ADJACENT AREAS



STRUCTURE	AREA (SF)	OCCUPANCY / UBC	CONST. TYPE
OFFICE	2880	B	5N
MAINTENANCE	2400	F1	2N
CSA I	3200	H3/H7	2N
CSA II	6510	H3/H7	USE 2N
COVERED DOCK	1575		
TOTAL	14,990		
WORK STATION #1	380	H3/H7	2N
WORK STATION #2	380	H3/H7	2N
WORK STATION #3	380	H3/H7	2N
WORK STATION #4	380	H3/H7	2N
TOTAL	1520		

ASSUMPTIONS:

1. AEROSALS ARE CONTAINED WITHIN STEEL DRUMS.
2. THE EXIST. B (OFFICE) STRUCTURE WAS CONSTRUCTED A1 5N AND MEETS ALL REQUIREMENTS FOR 5' DISTANCE FROM EXIST. H7, TYPE 2N LOCATED TO THE EAST.
3. WORK STATIONS CAN BE EXPECTED TO HAVE MATERIAL QUANTITIES IN EXCESS OF EXEMPT AMOUNTS & MONITORING OF QUANTITIES TO MAINTAIN QUANTITY BELOW EXEMPT AMOUNT IS NOT FEASIBLE.
4. VERTICAL EXTERIOR STORAGE TANKS ARE EQUIPPED W/ EMERGENCY RELIEF VENTS & ARE ATMOSPHERIC TANKS < 2.5 PSI.

WASTE TYPE	BUILDING
LIQUID ON--	CSA II
SOLID/SLUDGE ON-	CSA II
WATER/METAL SOLUTIONS	CSA I, II, WORKSTATIONS
AEROSOLS IN CLOSED DRUMS	CSA II
FUELS	CSA II, WORKSTATIONS
INCINERABLE SOLIDS	CSA II, IV, V, VI, VII
GAS CYLINDERS	
PROPANE	CSA IV
OXYGEN	CSA IV
IGNITABLE LIQUIDS	CSA II, WORKSTATIONS
LABPACK SOLVENTS	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK ICINERABLE SOLIDS	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK REACTIVES	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK OXIDIZERS	CSA II, IV, VI, VII, WORKSTATIONS
OXIDIZER SOLIDS	WORKSTATIONS
OXIDIZER LIQUIDS	WORKSTATIONS
METALLIC WASTE	CSA II, IV, V, VI, VII
ACID SOLUTIONS	
NITRIC ACID (OX)	CSA WORKSTATIONS
NON--OXIDIZERS	CSA I
CAUSTIC SOLUTIONS	CSA II, WORKSTATIONS
LATEX PAINTS	CSA II, IV, V, VI, VII
OIL BASED PAINTS LOOSEPACKED	CSA II, IV, V, VI, VII
SOLVENTS BASED STAINS LOOSEPACKED	CSA II, IV, V, VI, VII
CHLORINATED SOLVENTS	CSA II, WORKSTATIONS

NOTE: WASTES IN THE WORKSTATIONS ARE ISOLATED BY COMPATIBILITY FOR EACH UNIT. I.E., SOLVENTS AND OXIDIZERS WILL NOT BE STORED IN THE SAME WORKSTATION

LEGEND:

WALLS:

- NO RATING, NON-COMBUSTIBLE
- STRUCTURAL FRAME ONLY NO NON-STRUCTURAL ELEMENTS
- 1 HOUR RATED OCCUPANCY SEPERATION REQUIRED
- 1 HOUR RATING TO 10' ABOVE COURT FLOOR OR TO ROOF WHICHEVER COMES FIRST
- NONCOMBUSTIBLE WALL 18" TALLER THAN STORAGE & 24" WIDER THAN STORAGE
- X—X— CHAIN LINK FENCE

PROPERTY OUTLINES:

- PROPERTY LINE, EITHER LEGAL OR FOR BUILDING SEPARATION
- OUTLINE OF WEST BUILDING FOR SETBACK AND ACCESS PURPOSES

N

GRAPHIC SCALE 1"=20'

10 0 10 20 40 60

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
MAR 01 2010
Waste Programs Div.
Permits Section

REVISION

PROJECT: CLEAN HARBOR

CLIENT: CLEAN HARBOR, 1340 W LINCOLN S, PHOENIX AZ 85005

AHJ: CITY OF PHOENIX DEPARTMENT OF ENVIRONMENTAL QUALITY

DESIGNED BY GWP DATE 12/17/07
CALCULATED BY GWP SE CALC DATA
DRAWN BY GWP DATE 12/17/07
CHECKED BY SG DATE 12/17/07

Registered Professional Engineer, State of Arizona, CERTIFICATE NO. 30031, SCOTT G. GRAINGER, Date Signed 12/17/07

ELECTRICAL CLASSIFICATION

SHEET EC-1 OF 1

GC# 2328

Grainger Consulting, Inc.
*Fire Protection / Forensic Engineering * Code Consulting*
4135 E Fairview Cir * MESA, AZ 85206 * 480.833.2100 * Fax 480.833.2941 *www.grangerconsulting.com

REPORT OF FINDINGS - ELECTRICAL CLASSIFICATION

PROJECT: CLEAN HARBOR TANK FARM GC #2371

DATE: 28 July 2009

CLIENT:
Brian Parker
Clean Harbor Environmental Services
1340 W Lincoln St
Phoenix, AZ 85007
602-462-2300 Office
602-721-7238 Mobile
602-462-2390 Fax
Parker.brian@cleanharbors.com

Registered Professional Engineer (Fire Protection)
CERTIFICATE NO. 30031
SCOTT C. GRAINGER
07/28/09
Date Signed
ARIZONA U.S.A.

Exp 03/31/2011

PURPOSE:
Determine the appropriate electrical classification of areas within and immediately adjacent to: Tank farm containment and the compactor area.

STATEMENT:
This Report of Findings is very limited in scope. It applies ONLY to the specific conditions noted for this project and at the location below. The information contained here-in may not be used for any other project or location without the expressed written approval of this Engineer. Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report and as the applicable codes and standards apply to the instant condition.

PROJECT LOCATION:
1340 W Lincoln St
Phoenix, AZ 85007

REFERENCES:
National Fire Protection Association (NFPA)

- NFPA 30, 2008, Flammable and Combustible Liquids Code
- NFPA 70, 2005, National Electrical Code, as adopted by City of Phoenix
- NFPA 497, 2004, Recommended Practice for Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

International Code Council (ICC)

- International Building Code (IBC), 2006, as adopted by City of Phoenix

- International Fire Code (IFC), 2006, as adopted by City of Phoenix

Grainger Consulting, Inc. (GCI) Reports of Findings

- Electrostatic Discharge
- Code Analysis
- Containment
- Lighting

SITE CONDITIONS:

- There are 15 Above Ground Storage Tanks (AGT) in the bulk storage area, see the attached Sketch #1 for a site plan. Certain of these tanks are used to store waste flammable and combustible liquids. A detailed list of all tanks by ID is attached as the Tank Table. The content of each tank is listed generically as well as tank volume and information regarding the pressure relief system.
- All tanks are fitted with a relief valve such that the pressure within the tank will not exceed 2.5 psi.
- All tanks containing or planned for future storage of flammable or combustible liquids are identified in the Tank Table. Each of these tanks is steel.
- Certain tanks are out of service. This condition is noted in the Tank Table and also placarded as "out of service" on the affected tanks. Out of service tanks also carry the NFPA diamond with all quadrants as "0".
- Liquid is transferred to the individual tanks and from a selected tank via hose lines and pumps. All tank transfer is accomplished via outlets at the base of each tank.
- All flammable / combustible liquid storage tank vents are vapor controlled. Vapors are processed prior to release.
- Clean Harbor operates the facility as though all flammable or combustible liquids are flammable
- Liquid transfer from tank vehicle to / from AGST is accomplished using pneumatic pumps.
- Movement of rainwater / wash water for AGST is accomplished with an electrically driven pump[1]. All equipment is listed for the use.

ANALYSIS:

The purpose of the electrical classification of areas in and around the storage and transfer of all flammable liquids and certain combustible liquids, specifically in the instant condition, various flammable liquids and Combustible Class II liquids (flash point <140F) is to reduce the risk of ignition of flammable vapors when they may be expected to exist in excess of 25% of the lower flammable limit (LFL) under normal or frequent operating conditions {IFC 3403.1.1; NFPA 497, 5.2.1.1.; NFPA 70, 500.5(B)(1)(1-3)}. Many of these conditions or similar conditions are described in the referenced codes and standards as noted in the material following. A summary of the following description of classified areas is presented graphically in the attached Sketches, 1, 2, & 4

[1] See GCi Report of Findings – Code Analysis, photos 7034, 7035

The IFC contains a table, 3403.1.1, of conditions that are described in text only. This table is a partial copy of a similar table contained in NFPA 70, Art 515, Table 515.3. Electrical Classification for Bulk Storage Plants. NFPA 70 also references NFPA 30. NFPA 30 contains an abbreviated table, similar to that of the IFC for classification purposes. NFPA 497 specifically addresses chemical processes which have some similarities to the instant conditions that are more specific than those in any of the other referenced materials. Where this is the case, 497 is referenced.

All conditions described are for equipment handling or storing any flammable liquids or Class II combustible liquids. In other words, all combustible and flammable liquids with a flash point less than 140F. Fluid temperatures are not expected to exceed 140F due to volumes stored.

Pumps, meters, scrubbing and other piping equipment – (see Sketch #3)

- [All pumps and similar equipment are within the storage tank containment barriers]
- C1D2 - 3' sphere around each piece of equipment and hose connections.

Pits without mechanical ventilation in areas with a classified space above the depression.

- None of the standards considers an exterior condition similar to the instant condition (no roof or walls condition) to provide adequate ventilation for this purpose. The containment area is not considered a pit, however.
- C1D1 – the volume of the pit, level to the top of the pit

Tank vehicle loading via bottom connection with vapor control – (see attached Sketch # 2) [This is the manner and method used for all liquid transfer according to Client.]

- C1D1 – area within the tank
- C1D2 – 3' sphere around points of connection
- C1D2 – 10' radius from point of connection(s) horizontally along grade and 18" deep above grade
  - C1D2 – 3' around all hoses

Storage tank (AGT) with vapor control, there is no atmospheric vent – (see attached Sketch #3)

- C1D1 – area within the tank
- C1D2 – 3' sphere around points of connection for hoses, regardless of connection point location.
- C1D2 – 3' sphere around pressure relief valve (see attached sketch # 3 & 4 and typical top of tank detail.

Storage tank containment- (see attached Sketch #1 & 3)

- C1D2 – within the containment barriers to the depth of the containment barriers
- C1D2 – area directly above the containment an additional 18" above the containment barriers
- C1D2 – area around the exterior of the containment barriers horizontally 15' and vertically 18" above grade

Vapor Recovery System (see attached sketch # 3)

- C1D1 – Area within drums
- C1D2 – 3' around all hoses
- C1D2 – 3' radius sphere around all drums

Adjacent Work Stations – (see attached Sketch #1)

- The walls of the work station facing the tank farm and the north and south walls of the Work Station are solid barriers except for the 4 exit doors located on the east wall. Each door has an automatic closer except for hose pass through openings. These openings are to be closed. The interior of each work station is classified C1D1 as determined in a previous GCi report of findings. The C1D2 classification from the tank farm does not penetrate the wall of the work station and would not pass through the doors. If the C1D1 area was shown to emanate beyond any of the exit doors, it would have been 24" deep C1D2 and been stopped at the containment barrier (36" ±high) {NFPA 497, Fig. 5.9.1(j)}.

Equipment located above and outside of any classified area, although not within the classified area may be affected by the presence of the classified area below.

- Equipment located above a classified area should be designed to prevent burning brands or similarly hot material from falling into the classified area in case of an equipment failure that maybe reasonably expected. In the instant case, the only such equipment is the area light fixtures. All fixtures have lenses below the bulb. No additional protection is considered necessary, in my opinion.
- Ground Vapor recovery system – within 15' of containment; The tanks are steel; It is above the C1D2 space below, therefore – OK

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

ATTACHMENTS:

- Tank Table
- Electrical Classification Sketches 1 → 4

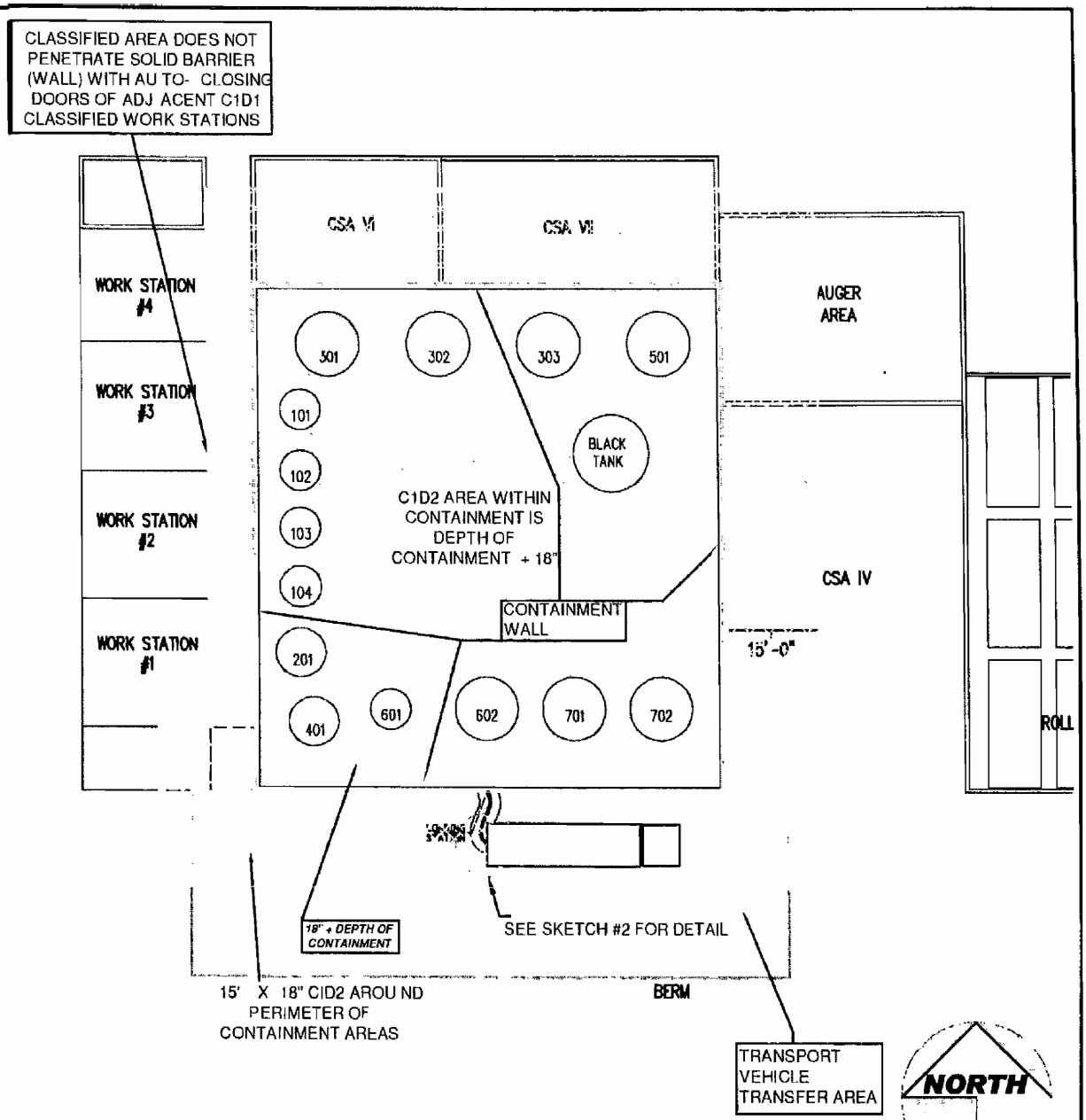
CLEAN HARBORS

GC # 2371
29 JULY 2009

TANK TABLE[1]

ID	Mfgr Tag	Vol. (gal) Full tank	Diam (Ft)	Height (Ft)	Liquid Surface Area[2] (SF)	In Use	Use	Liquid Level Monitor/upper limit[3] shut-off	Electrical Bond	Pressure Relief		
										Make/Model	+ oz	- oz
101	No tag	2,750	7	9.6'	211	N[4]	FL / C2[5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
102	No tag	2,750	7	9.6'	211	N[4]	FL / C2[5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
103	No tag	2,750	7	9.6'	211	N[4]	EVAL [5,6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
104	No tag	5,000	7.6	14.7	350	Y[9]	FL/C2[5,10,6,7]	Y[8]/ Y[8]	Y	Jayco / JT-20	12[11]	0.4
201	No tag	7,500	9	15.8	446	N[4]	C3A[5] or C3B[7]	N / N	Y	Jayco / JT-20	12[11]	0.4
301	No tag	10,000	11	14'	484	Y[9]	FL / C2[6,7]	Y[8] / Y[8]	Y	Jayco / JT-20	16	0.4
302	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Jayco / JT-20	16	0.4
303	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Clay & Bailey T 56	8	0.4
401	No tag	7,500	9	15.8	446	N[4]	C3A or B[5]	Y[8]/Y[8]	Y	Jayco / JT-20	16	0.4
501	No tag	10,000	11	14'	484	N[4]	Eval[12]	N / N	Y	Clay & Bailey T 56	0.4	0.4
601	No tag	5,000	7.6	14.7	350	N[4]	C3A or B[5,13]	N / N	Y	None		
602	Unknown, UL AGT[14]	10,000	11	14'	484	N[4]	C3A or B[5]	N / N	Y	Jayco / JT-20	16	0.4
701	FC Lowe, UL AGT	10,000	11	14'	484	N[4]	Rainwater[5]	N / N	Y	Jayco / JT-20	16	0.4
702	FC Lowe, UL AGT	10,000	11	14'	484	Y	Rainwater[7]	Y[8]/Y[8]	Y	Jayco / JT-20	16	0.4
Black		4,500	8.5	10.6	N/A	Y	Rainwater	N / N	N	None		

[1] All tanks are steel AGST except for Black which is a plastic material.
[2] Liquid surface area calculated using tank diameter shown (from AKE report) and tank total height which will provide a conservatively high total area. The maximum fill level for all AGST is ≤ 90% of total capacity.
[3] Clean Harbor has begun to install an upper limit alarm and shut down & level monitor on all AGST planned for use with FL and C2 liquids, see Code Analysis discussion.
[4] Tagged as OUT OF SERVICE, Tank has been cleaned.
[5] Contents is planned future use, Tank is presently not in use, see In Use Column
[6] Tank vent is designed for vapor recovery system, referred to as a Regulated Tank , by Clean Harbor
[7] Upper limit and level monitor devices are installed on these tanks. The monitor panel construction is not complete, see Code Analysis, Analysis –Tank liquid level discussion for detail.
[8] Electronic Device installed, not connected to monitor system.
[9] Tank is ready for service.
[10] The legs of this tank have been protected with an equivalent fire resistance of 2 hr using concrete, see Code Analysis, Fire Protection of Tank Legs Section for detail
[11] Pressure relief determined based upon spring color, white. 12oz per manufacture data
[12] Tank is under evaluation to determine if repair or replacement is warranted.
[13] The legs of this tank must be protected with an equivalent fire resistance of 2 hr before it may be used to store flammable or combustible C2 or C3A liquids, see Code Analysis, Fire Protection of Tank Legs Section for detail
[14] AGT (Above Ground Tank) same as Above Ground Steel Tank (AGST) in this report.



TANK FARM PLAN

N.T.S.

CLASS 1 DIV. II

CLASS 1 DIV. I

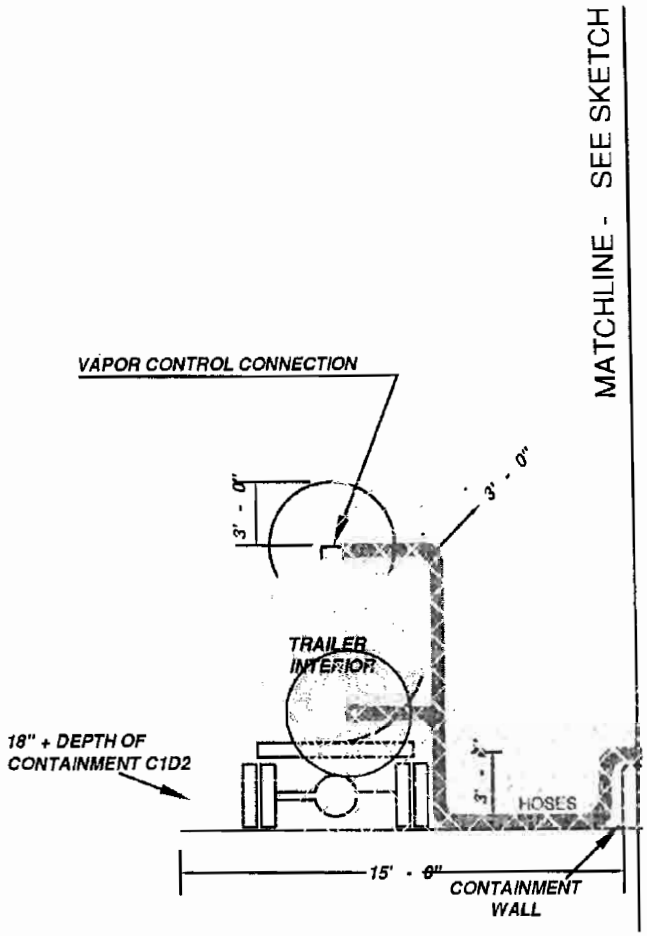
Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

Grainger Consulting

Fire Protection Engineering • Code Consulting
4135 E. FAIRVIEW CIR., MESA, AZ 85206 (480) 833-2100

PROJECT · CLEAN HARBOR TANK FARM
TANK FARM PLAN

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	1 OF 4



TANK TRAILER CROSS SECTION

N.T.S.

NOTES:

1. THERE ARE NO ATMOSPHERIC VENTS. ALL VENTS ARE VAPOR CONTROLLED. ON TANKS CONTAINING OR PLANNED FOR U SE WITH FL OR CL2 LIQ U IDS, SEE TANK TABLE FOR DETAIL.
2. CLASSIFIED TANK AREAS APPLY ONLY TO TANKS U SED FOR FLAMMABLE LIQ U IDS OR COMBU STIBLE CLASS 2 LIQ U IDS.
3. CLASSIFIED CONTAINMENT AREAS APPLY TO THE ENTIRE CONTAINMENT.

CLASS 1 DIV. II

CLASS 1 DIV. I

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

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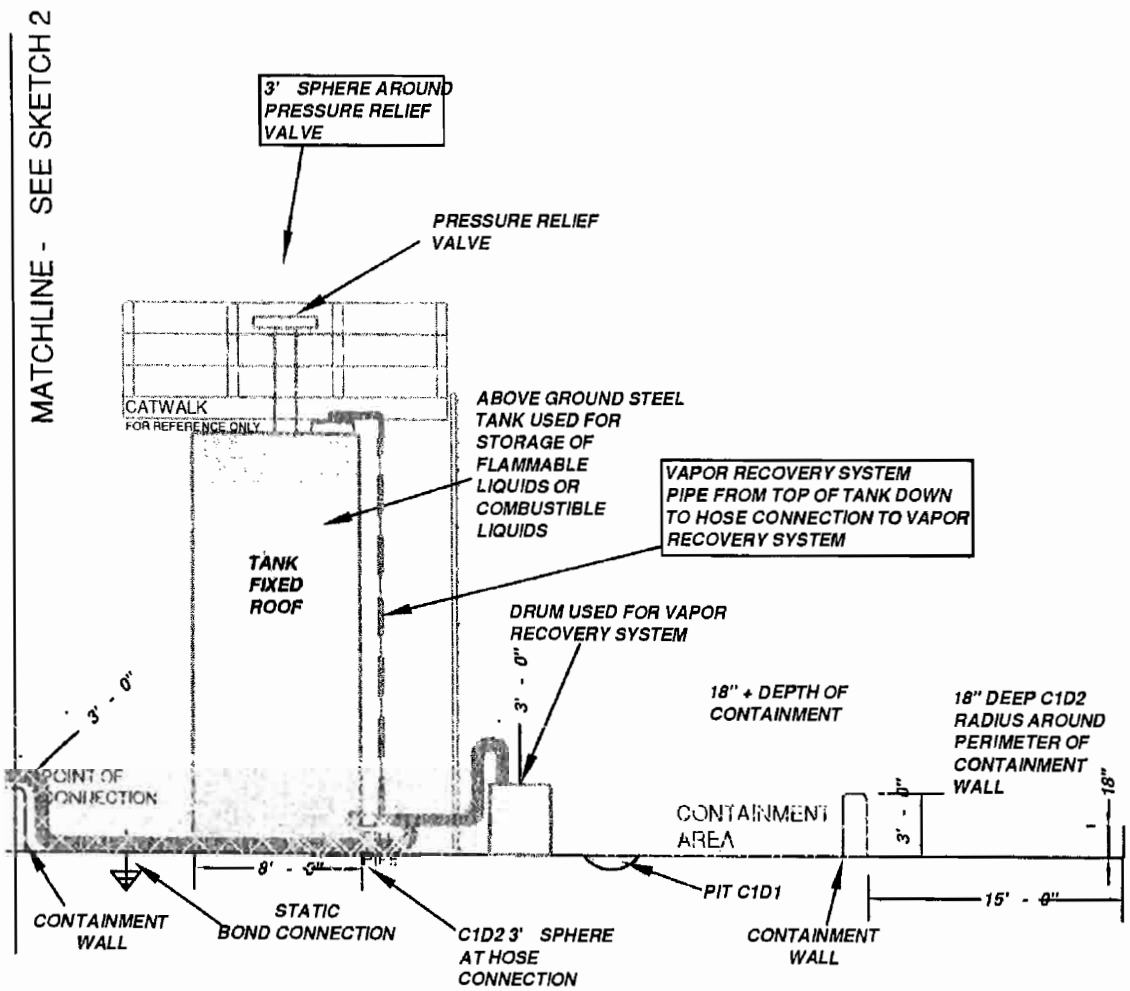
PROJECT · CLEAN HARBOR TANK FARM
TRANSPORT VEHICLE TRANSFER AREA

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	2 OF 4



TANK FARM
CONTAINMENT AREA
CROSS SECTION

N.T.S.

CLASS 1 DIV. II ☐

CLASS 1 DIV. I ☐

Registered Professional Engineer (Fire Protection)
CERTIFICATE NO. 30031
SCOTT C. GRAINGER
Date Signed 07/27/09
ARIZONA, U.S.A.
EXPIRES 3/31/2011

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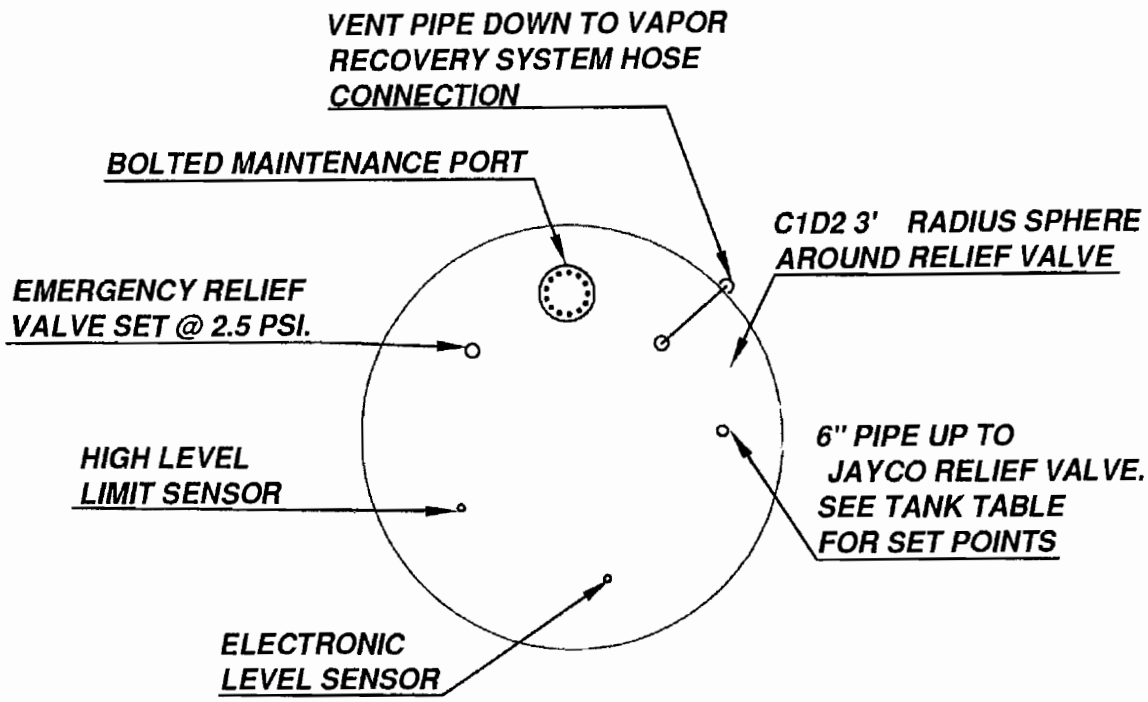
Fire Protection Engineering • Code Consulting
4136 E. FAIRVIEW CIR., MESA, AZ 85206 (480) 833-2100

PROJECT · CLEAN HARBOR TANK FARM
TANK FARM/CONTAINMENT AREA

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	3 OF 4



TYPICAL FLAMMABLE & COMBUSTIBLE LIQUID TANK TOP EQUIPMENT

N.T.S.

NOTES:

1. TANK DIAMETERS VARY .
2. LOCATIONS OF ACCESSORIES VARY .
3. ALL OPENINGS ARE SEALED AND EITHER LATCHED OR BOLTED.

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

CLASS 1 DIV. II

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PROJECT · CLEAN HARBOR TANK FARM
TYPICAL TOP OF TANK DETAIL

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	4 OF 4

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REPORT OF FINDINGS – ELECTROSTATIC DISCHARGE

PROJECT: - CLEAN HARBOR TANK FARM GC # 2371

DATE: 28 July 2009
Brian Parker
Facility General Manager
Clean Harbors Environmental Services
1340 West Lincoln St
Phoenix, AZ 85007
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602-721-7238 Mobile
602-462-2390 Fax
Parker.brian@cleanharbors.com

Registered Professional Engineer (Fire Protection)
CERTIFICATE NO. 30031
SCOTT C. GRAINGER
07/28/09
Date Signed
ARIZONA, U.S.A.

Exp 03/31/2011

PURPOSE:
Determine the appropriate application of Electrostatic Discharge (ESD) in accordance with current Standards. Determine if the existing conditions meet the applicable Standards.

STATEMENT:
This Report of Findings is very limited in scope. It applies ONLY to the specific conditions noted for this project and at the location below. The information contained here-in may not be used for any other project or location without the expressed written approval of this Engineer. Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report and as the applicable codes and standards apply to the instant condition.

PROJECT LOCATION:
1340 West Lincoln St
Phoenix, AZ 85007

REFERENCES:
Applicable Codes & Standards
International Code Council (ICC)

- International Fire Code (IFC), 2006, as adopted by City of Phoenix

National Fire Protection Association (NFPA) Standards

- NFPA 70, 2008, National Electric Code
- NFPA 77, 2007, Recommended Practice on Static Electricity

Grainger Consulting, Inc. Reports of Findings (GCi)

- Electrical Classification
- Code Analysis

SITE CONDITIONS:

- The Tank Farm has a ground plane below grade that is connected to or a part of the ground plane that is under the Clean Harbor structures to the west. This connection has been recently tested by Clean Harbor personnel and found to be adequate.
- Bond connections at each of the Above Grade Steel Tanks (AGST) are connected to the ground plane, also verified by Clean Harbor.
- Equipment has been bonded permanently to the grounding system. They are:
  - Gantry crane for tank wash system
  - Stairs over the tank containment wall
  - Compressed air piping around the perimeter of the containment
  - Catwalk
- Pieces of equipment that may use a temporary bond (clamp style) connection at one end of the connection. The opposite end should be a bolted connection
  - Electric pump assembly used to move rainwater and wash water[1]
  - Pneumatic pump
  - Tanker trailers that transfer liquid within the classified areas
  - Vapor recovery filter media drums

ANALYSIS:

Static Protection is required to prevent the accumulation of static charges during transfer operations {IFC 2703.9.5; 3406.5.1.7}
NFPA 77 is prepared as a recommended practice and as such does not provide direction with the same level of authority as a Standard or Code unless adopted by the local jurisdiction. No such adoption has been made by the City of Phoenix. Other codes adopted by Phoenix do not reference NFPA 77. The recommendations of NFPA 77 are recommended practice only. The portions referenced here-in are recommendations. They do not rise to the level of code compliance but are considered good industry practice.
This review did not include a measurement of charge accumulation or any other quantitative measurement of charge dissipation.
Electrostatic Discharge Static Grounding & Bonding
The following only apply to electrically classified areas {NFPA 77 8.1}, Class 1 Division 1 (C1D1) and Class 1 Division 2 (C1D2), see GCi RoF Electrical Classification for details Sketches, for diagrams describing classified area locations

- Bonding Equipment
  - All equipment shall be listed for the intended service
  - All bond straps shall be a minimum ½" braided bond strap {NFPA 77, 7.4.1.4}

[1] See GCi Code Analysis Photographs book, photo #7034

- All permanent bond strap connections shall be bolted with a dedicated bolt {7.4.1.6 and App G}
- Current path across a piece of equipment from one bond strap to another leading to the bus must be via either a single metal piece or, if this is not possible, the path from internal piece to piece must be via a bond strap, for example, a path from a bond strap to a leg to a frame rail to a bond strap must include a bond strap from leg to frame rail. **Do Not** rely upon equipment assembly bolted connections for continuous bond through equipment sections.

- Piping conveying flammable and combustible, CL2 liquids, and vapors { 8.4 and App.G}
  - Bond across all flexible or bolted connections
  - Bond across and to all valves, pumps and meters
  - Bond to ground plane with permanent connection
  - Other piping, regardless of product conveyed that is located within a classified area
    - Apply requirements for flammable liquid piping to pipe located within classified areas.
      - Water pipe
      - Compressed air
- Earth Ground – Ground Plane
  - Connect directly to service entrance section ground with minimum 1/0 wire at nearest electrical panel
- Containment Seal
  - Covering shall be:
    - Non-static generating
- Personnel tank workers in contact with bonded equipment working in the C1D1 or C1D2 areas {6.3}
  - ESD footwear, non-static generating, is recommended for work inside containment areas
- Inspection & Test Of Bonding And Grounding Systems {6.8}
  - Prepare Standard Operating Procedure (SOP) for equipment for the testing of ground / bond system in accordance with NFPA 77 for regularly scheduled testing
    - Frequency of testing depends upon the use of the equipment
    - Test bonding for continuity and resistance.
  - The Clean Harbor Standard Operating Procedures for Bulk Liquid Transfer and Flammable Drum Pumping each include appropriate references to bonding verification.
  - Test Equipment {6.5, 6.6, 6.7}
    - Electrostatic Voltmeter (non-contact)
      - Electrostatic Voltmeter with impedance > 10^{12} ohms & low capacitance
      - Use to measure voltages on ungrounded conductors.
    - Non-contact voltmeter or field meter or field mill or charge locator

- Use to measure charge on non-conductors

END OF REPORT

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

Grainger Consulting, Inc.

*Fire Protection / Forensic Engineering * Code Consulting*

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REPORT OF FINDINGS - CONTAINMENT

PROJECT: CLEAN HARBOR TANK FARM GC #2371

DATE: 28 July 2009

CLIENT:

Brian Parker
Clean Harbor Environmental Services
1340 W Lincoln St
Phoenix, AZ 85007
602-462-2300 Office
602-721-7238 Mobile
602-462-2390 Fax
Parker.brian@cleanharbors.com

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER 07/28/09 Date Signed ARIZONA, U.S.A.

Exp 03/31/2011

PURPOSE:
Evaluate the existing containment for compliance with applicable Standards.

STATEMENT:
This Report of Findings is very limited in scope. It applies ONLY to the specific conditions noted for this project and at the location below. The information contained here-in may not be used for any other project or location without the expressed written approval of this Engineer. Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report and as the applicable codes and standards apply to the instant condition.

PROJECT LOCATION:
1340 West Lincoln St
Phoenix, AZ 85007

REFERENCES:
National Fire Protection Association (NFPA)
- NFPA 30, 2008, Flammable and Combustible Liquids Code

International Code Council (ICC)
- International Fire Code (IFC), 2006, as adopted by City of Phoenix

Augspurger Komm Engineering Inc.(AKE)
- Report on Containment Volume, dated Jan. 10, 2008

SUMMARY:

The existing epoxy seal system of the containment area requires maintenance. There are openings in the existing seal system.
The existing tank farm containment seal must be extended up on the sides of the tank pedestals and the containment walls. The existing sealant stops at about 8" above the containment floor.

EXISTING CONDITIONS:

The tank farm has one containment area[1].
No construction details for the containment were reviewed for this analysis.

Tank Farm

- One tank is currently used for flammable / combustible liquid storage. Other tanks may be used for flammable / combustible liquid storage. See Tank Table, USE Column for detail.
- All steel storage tanks within the containment are single wall, Above Grade Steel Tanks (AGST). There is one poly tank that is used for holding rain water. It is a single wall tank.
- The tank farm has a well defined containment area. It is surrounded by a cast-in-place concrete wall that varies in height based upon the slope of the containment floor. The highest portion of the wall is approximately 3' above grade on the south side.
- The containment wall appears to be structurally intact. No openings or failure points were noted.
- The floor of the containment is concrete slab on grade.
- The floor has had a sealant material applied. No quantitative measures were taken to determine the present quality of the seal. The seal extends up the side wall of each of the tank pedestals
- There are no openings in the sealant: at the base of the tank concrete pedestals.
- The foundation & leveling slab, pedestal, for each of the AGST is a raised circular concrete slab. These pedestals were placed on top of the containment floor. None of the pedestal top surfaces are sealed.

See the Analysis Section of this report for a discussion on volume of containments.

ANALYSIS:

The following analysis applies to the tank farm containment area.
All references, { } refer to the IFC

- Spill control is required {2704.2.1}
    - Containment shall be liquid tight; see discussion below regarding minimum depth of seal.
    - The liquid tight seal is to be compatible with the stored materials[2]

[1] See attached Sketch, Tank Farm Site Plan

- Secondary containment is required {Tbl. 2701.2.2 }
- Secondary containment volume to be sized for spill of single largest vessel (10,000 gal.) plus a 24 hr rainfall of a 25 year storm; provisions for draining rainwater are required {2704.2.2.4}
- Tank Farm
  - Tank Farm containment volume is provided in the AKE 10 Jan 08 Report as follows:
    - Maximum containment volume (to lowest point on containment barrier) Vmax = 10,305 cu ft which is equivalent to 77,081 Gal.
    - Vreq, the volume required to contain the single largest container volume (10,250 gal.) plus the volume from a 25 year rain storm 4") = 3,253 cu ft which is equivalent to 24,332 Gal.
    - Vuse, the volume available from the top of the lowest tank concrete pedestal (12"), is also provided in the report = 3,968 cu ft which is equivalent to 29,681 Gal.
  - Therefore:
    - The tank farm containment volume is adequate.
    - Containment is adequately sealed.
    - The minimum required depth of sealant for the containment is approximately 10" ,(ratio of (Vreq / Vuse)x 12", at the low, south, side. The minimum sealant height must be increased to 15.5" The required depth of the containment does not exceed the height of the tank pedestals, therefore it is not necessary to seal the bond cable penetrations of the top of the pedestals or the top of the pedestals

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

ATTACHMENTS:
- Tank Table
- Electrical Classification Sketches 1-4 which are included in the GCi RoF Electrical Classification
- AKE Report
  - 1/10/2008

[2] The AKE Report, 10 January 2008 includes references to a compatible sealant. No verification has been made to confirm that this sealant was used to seal either containment.

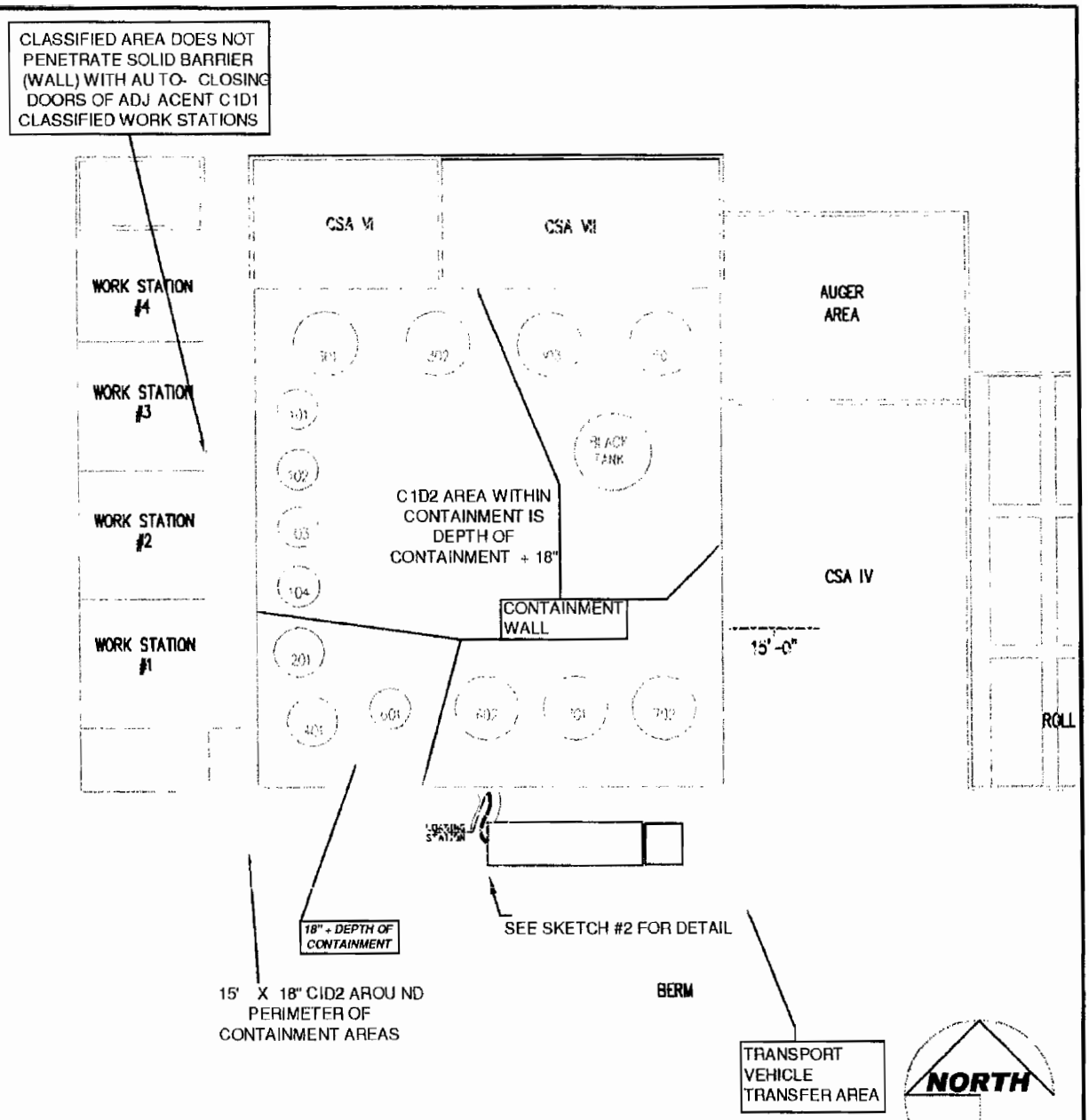
CLEAN HARBORS

GC # 2371
29 JULY 2009

TANK TABLE[1]

ID	Mfgr Tag	Vol. (gal) Full tank	Diam (Ft)	Height (Ft)	Liquid Surface Area[2] (SF)	In Use	Use	Liquid Level Monitor upper limit[3] shut-off	Electrical Bond	Pressure Relief		
										Make Model	+ oz	- oz
101	No tag	2,750	7	9.6'	211	N[4]	FL C2[5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
102	No tag	2,750	7	9.6'	211	N[4]	FL C2[5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
103	No tag	2,750	7	9.6'	211	N[4]	EVAL[5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
104	No tag	5,000	7.6	14.7	350	Y[9]	FL C2[5,10,8,7]	Y[8] Y[8]	Y	Jayco JT-20	12[11]	0.4
201	No tag	7,500	9	15.8	446	N[4]	C3A[5] or C3B[5]	N N	Y	Jayco JT-20	12[11]	0.4
301	No tag	10,000	11	14'	484	Y[9]	FL C2[6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
302	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Jayco JT-20	16	0.4
303	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Clay & Bailey T 56	8	0.4
401	No tag	7,500	9	15.8	446	N[4]	C3A or B[5]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
501	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Clay & Bailey T 56	0.4	0.4
601	No tag	5,000	7.6	14.7	350	N[4]	C3A or B[5,13]	N N	Y	None		
602	Unknown, UL AGT[14]	10,000	11	14'	484	N[4]	C3A or B[5]	N N	Y	Jayco JT-20	16	0.4
701	FC Lowe, UL AGT	10,000	11	14'	484	N[4]	Rainwater[5]	N N	Y	Jayco JT-20	16	0.4
702	FC Lowe, UL AGT	10,000	11	14'	484	Y	Rainwater	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
Black		4,500	8.5	10.6	N A	Y	Rainwater	N N	N	None		

[1] All tanks are steel AGST except for Black which is a plastic material.
[2] Liquid surface area calculated using tank diameter shown (from AKE report) and tank total height which will provide a conservatively high total area. The maximum fill level for all AGST is ≤ 90% of total capacity.
[3] Clean Harbor has begun to install an upper limit alarm and shut down & level monitor on all AGST planned for use with FL and C2 liquids, see Code Analysis discussion.
[4] Tagged as OUT OF SERVICE, Tank has been cleaned.
[5] Contents is planned future use. Tank is presently not in use, see In Use Column
[6] Tank vent is designed for vapor recovery system, referred to as a Regulated Tank , by Clean Harbor
[7] Upper limit and level monitor devices are installed on these tanks. The monitor panel construction is not complete, see Code Analysis, Analysis --Tank liquid level discussion for detail.
[8] Electronic Device installed, not connected to monitor system.
[9] Tank is ready for service.
[10] The legs of this tank have been protected with an equivalent fire resistance of 2 hr using concrete, see Code Analysis, Fire Protection of Tank Legs Section for detail
[11] Pressure relief determined based upon spring color, white. 12oz per manufacture data
[12] Tank is under evaluation to determine if repair or replacement is warranted.
[13] The legs of this tank must be protected with an equivalent fire resistance of 2 hr before it may be used to store flammable or combustible C2 or C3A liquids, see Code Analysis, Fire Protection of Tank Legs Section for detail
[14] AGT (Above Ground Tank) same as Above Ground Steel Tank (AGST) in this report.



TANK FARM PLAN

N.T.S.

CLASS 1 DIV. II

CLASS 1 DIV. I

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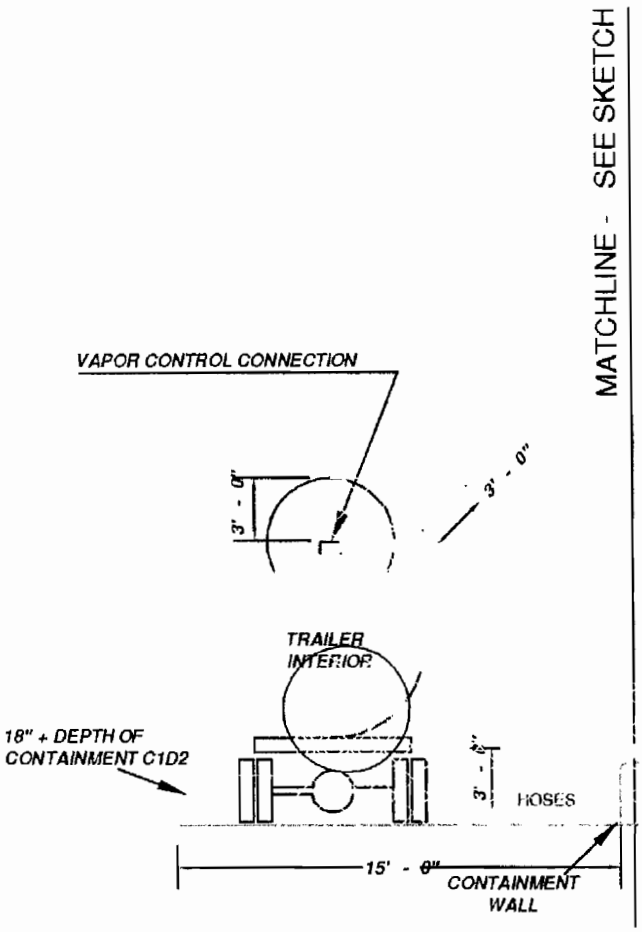
PROJECT · CLEAN HARBOR TANK FARM
TANK FARM PLAN

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	1 OF 4



TANK TRAILER CROSS SECTION

N.T.S.

NOTES:

1. THERE ARE NO ATMOSPHERIC VENTS. ALL VENTS ARE VAPOR CONTROLLED. ON TANKS CONTAINING OR PLANNED FOR U SE WITH FL OR CL2 LIQ U IDS, SEE TANK TABLE FOR DETAIL.
2. CLASSIFIED TANK AREAS APPLY ONLY TO TANKS U SED FOR FLAMMABLE LIQ U IDS OR COMBU STIBLE CLASS 2 LIQ U IDS.
3. CLASSIFIED CONTAINMENT AREAS APPLY TO THE ENTIRE CONTAINMENT.

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CLASS 1 DIV. I ☐

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

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PROJECT · CLEAN HARBOR TANK FARM
TRANSPORT VEHICLE TRANSFER AREA

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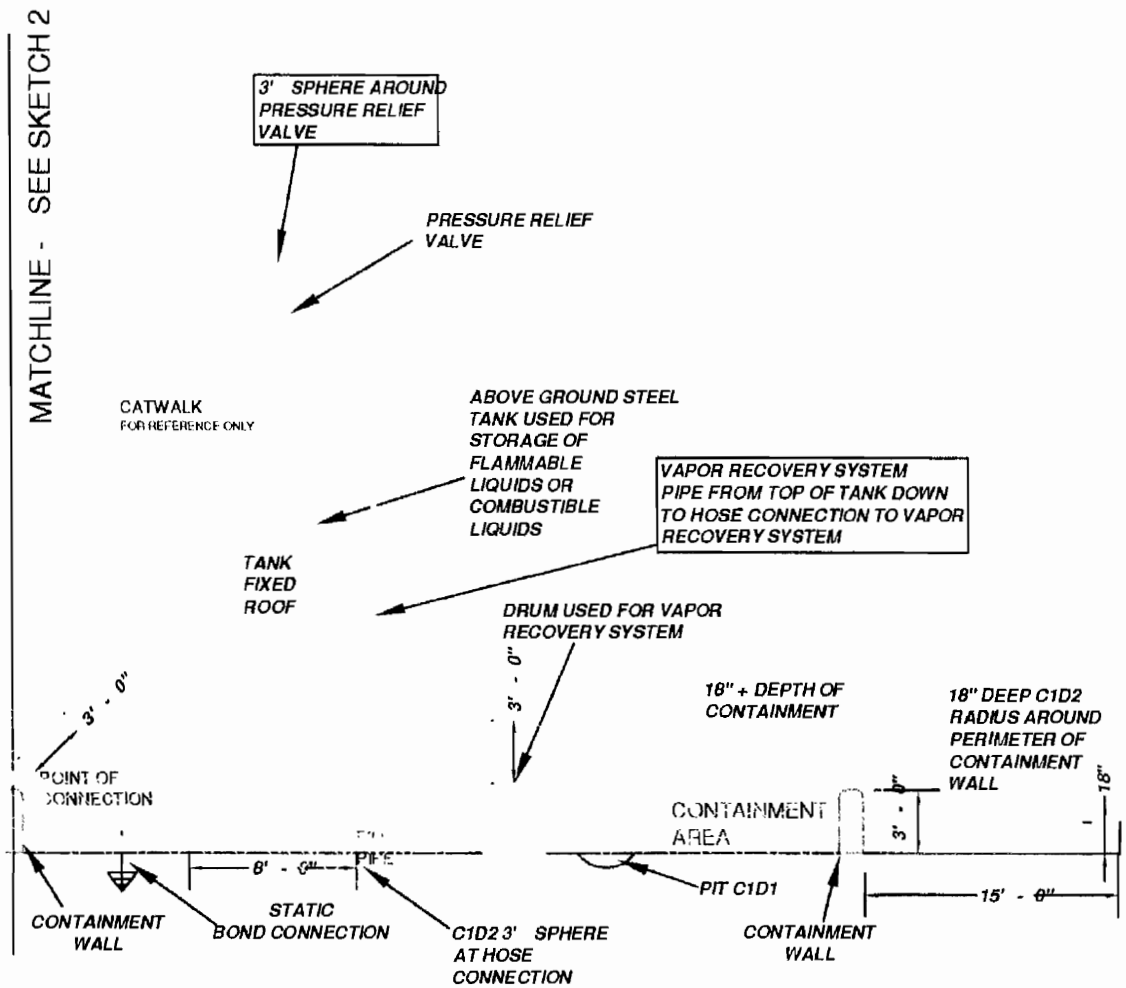
ELECTRICAL CLASSIFICATION



TANK FARM
CONTAINMENT AREA
CROSS SECTION

N.T.S.

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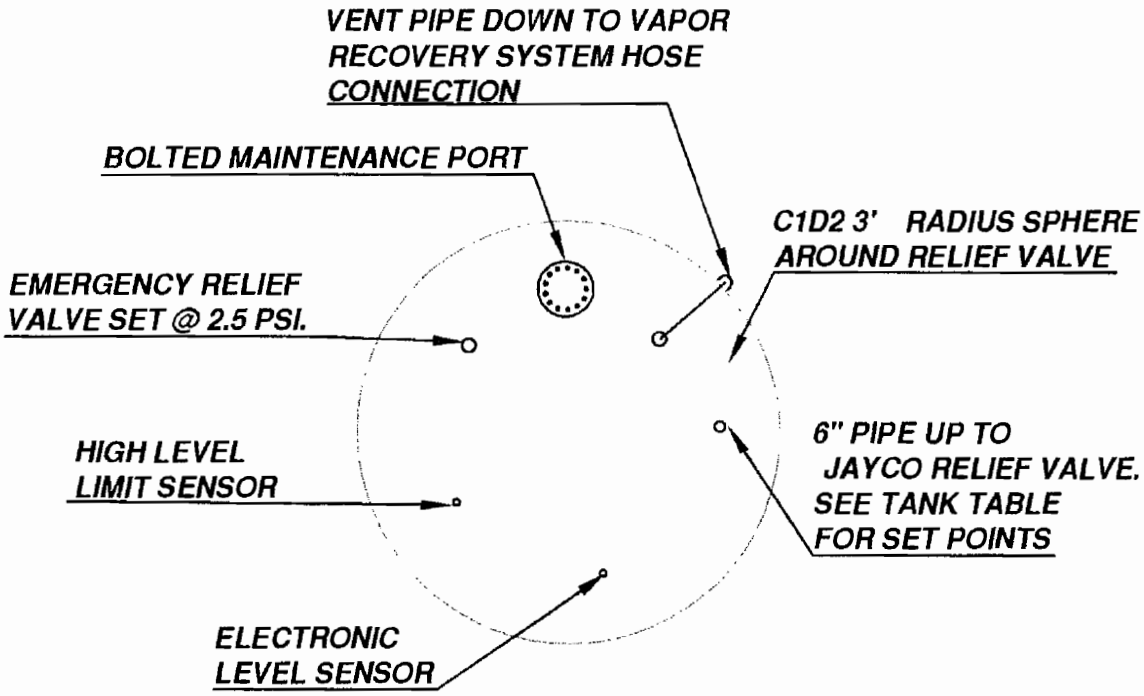
PROJECT · CLEAN HARBOR TANK FARM
TANK FARM/CONTAINMENT AREA

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	3 OF 4



TYPICAL FLAMMABLE & COMBUSTIBLE LIQUID TANK TOP EQUIPMENT

N.T.S.

NOTES:

1. TANK DIAMETERS VARY .
2. LOCATIONS OF ACCESSORIES VARY .
3. ALL OPENINGS ARE SEALED AND EITHER LATCHED OR BOLTED.

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 07/27/09 ARIZONA, U.S.A. EXPIRES 3/31/2011

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PROJECT: CLEAN HARBOR TANK FARM
TYPICAL TOP OF TANK DETAIL

GC #: 2371	DRAWN BY: TABII REVIEWED BY: SG DATE: 07/27/09	ELECTRICAL CLASSIFICATION	4 OF 4

Tank Farm Containment Calculations

The Clean Harbors Environmental Services site at 1340 West Lincoln Street, Phoenix, Az. has a tank farm constructed on a post tension concrete slab with an integrated wall that provides containment of spills and rainwater. The tanks vary in size from 2,570 gallons to 10,250 gallons and are anchored to one foot tall grooved concrete pedestals with the exception of the rain water collection tank which rests directly on the concrete surface. The top of the liquid resulting from a spill and rain was set to 1 ft. above the lowest point of the tank farm such that the liquid level crested the top of the lowest concrete pedestal, this is an elevation of 70.32 ft. Using this as the top of the liquid prevents the tanks from potentially contacting any incompatible liquids.

Vuse = 3,968 cu.ft. = usable containment volume in tank farm

Vreq = 3,253 cu.ft = containment volume required for tank farm
This is 100% of the largest tank volume + 4" rainfall.

The usable containment volume, Vuse, is greater than the required containment volume, Vreq, therefore the tank farm has sufficient containment volume.

If the liquid is allowed to fill the containment area the liquid level would rise to 72.42 ft and the total containment capacity is 10,305 cu.ft. The bottom of all tanks would be in the liquid.

Required Containment Volume:

40 CFR 264.193(e)(1) states that "External liner systems must be: (i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary". A plot of tank locations is on the next page along with a table giving locations, base diameters, and tank capacities. The total tank capacity is 113,000 gallons and the capacity of the largest single tank is 10,250 gallons. The containment system is required to contain the volume of the largest container, 10,250 gallons, plus the precipitation of a 24 hour / 25 year rain event.

Vreq1 = 10,250 gallons * (1 cu.ft./ 7.48 gallons) = 1,370 cu.ft. = liquid spill

Since the tank farm is not covered it must also contain the worst 24 hr rainfall expected in 25 yrs. At this location this is 4.0" of rainfall. This falls on an area of 72.67 ft x 77.75 ft giving a volume of:

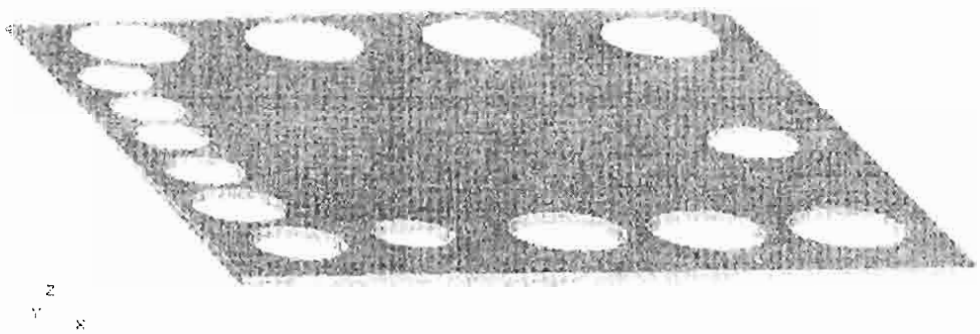
Vreq2 = 4.0" * (1 ft/ 12") * 72.67 ft * 77.75 ft = 1,883 cu.ft. = 24 hr rainfall

Total required containment volume is then:

Vreq = Vreq1 + Vreq2 = 1,370 cu.ft. + 1,883 cu.ft.
Vreq = 3,253 cu.ft = containment volume required for tank farm
This is 100% of the largest tank volume + 4" rainfall.

Usable Containment Volume:
A 3-D CAD model was made using measured elevations in the tank farm. This was extruded vertically and cut off at the top of the liquid, 71.04 ft. elevation. The model had cylinders removed that matched the locations and diameters of the tanks so that the remaining solid represented the usable containment volume of the tank farm. A picture of the solid representing the volume contained with a liquid level of 71.04 ft is shown below.

The northern most 8 tanks (301, 302, 303, 501, 101, 102, 103, and 104) contain hazardous waste liquids that could be potentially incompatible with each other. It is desired to keep any spills in the tank farm below the top of the pedestals under these 8 tanks. The pedestals are 1 ft high. The floor of the tank farm slopes downward to the south so the lowest pedestal of the 8 RCRA tanks is found under Tank 104. The top of the liquid resulting from a spill and rainfall is set to 1 ft above the lowest point around Tank 104 so that the liquid level just reaches the top of the concrete pedestal. The top of the liquid is then 71.04 ft.



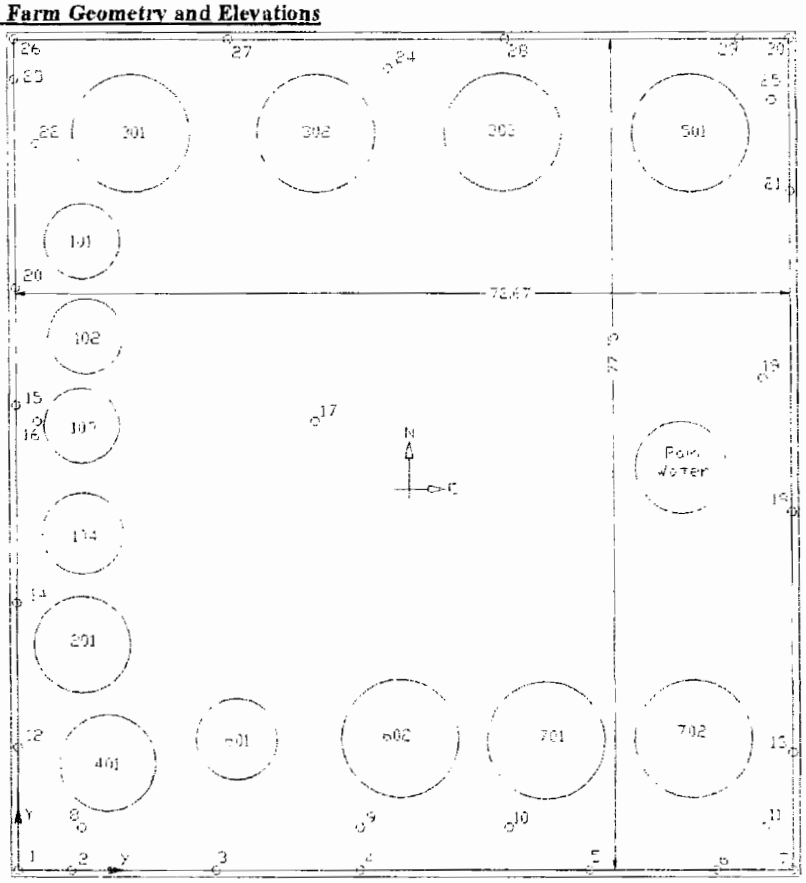
The volume of this solid is:

Vuse = 3,968 cu.ft. = usable containment volume in tank farm

The maximum containment volume is found by letting all tanks be immersed in liquid up to the low point on the containment wall. The low point on the wall is 72.42 ft. The tanks are assumed to have the same diameter as the concrete pedestals that they sit on. The same 3-D modeling approach using 72.42 ft. for the top of the liquid gave:

Vmax = 10,305 cu.ft. = total liquid that can be contained in the tank farm

Tank Farm Geometry and Elevations



X and Y are dimensions from the inside SW corner of the tank farm to the tank center, scaled from Guida Surveying 1"=20' drawing.
Dia. is the diameter of the concrete pad that the tanks sit on.

X, Y, and Dia. are in feet

tank	X	Y	Dia.	gallons
501	63.34	68.92	11	10,150
303	45.74	69.02	11	10,150
302	28.22	68.92	11	10,150
301	10.90	68.94	11	10,250
101	6.29	58.86	7	2,570
102	6.54	49.95	7	2,570
103	6.18	41.62	7	2,570
104	6.18	31.51	7.583	4,530
201	6.13	21.12	9	7,540
401	8.43	10.03	9	7,540
601	20.49	12.25	7.583	4,530
602	35.80	12.31	11	10,150
701	49.50	12.11	11	10,150
702	63.38	12.25	11	10,150
rain tank	62.36	37.65	8.583	10,000

113,000 gallons = Total tank capacity

Elevations for containment calculations

The table below shows the elevations of the concrete floor and containment walls of the tank farm. These were obtained from 3 points taken by Guida Surveying, Inc (Top of Wall at NW, NE, and SE corners) and additional points taken by Lindsey Lawlis of Peterson Geotechnical Group with a Pro-Level Manometer (water level). The tanks are all mounted on concrete pedestals that raise the tanks 12" above the surface of the containment floor to prevent the tanks from contacting spilled liquids. The top of the liquid for containment calculations was set at 12" above the lowest finished surface near Tank 104 in order to keep the 8 tanks on the north side of the tank farm from contacting liquid.

FS = finished surface = bottom of containment surface
TW = top of wall, n/a means not applicable since no wall exist at this point

depth = liquid level depth in inches based on --> 71.04 ft elevation at top of Tank 104 pedestal
Bold numbers are direct data points 72.42 = min TW

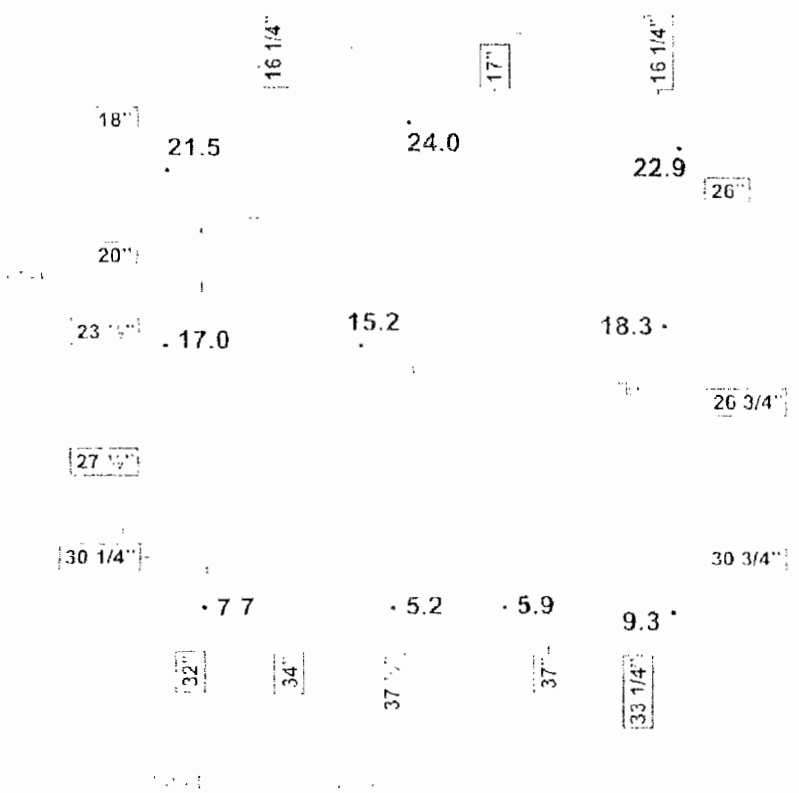
point	X	Y	FS	TW	Depth~in
1	0	0	69.68	72.44	16.3
2	5	0	69.77	72.44	15.2
3	18.5	0	69.61	72.44	17.2
4	32	0	69.32	72.44	20.6
5	53.5	0	69.82	72.44	14.6
6	65.5	0	69.67	72.44	16.4
7	72.67	0	69.86	72.44	14.2
8	6	4	69.52	n/a	18.2
9	32	4	69.32	n/a	20.6
10	46	4	69.37	n/a	20.0
11	70	4	69.66	n/a	16.6
12	0	11.5	69.93	72.45	13.3
13	72.67	11	69.88	72.44	13.9
14	0	25	70.17	72.46	10.4
15	0	43.5	70.51	72.47	6.4
16	2	42	70.3	n/a	8.9
17	28	42	70.15	n/a	10.7
18	72.67	33.5	70.2	72.43	10.1
19	70	46	70.41	n/a	7.6
20	0	54.5	70.8	72.47	2.9
21	72.67	63.55	70.75	72.42	3.5
22	2	68	70.67	n/a	0.4
23	0	74	70.98	72.48	0.7
24	35	75	70.88	n/a	1.9
25	71	72	70.79	n/a	3.0
26	0	77.75	71.17	72.49	0.0
27	20	77.75	71.12	72.47	0.0
28	46	77.75	71.03	72.45	0.1
29	68	77.75	71.07	72.42	0.0
30	72.67	77.75	71.09	72.42	0.0

The diagram and numbers below were provided by Lindsey Lawlis of Peterson Geotechnical Group. North is to the top of this picture. Guida Surveying, Inc. provided top of wall elevations at three of the four corners of the wall around the tank farm. These values were: "no measurement at SW corner", "72.44 at SE corner", "72.49 at NW corner", and "72.42 at NE corner"

A Pro-Level Monometer (water level) was used to define elevations of the concrete floor inside the tank farm. Pro-Level (water level) points are shown below relative to an arbitrary zero. In order to use this information with the points taken by Guida Surveying it was necessary to determine what 'Guida' elevation matched 0.0" on the Pro-Level Manometer (water level). Unfortunately a Pro-Level Manometer (water level) point was not taken at one of the three TW points Guida checked consequently zero had to be deduced from another location. The south wall was assumed to be level at 72.44 ft and this value was used with the 37.5" from top of wall to finished surface and 5.2" at the finished surface to determine that 0.0" on the Pro-Level Manometer (water level) was 68.88 ft elevation.

18" Measurement from top of wall to concrete slab

· 21.5 Point taken with water level.



Data point number 21 which shows a 26" top of wall to slab dimension in the picture below was changed to 20" to smooth the floor surface (east wall near NE corner).

Grainger Consulting, Inc.

*Fire Protection / Forensic Engineering * Code Consulting*

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REPORT OF FINDINGS – FOAM FIRE SUPPRESSION

PROJECT: CLEAN HARBOR – TANK FARM GC # 2371

DATE: 28 July 2009
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Registered Professional Engineer (Fire Protection)
CERTIFICATE NO. 30031
SCOTT C. GRAINGER
07/28/09
Date Signed
ARIZONA, U.S.A.

Exp 03/31/2011

PURPOSE:

Summarize the requirements for fire suppression (foam) at the tank farm.

STATEMENT:

This Report of Findings is very limited in scope. It applies ONLY to the specific conditions noted for this project and at the location below. The information contained here-in may not be used for any other project or location without the expressed written approval of this Engineer. Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report and as the applicable codes and standards apply to the instant condition.

PROJECT LOCATION:

1340 West Lincoln St
Phoenix, AZ 85007

REFERENCES:

Applicable Codes & Standards
International Code Council (ICC)

- International Fire Code (IFC) 2006 as adopted by City of Phoenix

National Fire Protection Association (NFPA) Standards

- NFPA 30, 2008, Flammable and Combustible Liquid Code

ANALYSIS & DISCUSSION:

REPORT OF FINDINGS – FOAM FIRE SUPPRESSION

28 JULY 2009

CLEAN HARBOR TANK FARM GC # 2371

- Fire suppression {3404.2.9.1}
  - The IFC requires foam fire protection on AGST storing either flammable or combustible. C2, liquids when
    1. Tanks are < 50' apart – Tanks on site are less than 50' apart
       a. And
    2. Liquid surface area is > 1500 SF – the largest surface area for any single tank is 484 SF, see Tank Table for details
  - The Tank Table describes which tanks are planned to contain either FL 1B, 1C or C2 liquids
    - The liquid surface area of each tank is < 1,500 SF
    - The total liquid surface area of all tanks planned for storage of FL1B, 1C or C2 liquids is >1,500 SF. All of these tanks are presently Out-of-Service except 301. Prior to being placed into service each tank must comply with all the applicable requirements in this Report of Findings.
      - A foam fire suppression system is not required at this time
      - A foam fire suppression system will be required when the total liquid surface area of all tanks containing FL or C2 liquids exceeds 1,500 SF. See Tank Table attached, Liquid Surface Area Column. When tanks are placed in service, and the total of all surface areas exceeds 1,500 SF, a foam suppression system will be required.

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

ATTACHMENTS:

- Tank Table

TANK TABLE[1]

ID	Mfgr Tag	Vol. (gal) Full tank	Diam (Ft)	Height (Ft)	Liquid Surface Area[2] (SF)	In Use	Use	Liquid Level Monitor upper limit[3] shut-off	Electrical Bond	Pressure Relief		
										Make Model	+ oz	- oz
101	No tag	2,750	7	9.6'	211	N[4]	FL C2[5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
102	No tag	2,750	7	9.6'	211	N[4]	FL C2[5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
103	No tag	2,750	7	9.6'	211	N[4]	EVAL [5,6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
104	No tag	5,000	7.6	14.7	350	Y[9]	FL C2[5,10,6,7]	Y[8] Y[8]	Y	Jayco JT-20	12[11]	0.4
201	No tag	7,500	9	15.8	446	N[4]	C3A[5] or C3B[5]	N N	Y	Jayco JT-20	12[11]	0.4
301	No tag	10,000	11	14'	484	Y[9]	FL C2[6,7]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
302	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Jayco JT-20	16	0.4
303	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Clay & Bailey T 56	8	0.4
401	No tag	7,500	9	15.8	446	N[4]	C3A or B[5]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
501	No tag	10,000	11	14'	484	N[4]	Eval[12]	N N	Y	Clay & Bailey T 56	0.4	0.4
601	No tag	5,000	7.6	14.7	350	N[4]	C3A or B[5,13]	N N	Y	None		
602	Unknown, UL AGT[14]	10,000	11	14'	484	N[4]	C3A or B[5]	N N	Y	Jayco JT-20	16	0.4
701	FC Lowe, UL AGT	10,000	11	14'	484	N[4]	Rainwater[5]	N N	Y	Jayco JT-20	16	0.4
702	FC Lowe, UL AGT	10,000	11	14'	484	Y	Rainwater[5]	Y[8] Y[8]	Y	Jayco JT-20	16	0.4
Black		4,500	8.5	10.6	N A	Y	Rainwater	N N	N	None		

[1] All tanks are steel AGST except for Black which is a plastic material.
[2] Liquid surface area calculated using tank diameter shown (from AKE report) and tank total height which will provide a conservatively high total area. The maximum fill level for all AGST is ≤ 90% of total capacity.
[3] Clean Harbor has begun to install an upper limit alarm and shut down & level monitor on all AGST planned for use with FL and C2 liquids, see Code Analysis discussion.
[4] Tagged as OUT OF SERVICE, Tank has been cleaned.
[5] Contents is planned future use, Tank is presently not in use, see In Use Column
[6] Tank vent is designed for vapor recovery system, referred to as a Regulated Tank , by Clean Harbor
[7] Upper limit and level monitor devices are installed on these tanks. The monitor panel construction is not complete, see Code Analysis, Analysis –Tank liquid level discussion for detail.
[8] Electronic Device installed, not connected to monitor system.
[9] Tank is ready for service.
[10] The legs of this tank have been protected with an equivalent fire resistance of 2 hr using concrete, see Code Analysis, Fire Protection of Tank Legs Section for detail
[11] Pressure relief determined based upon spring color, white. 12oz per manufacture data
[12] Tank is under evaluation to determine if repair or replacement is warranted.
[13] The legs of this tank must be protected with an equivalent fire resistance of 2 hr before it may be used to store flammable or combustible C2 or C3A liquids, see Code Analysis, Fire Protection of Tank Legs Section for detail
[14] AGT (Above Ground Tank) same as Above Ground Steel Tank (AGST) in this report.

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REPORT OF FINDINGS – SPRINKLER HYDRAULICS

PROJECT: CLEAN HARBOR (LAIDLAW), PHOENIX GC #2328

DATE: 9 June 2008
CLIENT:
Brian Parker
Clean Harbor Environmental Services
42 Longwater Dr
Norwell, MA 02061-1612
602-391-9508 cell

EX 03/31/2011

PURPOSE:
Provide analysis of the fire suppression systems at the site for compliance with the Phoenix Fire Code including a discussion regarding containment requirements as requested in Item #76, ADEQ Second Notice of Deficiency.

STATEMENT:
Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report. This report may be amended if new facts are discovered.

REFERENCES:
National Fire Protection Association (NFPA)
- NFPA 13, 2002, Installation of Sprinkler Systems
- NFPA 25, 2002, Inspection Testing and Maintenance of Water-Based Fire protection Systems

International Council of Building Officials (ICBO)
- Uniform Building Code (UBC), 1994, as adopted by City of Phoenix
- Uniform Fire Code, (UFC), 1994, as adopted by City of Phoenix

International Code Council (ICC)
- International Building Code (IBC), 2006, as adopted by City of Phoenix
- International Fire Code (IFC), 2006, as adopted by City of Phoenix

SITE CONDITIONS EXISTING:

Suppression System Description

There is an automatic fire sprinkler system protecting the Office, Maintenance Area, Work Stations #1, 2, 3, & 4 and the hazmat warehouse areas (CSA I & CSA II) and the loading dock. All systems are wet pipe. The suppression system is system is monitored by a fire alarm system. All valves are supervised. Water flow is monitored.
The system in CSA II is a double-interlocked closed head ARC AFFF (Alcohol Resistant Concentrate, 3%, Aqueous Film Forming Foam) system. This pipe is flooded but requires the activation of at least one sprinkler head and heat detection by the linear heat detection system prior to automatic activation of the deluge valve. The foam storage is located in the riser room. A minimum of 384 gal of concentrate is required (15 minutes of design flow).

The temperature ratings of the heads in each area are as follows:

AREA	HEAD TEMPERATURE (F)	LINEAR HEAT DETECTOR TEMP (F)
Office	165	
Maintenance	286	
CSA I	286	
CSA II	286	190
Work Stations	286	

Hydraulic Calculations

GCi prepared hydraulic calculations for the suppression system in each area except the Office and Loading Dock. The office area is supplied by the same wet pipe system that supplies the Maintenance area. The design requirements of the Maintenance area are considerably greater than those of the Office. There is no question that the design density of the Office system will be provided. The Loading Dock is supplied by the same piping system that supplies CSA I. The Loading Dock is smaller than CSA I. The smallest piping in the Loading Dock system is 2". The smallest pipe size in CSA I is 1". There is no question that the Design Density of the Loading Dock will be provided if the CSA I system is compliant, which it is. A copy of the hydraulic calculation sheets for each system is located in the GCi project file and is available upon request.

The calculations are based upon the original fire hydrant flow test that is referenced in the original design documents. Static pressure: 82 psi; Residual pressure 78 psi with 1185 gpm flowing. The current static pressure at the site is approximately 82 psi. a city flow test was run by Phoenix Water Services Department on 4 February 2008. A Copy is attached.
(The static is now 88 psi, residual 82 psi with 1278 gpm flowing. The available pressure and flow have increased thus improving the operational characteristics of the system.)

Containment

The secondary containment is the warehouse floor of each area in all cases. {IFC 2704.2.2.3} The required volume of containment is the largest vessel plus the sprinkler design flow over the minimum design area or the room or area where storage is located; whichever is smaller for 20 minutes.

A summary of the containment requirements for each warehouse system and the hydraulics routine results is provided in the Hydraulics Table. The Table provides the design density, design area, design flow, containment volume based upon the design flow and the available containment volume for each area. The required containment volumes for the CSA I, CSA II areas exceed the available containment volume. This does not comply with the requirements of the IFC.

Testing / Maintenance

NFPA 25 is the primary source of regularly scheduled testing and maintenance requirements for the sprinkler and fire alarm systems. Records available at the site indicate that the testing / maintenance inspections have not been adequate. All of the deficiencies noted below in this report are of the nature to have been noted in annual or more frequent tests and inspections.

General Code Compliance of Suppression Systems

There are deficiencies in the systems as noted below:

1. The fire riser room is not heated or separated from the hazardous storage area. A 1 hour fire resistive wall is required to separate the riser room from the adjacent hazmat storage area. This room is required to be heated to maintain a minimum temperature of 40° F. No heat is provided.
2. The fire riser room requires ventilation adequate to keep the interior ambient temperature below 120° F to maintain the Protecto-wire fire panel within manufacturer prescribed limits.
3. No heating or cooling provided in riser room. Heating is required to maintain a minimum temperature of 40° F. Cooling or other means is required to maintain room temperature below 120° F.
4. A reduced pressure backflow preventer is required to separate all of the fire sprinkler systems from the city supply and also to separate the foam system piping from the city supply. This includes the work station systems. No reduced pressure backflow preventer is provided. The device may be located at either the riser or at the site fence. The hydraulic calculations that GCi prepared include the pressure loss for an Ames 4000SS 6" reduced pressure device.
5. The number of snouts on the existing fire department connection (2) is not adequate to supply the minimum flow requirements of the largest (CSA II) system. A minimum of 4 snouts is required.

6. The foam bladder tank is located in the riser room which has no temperature control system. The foam, Ansulite 3x3 low viscosity alcohol resistant concentrate has been exposed to temperatures below the manufacturer recommended minimum of 35F and to temperatures above the maximum recommended 120F. The foam should be sampled and tested for separation. The foam storage must be modified to comply with the temperature limits recommended.
7. The foam system proportioner is 4". The characteristics of this valve are such that it is not appropriate for use with the system. It is only functional at flows between 245 gpm and 1469 gpm. A release of less than approximately 3 heads or fewer will result in no foam injection into the water flow. A 3" valve would provide flows more closely aligned with both the minimum flow (1 head) and the design flow for the entire system. The calculations prepared by GCi are based upon a 3" proportioner being installed. If the 4" proportioner is left in place, the actual flows will be greater due to a smaller pressure loss in the existing 4" proportioner.
8. The foam storage has been exposed to excessive temperatures in both extremes in the storage area. The foam must be mixed and tested in accordance with manufacturer recommendations.

HYDRAULICS TABLE

Location	Design Density (gpm / SF)	Design Area (SF)	Flow[1] (gpm)	Containment[2] (gal)	
			Design[3] Flow	Design[4]	Available[5] Volume
CSA I	0.17	3,000	530	10,600	4,301
CSA II	0.25	3,000	854	17,080	14,300
Maintenance	0.20	1,500	311	No containment required	
Work Stations four equal size rooms	0.20	3,000, actual area, all 4 rooms, 1,368	360 (full design area) 90 (one work station)	1,800[6]	1,877[7]
Loading Dock	0.20	3,000 Actual area is 1,400		No containment required	
Office	0.10	1,500		No containment required	

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

Attachment:
Phoenix Flow Test Report dated 2/4/08

---

[1] Flow over design area. The minimum design complies with Phoenix Fire Code requirements. Flows shown do not include hose flows.

[2] The volume of water for a 20 minute flow in the design area based upon. The Phoenix Fire Code {IFC 2704.2.2.3} requires containment of 20 minutes of design flow except when the design area is separated by rated walls or in the case in the work stations where containment is only required for the single largest separated area; all four of the workstations are the same size.

[3] Min.Flow to comply with design density. Based upon hydraulic calculations prepared by GCi using the existing piping

[4] Based upon 20 min. flow per IFC and original flow test data

[5] Volume data provided was taken from the AKE report, converted from cubic feet to gallons. Total containment volumes are used. The IFC recognizes that materials are moved in and out and total displacement volumes fluctuate.

[6] Flow volume in one workstation.

[7] Volume of containment in one workstation.

City of Phoenix, Water Services Department Fire Flow Test

Location: 1340 W LINCOLN ST. Q.S. No. 9-25

For: GRAINGER CONSULTING
Requested By: SCOTT Request Date: 1/30/2008
Phone: Fax Number: 480-833-2941
Test Type: X 2.5" Std. 4" Std. Complex
Observers: White/List
Test Time: 2:45 PM Test Date: 2/4/2008

CAUTION Results of this flow test identify water system characteristics for the date, time, and locations of this test only.

Pressure and flows within the water system vary of time, it is expected and should be considered when preparing designs based upon the flow test data

Numerous factors affect the water system, such as water level fluctuations in reservoirs, operating pressure ranges at booster pump stations, elevations at point of use, daily demand fluctuations, seasonal demands, emergency demands, water treatment plant availability, increased demands due to growth, operation/maintenance schedules, etc.

Designers should consider the above when preparing designs based upon fire flow test data. The City of Phoenix may be able to provide additional information on water system characteristics upon request

NOTE TEST LOCATION SKETCH IS ATTACHED

Observed Test Data

Hydrant Designation	Hydrant Number	Flow Opening (2.5" or 4")	Static Pressure (psi)	Residual Pressure (psi)	Pitot Pressure (psi)	Flow (gpm)
Pressure: R	208		65	62		
Flow, F1	210	2.5			58	1278
Flow, F2						
Flow, F3						
Flow, F4						

Note: Hydrant Nozzle Coef. = 0.9

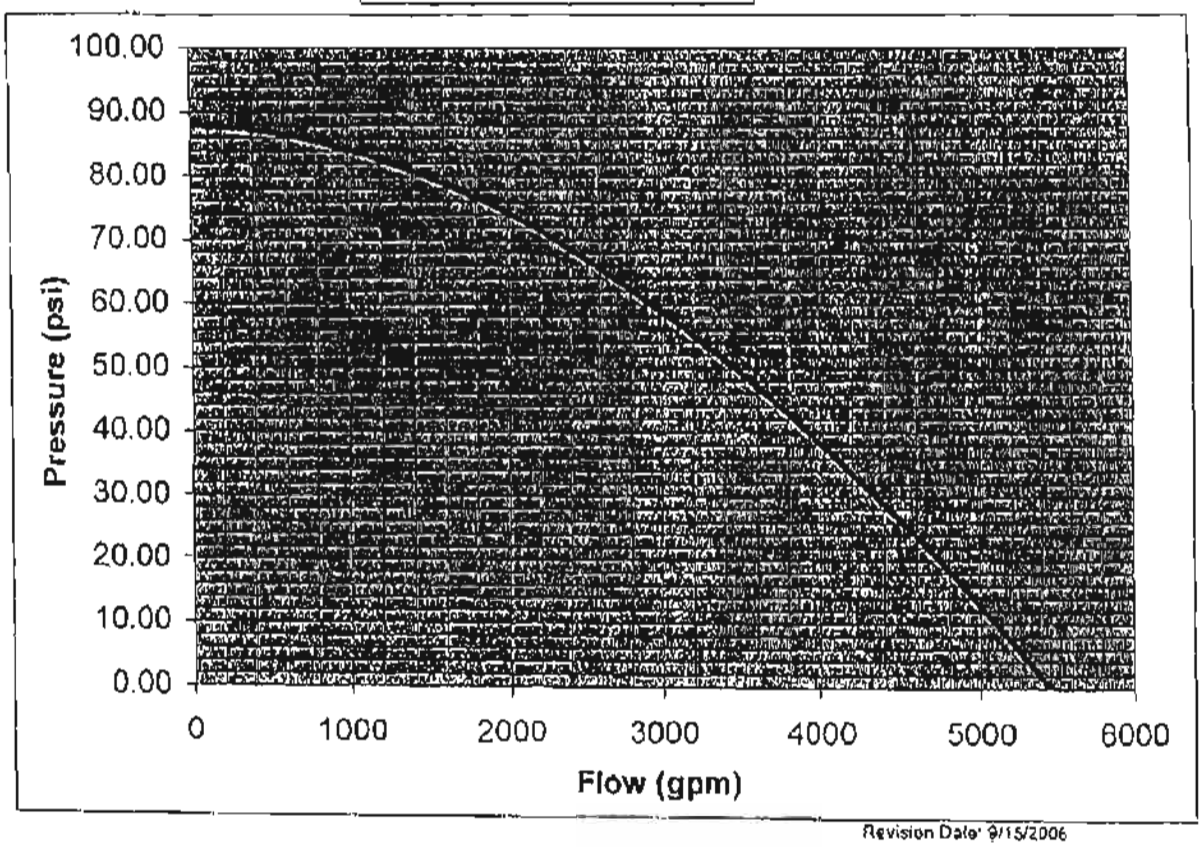
**Pressure Drop % 6.8%

Total Flow: 1278

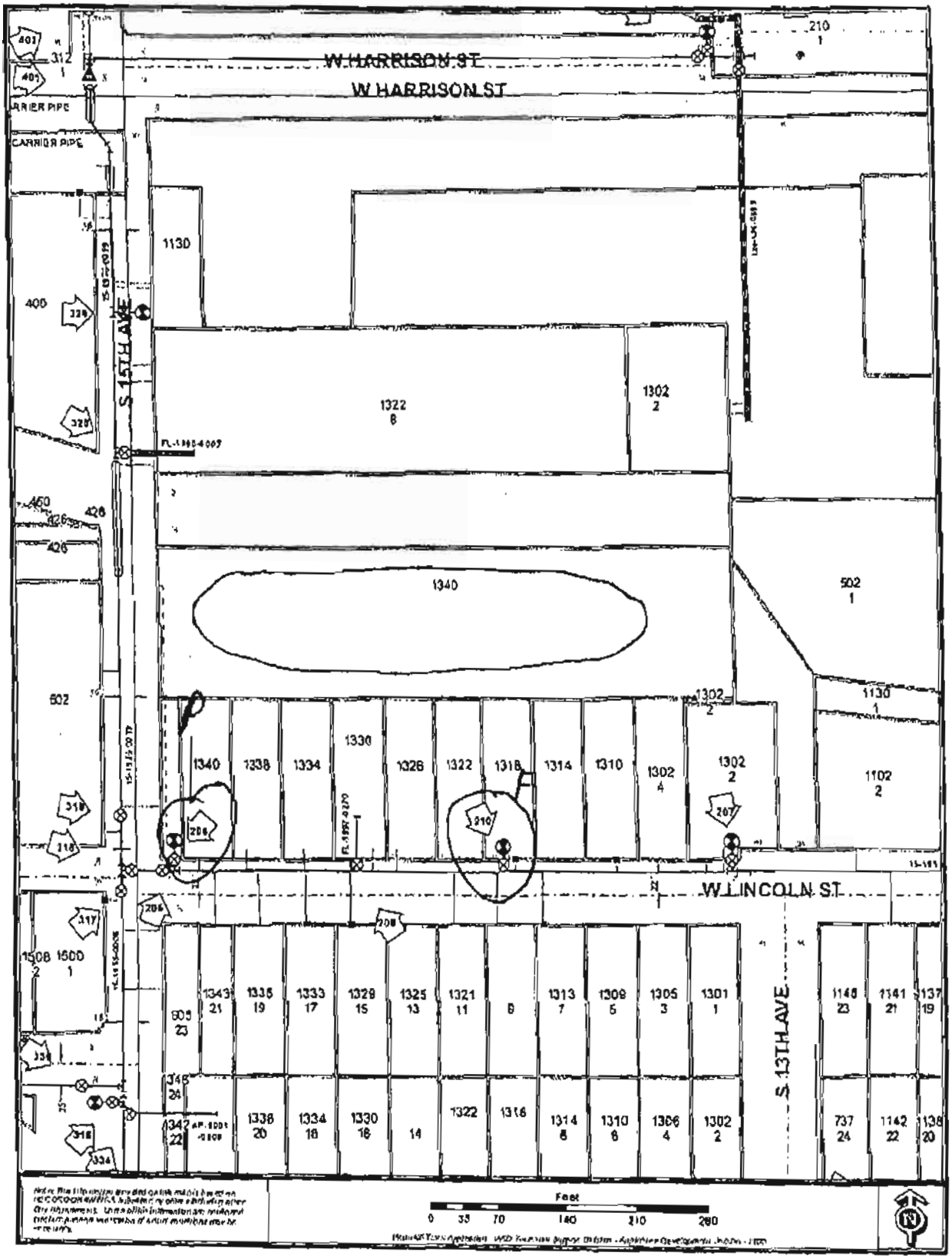
Calculated Results

Pressure (psi)	20	25
Flow (gpm)	4741	4549

** To obtain satisfactory test results of theoretical calculation of expected flows or rated capacities, sufficient discharge should be achieved to cause a drop in pressure at the residual hydrant of at least 25%, or to flow the total demand necessary for fire-fighting purposes.



Revision Date: 9/15/2006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REPORT OF FINDINGS – BUILDING CODE ISSUES

PROJECT: GC #2328
CLEAN HARBOR / LAIDLAW
17 January 2008

Exp 03/31/2008

CLIENT:
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APPLICABLE CODES:
International Code Council (ICC)
2006 INTERNATIONAL BUILDING CODE (IBC)
International Conference of Building Officials (ICBO)
1994 Uniform Building Code as adopted by city of Phoenix (UBC)

REFERENCES: (Not attached)
GCI drawing FP1 dated 5/10/1996, Proposed Facility Improvements Code Summary
Field notes from recent site observations Dec. 2007 by GCi

BUIDLING CONDITIONS:
Construction Type: CSA1, CSAII and Work stations: Type 2N (IBC), Type 2B (IBC)

ANALYSIS:
Separation of buildings,
In the original code analysis, the office building, CSA1A&B CSAII and CSAIII and the proposed Maintenance were all treated as a single building with multiple occupancies with occupancy separations between as needed. This was necessary in order to permit the H occupancies to be as large as they were as close as they were to the adjacent buildings. The Work stations were treated as a separate building. Sht. FP1 shows an property line (an imaginary line used for code purposes when the buildings are all located on a single platted lot). The distance shown is 68'. The actual constructed distance is less, 58', between CSAII and the Work Stations. Since the distance was

expected to be greater than 40', no further data was provided in the original code analysis preparation. IBC Table 5A for H2, H3 & H7 occupancies required no rating on an exterior wall with a separation >20'. The actual construction, includes the addition of a riser room on the east wall of CSAII with extends into the clear space between the two buildings and reduces the clear distance to 49'. This reduction was not shown in the original code material, FP1.

The IBC requirements are different for separation distances. Table 602 requires a 1 hour wall for separations less than 30' for Type IIB construction. For separations ≥ 30', the rating is 0. If the IBC is applied, the present condition is not compliant. This would not be a factor if the occupancy of CSAIB had not been changed. CSAIB was to have been an H3/H7 occupancy (IBC). It is being used as an F1/S2 occupancy. The material that I requested from city of Phoenix does not indicate it was ever changed from the original designation. I have not received a copy of the Certificate of Occupancy for the facility which may indicate this, but I doubt it. Since the occupancy has changed, the original code analysis is not valid and a revised or current one is needed which will be based upon the current code, the IBC.

If the east wall of the riser room is modified to a 1 hour wall, the property line may be moved to 30' away from the work station (leaving 19' from the riser room to the line) the requirements of the IBC are met. This will include structural fireproofing on the structural frame of the wall.

OUT BUILDINGS:

Two wood frame sheds have been added to the site. Both are small, about 12' x 12'. Neither was constructed with a permit. They are construction type IIIN. They are both immediately adjacent to the north wall of CSAII. They are NOT part of CSAII building as they are not of the correct construction, not fire sprinklered etc. If these are to remain on the property, they must be permitted, and located greater than 60' from any other structure. There are also code issues with lot line separations that I have not fully researched. The numbers will be greater than 30' from a property line. At the present general location, it is impossible to place the buildings 30' from the property line and still be 60' from CSA.

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

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REPORT OF FINDINGS
ELECTRICAL CLASSIFICATION

PROJECT: : CLEAN HARBOR (LAIDLAW) , PHOENIX GC #2328

DATE: 26 January 2008, Rev 061208

Registered Professional Engineer (Fire Protection) CERTIFICATE NO. 30031 SCOTT C. GRAINGER Date Signed 01/26/08 ARIZONA, U.S.A.

Exp 03/31/08

CLIENT:
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1340 W Lincoln St.
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PURPOSE:

Determine the appropriate electrical classification of areas within and immediately adjacent to: Office, CSA I, CSA II, Work Stations #1, 2, 3 & 4, and the Maintenance and Supply area. Due to the complexity of the facility, this Report of Findings includes numerous items that may affect the electrical classifications such as fire resistance ratings of occupancy separations and the occupancy of some areas.

STATEMENT:

Findings, conclusions, recommendations and opinions presented in this report are based on the facts known to this Engineer as of the date of this report. This report may be amended if new facts are discovered.

REFERENCES:

National Fire Protection Association (NFPA)
- NFPA 30, 2008, Flammable and Combustible Liquids Code
- NFPA 70, 2005, National Electrical Code, as adopted by City of Phoenix
- NFPA 497, 2004, Recommended Practice for Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

International Council of Building Officials (ICBO)

Uniform Building Code (UBC), 1994, as adopted by City of Phoenix
Uniform Fire Code, (UFC), 1994, as adopted by City of Phoenix
International Code Council (ICC)
International Building Code (IBC), 2006, as adopted by City of Phoenix
International Fire Code (IFC), 2006, as adopted by City of Phoenix

SITE CONDITIONS EXISTING:

The existing Occupancies and code requirements were determined in 1996 using the Phoenix codes in force at that time, the '94 UBC & UFC. The use and occupancies have not been changed with one exception, as noted here-in. A site plan showing each of the areas discussed here-in is attached.

Office
Occupancy, B. A typical office area, no hazmat is stored or transferred through this area.
The area is protected by a wet pipe automatic fire sprinkler system.

Maintenance and Supply area
This area is not used for the storage of hazmat. The use was changed after the 1996 classification, H3/H7, which was based upon original planned use. The original use for this space was originally intended to be similar to that of CSA I. The current use of the area is as a maintenance shop and spare parts storage. The storage is on shelves under 8' in height. Activities include welding repairs. The occupancy is F1. The area is separated from the adjacent CSA I by an 8"concrete masonry unit (CMU) wall with a heat activated automatic closing overhead coiling door. The CMU wall has a min fire resistance of 1 hour. The door has a 3 hr fire rating. The area is separated from CSA II by a metal wall which has no fire resistance rating.

The area is protected by a wet pipe automatic fire sprinkler system.

Continuous mechanical ventilation with emergency power is provided.

CSA I
Occupancy, H3/H7 (original classification according to the '94 UBC in 1996), H3/H4 (IBC 2006).

The area is used to store acids and acid compatible wastes. All hazmat storage is in closed, non-pressurized DOT approved containers. There is no transfer of material from container to container. The drums are stored on pallets and may be double stacked with pallets between layers of containers. The exception being smaller containers, up to 16 gallon capacity, may be double stacked to a maximum height of the equivalent of double stacked 85-gallon overpacks. Drums may be moved individually with "drum grabbers" or on pallets by use of a lift truck.
Continuous mechanical ventilation with emergency power is provided.
The area is protected by a wet pipe automatic fire sprinkler system.

There is a small toilet room in the southeast corner of the area enclosed by wood frame drywall construction. The walls, ceiling and door do not have any fire resistance rating. The floor of the restroom is approximately 8" below the floor level of CSA I. There is NEMA 1 electrical panel board on the exterior south wall of the restroom that is in poor condition.

CSA II
Occupancy, H3/H7 (original classification according to the '94 UBC in 1996), H3/H4 (IBC 2006)

The area is used to store hazmat that includes flammable and combustible liquids. Hazmat storage is in closed, non-pressurized DOT approved containers, usually ranging in size between 5 and 55 gallons. In the Temporary Holding/Sampling area (see attached plan EC-1) of the area, containers are opened to remove an 8 ounce sample and then securely closed again. The drums are stored on pallets and may be double stacked with pallets between layers of containers. The exception being smaller containers, of up to 16 gallon capacity, may be double stacked to a maximum height of the equivalent of double stacked 85-gallon overpacks Drums may be moved individually with "drum grabbers" or on pallets by use of a lift truck.

Continuous mechanical ventilation with emergency power is provided.

The area is protected by an AFFF closed head automatic double – interlocked fire sprinkler system.

The existing fire sprinkler riser room is located adjacent to the southeast corner this area. The riser room is not separated from the adjacent CSA II by a rated separation.

Work Station #1, 2, 3, & 4
The area is used for storage or transfer of hazardous materials, including flammable and combustible liquids, Samples may be collected from containers in this area, fluids may be poured from one container to another or pumped from the container into a tank or tanker.

Continuous mechanical ventilation with emergency power is provided.

The area is protected by a wet pipe automatic fire sprinkler system.

1 hour rated fire separations are provided between the adjacent Station(s) and the tank farm to the east.

DISCUSSION – GENERAL:

Office
No changes to existing conditions
Maintenance and Storage

There is no hazmat stored in the area other than those that are used in a typical maintenance shop. The hazmat quantities do not exceed the maximum allowable quantities permitted for a non-hazardous occupancy. Therefore the occupancy should be F1.

Continuous mechanical ventilation of the space is not required although it is provided.
The southeast corner of this area is used as a transport corridor for moving all containers in and out of CSA 1 similar to a service corridor use in semiconductor occupancy, H5. A separation between the transport corridor and the F1 occupancy is required. The service corridor has the same occupancy as the area it serves which, in this case is H3/H4. The required separation is one hour occupancy separation. This is the same as it would be if the corridor was assumed to have an H3/H4 occupancy similar to the adjacent CSA I and II areas. The existing separation from the adjacent CSA II area is a metal wall with an unclosed opening. The wall assembly has no fire resistance rating. The wall is required to be a 1 hour occupancy separation wall (fire barrier). {IBC Table 508.3.3}. A fire door opening in 1 hr fire barrier is required to have at least a 45 min fire protection rating {IBC Table 715.4}. See Drawing EC –1 attached for a description of the wall conditions.

CSA I
No separation is required between CSA I and CSA II. Both areas store similar materials and have the same occupancy classification. A separation is required between CSA I and the Maintenance and Storage area, see Maintenance and Storage for discussion and recommendations regarding this separation.

CSA II
No separation is required between CSA II and I. Both areas store similar materials and have the same occupancy classification. A separation is required between CSA II and the Maintenance area. See the discussion section above for Maintenance and Storage regarding this separation.

The riser may be exposed in CSA II but the AFFF foam tank may not be exposed. The riser requires heat which is not provided in CSA II. In addition all electrical equipment (linear heat detection panel and release equipment) requires an ambient temperature below 120F. A 1 hour wall separation is required between CSA II and the Riser Room.

DISCUSSION – ELECTRICAL CLASSIFICATION:

Office
No Classification
No changes to existing conditions

CSA I
No classification.

The IFC addresses requirements for electrical wiring and equipment in Section 3403 of Chapter 34, Flammable and Combustible Liquids. Table 3403.1.1 describes the classified locations for all flammable liquids and combustible liquids that are, "heated by a process to within 25 degrees F of their flash points". This results in Table 3403.1.1 being applied to Class II liquids (flash point ≥ 100 F) and some Class IIIA liquids (flash point > 140 F, The ambient summer temperature in the area may exceed 115 F) (process is not defined by the IFC). The area is not cooled. The Table would not apply to Class IIIB liquids (flash point ≥ 200F). For areas described as, "Indoor warehousing where there is no flammable liquid transfer" the classification specified by the Table is "Ordinary", no electrical classification.

NFPA 30, Table 7.3.3 provides the same classification recommendation for the same type of location, however, there is also a reference to "inside rooms or storage lockers used for the storage of Class I liquids which is classified as Class I Div. 2 for the "entire room or locker". Subject area is not an "inside room" or a "storage locker", both of which imply a small contained space.

NFPA 30 does not define either condition. NFPA 30 is not referenced in Section 3403.1 of the IFC and therefore does not apply.

The IFC Table 3403.1.1 does not include a reference similar to the NFPA 30 inside room but does include a reference to "indoor equipment where flammable vapor/air mixtures could exist under normal operations" which is classified as Class I Div 1 & 2 depending upon the distance and relative position from the source of vapor. This condition does not apply to the project as there is no equipment involved. Also under normal conditions, there is no vapor present as the drums are closed. The only condition where there may be flammable or combustible vapors present is under an abnormal situation.

The City has also adopted NFPA 70 (NEC) as the electric code. Article 500.5(B) describes locations to be classified as Class 1, Div.1 in subpart (1) and Class 1 Div. 2 in subpart (2). The descriptions for Class 1, Div. 1 do not apply as the flammable vapors in the definition must exist under normal operating conditions either normal or frequent conditions. The description for Class 1 Div. 2 states, ". . . vapors are handled, processed or used, but in which the . . . vapors . . . will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers . . . <u>or</u> in case of abnormal operation of equipment, or vapors are normally prevented by positive mechanical ventilation and which might become hazardous through failure or abnormal operation of the ventilating equipment, or . . .". The descriptions for Class 1, Div. 2 provided do not apply for the following reasons:

1) The first description specifically describes vapors being "handled, processed or used" within some sort of "closed containers or closed systems" which is not the case for this area. The liquids are stored. There is no process or handling that would significantly increase the risk of a breach or failure of some sort that could allow the release of vapors from a close container.

2) The second description describes a condition in which the vapors are normally exposed but controlled by a ventilation system. This description describes a Class 1, Div. 1 condition with ventilation which does not apply.

There is a Fine Print Note (FPN) #1 that appears after the Class 1, Div. 2 description section (2) of the NEC discussed above. The FPN provides information related to the Code rule {NEC 90.5(C)}. It states, "This classification usually includes locations where volatile flammable liquids or . . . vapors are used but that, in the judgment of the authority having jurisdiction, would become hazardous only in case of an accident or some unusual operation condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location." This explanatory material, although not officially a part of the code, does further emphasize the reference of some manner of use of the materials, not storage. In addition, the site conditions include a compliance with ventilation requirements of the UFC. Ventilation and the benefits of it in reducing the probability of escaped liquid vapors from exceeding a 0.25% LEL level are implied. The requirements of NEC are, as described for warehoused materials in agreement with the IFC requirements. There is no electrical classification required for CSA I

Maintenance and Storage
No Classification

There is no hazmat stored in the area other than those that are used in a typical maintenance shop. There is no electrical classification required. The area has no classification when it is properly separated from the adjacent H3/H7 occupancies.
The electrical classification of the transport corridor is based upon the adjacent hazmat storage areas CSA I and the immediately adjacent portion of CSA II. The transport corridor has no electrical classification.

CSA II
No Electrical Classification required for general storage areas. See Electrical Classification Section above for CSA 1. The conditions in and around the Temporary Holding & Sampling areas are different and are discussed below.

CSA II Temporary Holding & Sampling
Classification C 1, D 1, and D 2

Drums in this area are opened, an 8 oz sample is removed and the lid or opening is replaced. The drums are stored 1 high to permit the sample to be taken. The sampling process may occur at any drum within the limits of this area. The area is marked on the floor and overhead with a sign.

The IFC addresses requirements for electrical wiring and equipment in Section 3403 of Chapter 34, Flammable and Combustible Liquids. Table 3403.1.1 describes the classified locations for all flammable liquids and combustible liquids that are, "heated by a process to within 25 degrees F of their flash points". For areas described as "Drum and container filling, outdoor or indoor with adequate ventilation." The Class 1 Div. 1 area extends from the floor to above the top of the container (a 55 gal. drum 34.5" tall) an additional 3' to 5' 10.5" above floor level. The area above 5' 10.5" an additional 2' in all directions and 18" deep above the floor to a radius of 10' from the drum is Class 1 Div. 2.

NFPA 30 contains an identical requirement in Table 7.3.3. NFPA 70 also contains an identical requirement in Article 515, Bulk Storage Plants, Table 515.3, drum and container filling – outdoors or indoors. The NFPA 30 and NFPA 70 referenced tables each also contain a reference to "Indoor equipment installed ...where flammable vapor –air mixtures can exist under normal operation". These descriptions were not used in preference to the "drum & container" references discussed previously because the drum and container filling exposure is a better comparison to the hazard exposure presented by the actual Clean Harbor operation.

<u>Work Station #1, 2, 3 & 4</u>
Classification C 1, D 1, and D 2

The IFC addresses requirements for electrical wiring and equipment in Section 3403 of Chapter 34, Flammable and Combustible Liquids. Table 3403.1.1 describes the classified locations for all flammable liquids and combustible liquids that are, "heated by a process to within 25 degrees F of their flash points". This results in Table 3403.1.1 being applied to Class II liquids (flash point $\geq$ 100 F) and some Class IIIA liquids (flash point > 140 F, The ambient summer temperature in the area may exceed 115 F) (process is not defined by the IFC). The area is not cooled. For locations where, "drum and container filling, outdoor or indoor with adequate ventilation" occurs, the IFC recommended Classification is Class1, Div. 1 & 2. As described in IFC Table 3403.1.1, Class 1 areas are within 3' of vent and fill opening, extending in all directions. The Class 2 areas extend beyond the Class 1 areas described from 3' to 5' from the same points and up to 18" above floor level within a horizontal radius of 10' from the referenced point. In the case of all four of the Work Stations, the drums may be located at any point within the Station; therefore, the Class 1 Div. 1 area within each Station is a layer extending above the top of a 55 gal. drum (34.5" tall) an additional 3' to 5' 10.5" above floor level and down to the floor. The area above 5' 10.5" above the floor to the ceiling is Class 1 Div. 2. All measurements should be made from the highest drum. The floors of the stations slope. See the attached EC-1 for a sketch of the classified areas.

NFPA 30 contains a similar requirement in Table 7.3.3. NFPA 70 also contains a similar requirement in Article 515, Bulk Storage Plants, Table 515.3, drum and container filling – outdoors or indoors.

RECOMMENDATIONS:
In all area conditions, the electrical classification recommended is subject to all other recommendations being addressed.

Office
No Electrical Classification is required.
No changes to the existing separations.

Maintenance and Storage
No Electrical Classification is required.

Construct 1 hour fire barrier {IBC 706} between the transport corridor and the remainder of the Maintenance and Storage or another wall/door configuration that provides the necessary functions and exiting.

Construct 1 hour fire barrier {IBC 508.3.3, 706} where Maintenance and Storage area is adjacent to CSA II and extend it north to the north wall of CSA II.

Remove or disable the continuous mechanical ventilation system to reduce operating costs. The equipment is not required by code. Allowing it to remain either in service or out of service is acceptable.

Exiting requirements must be addressed. An additional exit door is not required when the fire barrier is constructed however, for operational requirements, a door at the south end is probably necessary. Details of this are not included in this report.

CSA I
No Electrical Classification is required.

Remove the existing toilet room; repair/replace the existing electrical panel as may be necessary to comply with NFPA 70.

CSA II
No Electrical Classification is required in the storage portions of this area.

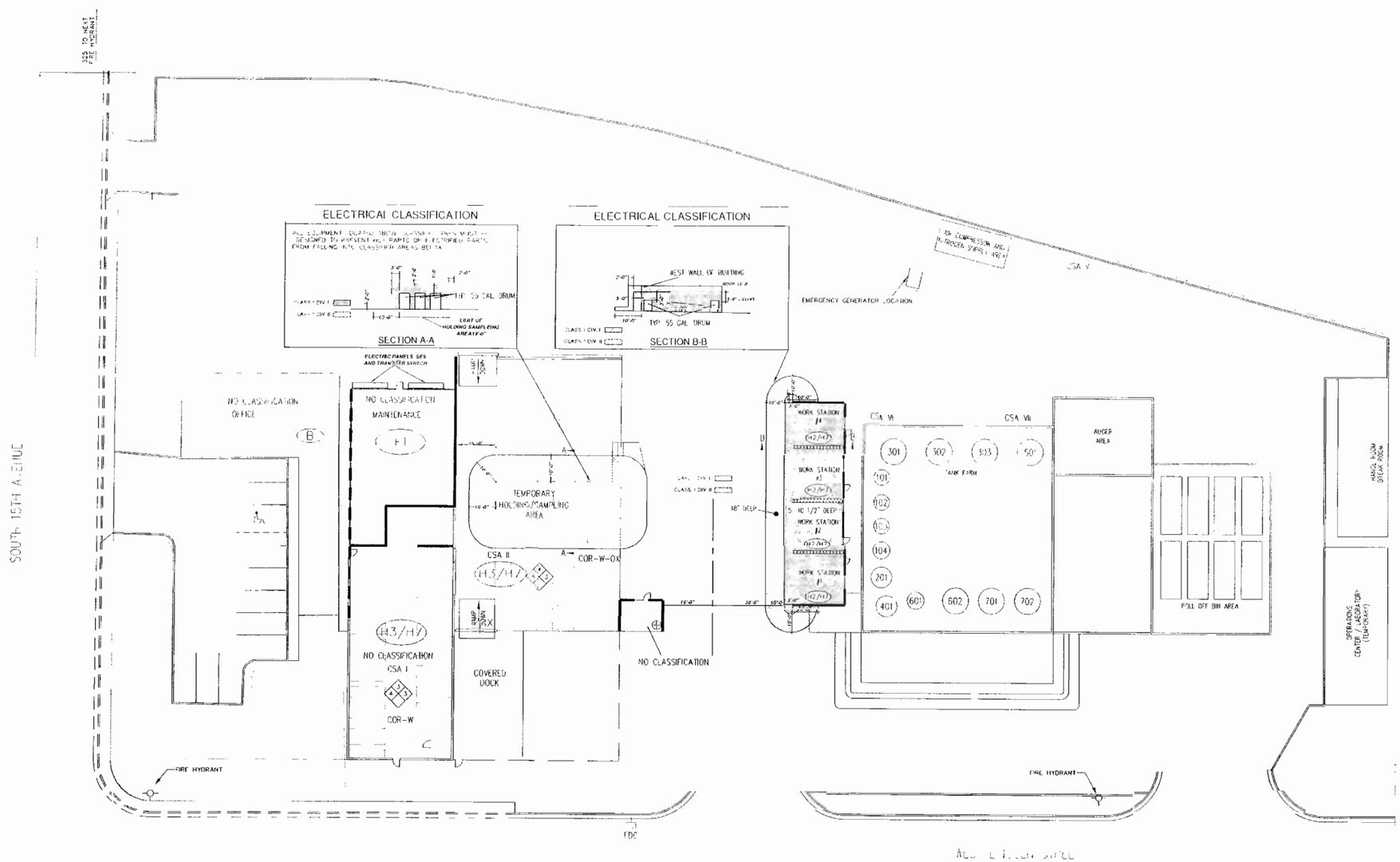
Classification as Class 1 Div. 1 and Div. 2 is required in the Temporary Holding/Sampling area; see attached EC-1 for location, in accordance with the details described in the discussion Section CSA II of this Report and.

Construct 1 hour fire barrier {IBC 706} between the Riser room and the remainder of CSA II.
The north wall of the Riser Room requires similar protection.
Provide heat and ventilation in the Riser Room.

Work Station #1, 2, 3, & 4
Electrical Classification as Class 1, Div. 1 and Class 1 Div. 2 is required; see Discussion Section of the report for details and sheet EC – 1 attached for a description.

PREPARED BY:
Scott Grainger, PE
Fire Protection Engineer

Attachment:
Sheet EC - 1, site plan



STRUCTURE	AREA (SF)	OCCUPANCY / UBC	CONST. TYPE
OFFICE	2880	B	5N
MAINTENANCE	2400	F1	2N
CSA I	3200	H3/H7	2N
CSA II	6510	H3/H7	USE 2N
COVERED DOCK	1575		
TOTAL	14,990		
WORK STATION #1	380	H3/H7	2N
WORK STATION #2	380	H3/H7	2N
WORK STATION #3	380	H3/H7	2N
WORK STATION #4	380	H3/H7	2N
TOTAL	1520		

ASSUMPTIONS:

1. AEROSALS ARE CONTAINED WITHIN STEEL DRUMS.
2. THE EXIST. B (OFFICE) STRUCTURE WAS CONSTRUCTED A1 5N AND MEETS ALL REQUIREMENTS FOR 5' DISTANCE FROM EXIST. H7, TYPE 2N LOCATED TO THE EAST.
3. WORK STATIONS CAN BE EXPECTED TO HAVE MATERIAL QUANTITIES IN EXCESS OF EXEMPT AMOUNTS & MONITORING OF QUANTITIES TO MAINTAIN QUANTITY BELOW EXEMPT AMOUNT IS NOT FEASIBLE.
4. VERTICAL EXTERIOR STORAGE TANKS ARE EQUIPPED W/ EMERGENCY RELIEF VENTS & ARE ATMOSPHERIC TANKS < 2.5 PSI.

WASTE TYPE	BUILDING
LIQUID ON--	CSA II
SOLID/SLUDGE ON-	CSA II
WATER/METAL SOLUTIONS	CSA I, II, WORKSTATIONS
AEROSOLS IN CLOSED DRUMS	CSA II
FUELS	CSA II, WORKSTATIONS
INCINERABLE SOLIDS	CSA II, IV, V, VI, VII
GAS CYLINDERS	
PROPANE	CSA IV
OXYGEN	CSA IV
IGNITABLE LIQUIDS	CSA II, WORKSTATIONS
LABPACK SOLVENTS	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK ICINERABLE SOLIDS	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK REACTIVES	CSA II, IV, VI, VII, WORKSTATIONS
LABPACK OXIDIZERS	CSA II, IV, VI, VII, WORKSTATIONS
OXIDIZER SOLIDS	WORKSTATIONS
OXIDIZER LIQUIDS	WORKSTATIONS
METALLIC WASTE	CSA II, IV, V, VI, VII
ACID SOLUTIONS	
NITRIC ACID (OX)	CSA WORKSTATIONS
NON--OXIDIZERS	CSA I
CAUSTIC SOLUTIONS	CSA II, WORKSTATIONS
LATEX PAINTS	CSA II, IV, V, VI, VII
OIL BASED PAINTS LOOSEPACKED	CSA II, IV, V, VI, VII
SOLVENTS BASED STAINS LOOSEPACKED	CSA II, IV, V, VI, VII
CHLORINATED SOLVENTS	CSA II, WORKSTATIONS

NOTE: WASTES IN THE WORKSTATIONS ARE ISOLATED BY COMPATIBILITY FOR EACH UNIT. I.E., SOLVENTS AND OXIDIZERS WILL NOT BE STORED IN THE SAME WORKSTATION

LEGEND:

WALLS:

- NO RATING, NON-COMBUSTIBLE
- STRUCTURAL FRAME ONLY NO NON-STRUCTURAL ELEMENTS
- 1 HOUR RATED OCCUPANCY SEPERATION REQUIRED
- 1 HOUR RATING TO 10' ABOVE COURT FLOOR OR TO ROOF WHICHEVER COMES FIRST
- NONCOMBUSTIBLE WALL 18" TALLER THAN STORAGE & 24" WIDER THAN STORAGE
- X—X— CHAIN LINK FENCE

PROPERTY OUTLINES:

- PROPERTY LINE, EITHER LEGAL OR FOR BUILDING SEPARATION
- OUTLINE OF WEST BUILDING FOR SETBACK AND ACCESS PURPOSES

N

GRAPHIC SCALE 1"=20'

10 0 10 20 40 60

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
MAR 01 2010
Waste Programs Div.
Permits Section

REVISION

PROJECT: CLEAN HARBOR

CLIENT: CLEAN HARBOR, 1340 W LINCOLN S, PHOENIX AZ 85005

AHJ: CITY OF PHOENIX DEPARTMENT OF ENVIRONMENTAL QUALITY

DESIGNED BY GWP DATE 12/17/07
CALCULATED BY GWP SE CALC DATA
DRAWN BY GWP DATE 12/17/07
CHECKED BY SG DATE 12/17/07

Registered Professional Engineer, State of Arizona, CERTIFICATE NO. 30031, SCOTT G. GRAINGER, Date Signed 12/17/07

ELECTRICAL CLASSIFICATION

SHEET EC-1 OF 1

GC# 2328

APPENDIX D-6

TANK EMISSION CONTROL DESIGN ANALYSIS

Estimated Maximum Vent Flow Rate & Potential Maximum Internal Tank Pressure
Phoenix facility

2/6/2009
Rev 1 - 7/27/2009

A. **Tank Data & Thermal Breathing Volume**

Tank No.	Description of Contents	Tank Capacity (gal)	Emissions Control	Thermal Out breathing volume in cubic feet per hour - Per API 2000
	Tanks subject to RCRA regulation			
101	RCRA Flammable & Non-flammable Liquid	2570	Yes	60
102	RCRA Flammable & Non-flammable Liquid	2570	Yes	60
103	RCRA Flammable & Non-flammable Liquic	2570	Yes	60
104	RCRA Flammable & Non-flammable Liquic	4530	Yes	125
301	RCRA Flammable Liquid	10250	Yes	250
302	RCRA Flammable & Non-flammable Liquic	10150	Yes	250
303	RCRA Flammable & Non-flammable Liquic	10150	Yes	250
501	RCRA Flammable & Non-flammable Liquid	10150	Yes	250
	Total all Tanks	**52940**		**1305**

Therefore, Thermal Out breathing from all tanks in to vent header = 1,305 CFH
= **21.75** **CFM** (a)

Registered Professional Engineer (Chemical)
CERTIFICATE NO.
49850
JOHN WILLIAM
CALDWELL
DATE SIGNED 07/31/09
ARIZONA, U.S.A.
exp. res 06/30/12

Estimated Maximum Vent Flow Rate & Potential Maximum Internal Tank Pressure
Phoenix facility

2/6/2009

B. Working loss - out breathing in to vent system

(1) Calculation Basis - Operational Data

(1) All tanks are connected to a common 2" header which is directed into a knock-out/back pressure/rinse drum and then into four carbon beds and exits through a stack.
(2) Physical layout indicates that T- 501 is the farthest tank from the carbon beds.
(3) Total length of the Vent line from T-501 to the knock out drum is 100 ft with 5 -90 degree elbows.
This translate into an equivalent length of 130 ft of 2" pipe.
(4) Facility utilizes vapor balancing during tanker-truck off loading, which reduces the outflow through the knock-out drum and carbon beds.
(5) The vapor balancing connection is at the upstream side of the knock out drum. Facility utilizes a 73 feet of 2" flexible hose to connect tanker to the vent header connection at knock out drum.
(6) Facility can at the most perform two tank filling activities at a time - one from tanker truck and one from drum pumping operation. Two independent double diaphragm pumps are utilized to perform these two activities. Pumps have nominal capacity of 80 GPM. however, the drum pumping is done at a slower pace by regulating the air flow to the pump to achieve an effective average rate of 10 GPM and the peak rate of 20 GPM.
(7) The knock out drum is maintained to have 10" of water at all times. The vent pipe coming from the tanks is inserted into this water to the depth of 8". This will create an 8" of liquid back pressure into the tank header.
(8) Each tank has a conservation vent and an emergency vent.
Pressure setting for conservation vent = 1 psig
Pressure setting for emergency vent = 2.5 psig
(9) Flash point of liquid stored is less than 100 degrees F and boiling point is below 300 deg F for the API 2000 vent rate to be twice the liquid flow rate.
(10) The total piping equivalent beyond knock-out drum is 30 feet of 2 inch pipe.

(2) Assumptions for Pressure calculations

(1) For the maximum possible pressure/vent flow, it is assumed that a tanker truck is being pumped into T-501 and drum pumping is occurring into tank T-501, simultaneously. At the same time, all tanks are out breathing thermal loss at their maximum rate as indicated in the table.

(3) Working - Out breathing flow

No. of Simultaneous pumping operations	=	2		
Peak Flow rate of tanker truck off-load pump	=	80	GPM	
Peak Flow rate of drum pump-off pump	=	20	GPM	
Total combined Maximum pumping rate into the tanks	=	100	GPM	
Per API 2000, the out breathing volume for transfer of liquids with flash point below 100 degrees F	=	GPM/3.5		
Therefore working/outbreathing flow rate	=	**28.57**	**CFM**	(b)

Estimated Maximum Vent Flow Rate & Potential Maximum Internal Tank Pressure
Phoenix facility

2/6/2009

C. Calculations for Maximum Internal Tank Pressure

(1) Flow distribution

Due to vapor balancing, connection located at the knock-out drum inlet, vapor flow will split into two flows at that point. One going to tanker trailer in the amount equal to the volume being removed from the tanker, and, the remaining excess flow will go through knock-out drum, flame arrestor and carbon beds.

Total out breathing flow into the vent header = working displacement + Thermal displacement = (a) + (b)	=	**50.32**	**CFM**	(d)
Flow to the tanker truck = pump out rate@80 GPM	=	**10.70**	**CFM**	(e)
Therefore, net flow through knock-out drum and to the stack = (d) - (e)	=	**39.63**	**CFM**	(f)

(2) Pressure drop

Flow Frictional pressure drop in vent pipe

Pressure drop for the total outbreathing flow through the 130 feet of vent header, @ 0.1482 psi/100 feet per Crane Handbook	=	**0.19**	**psi**	(g)

Knock-out Drum Resistance(pressure drop)

Vent flow going through knock out drum needs to overcome 8" of water layer, which is	=	**0.29**	**psi**	(h)

Flame Arrestor Resistance(pressure drop)

Flow through flame arrestor = (f) x60	=	2377.57	CFH	
Pressure drop from the curve for Protectoseal model 4952F - 2", for the total flow through the flame arrestor	=	3.5	inches of WC	
	=	**0.13**	**psi**	(j)

Carbon beds Resistance(pressure drop)

Vapor flow from knock-out drum is split into two sets of carbon beds.				
Therefore, flow through each carbon bed	=	19.81	CFM	
Pressure drop from the curve for Ecosorb activated carbon drum model VSC200	=	0.75	inches of WC	
	=	0.027	psi	
For two carbon beds in series, total pressure drop	=	**0.054**	**psi**	(k)

Estimated Maximum Vent Flow Rate & Potential Maximum Internal Tank Pressure
Phoenix facility

2/6/2009

Exit piping pressure drop				
Through 30 feet of pipe @0.13 psi/100 feet	=	0.039	psi	(l)
Total pressure drop through the knock out drum, carbon beds & vent - after the flow split, = (h)+(j)+(k)+(l)	=	0.509	psi	(m)
Total Required Maximum Internal Pressure of the tanks for the maximum vent flow = (g) + (m)	=	0.70	psi	(n)
The conservation vent pressure setting far exceeds the potential maximum internal pressure and is	=	1	psi	

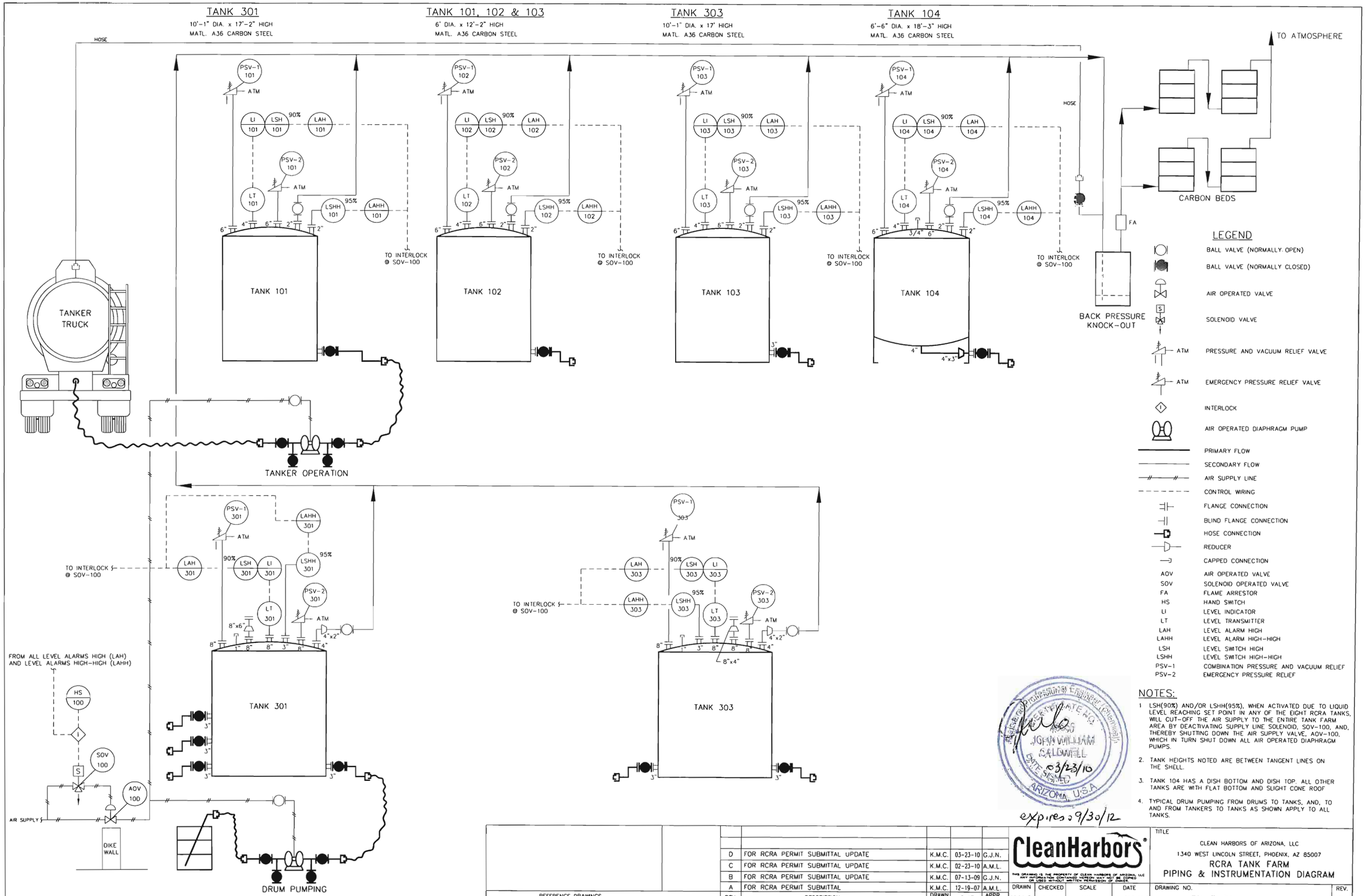
Hence, under normal operation, vent flow will not be released through either conservation vent or emergency vent

D. Calculations for Pressure Drop through vapor balance

Hose length between tanker truck vapor balance connection and the branch connection at knock-out drum	=	73	ft.	(p)
Flow to the tanker truck = pump out rate@80 GPM	=	10.70	CFM	(e)
Pressure drop through vapor balance line - 73 ft of 2" hose, @0.015 psi/100 ft per Crane Handbook	=	0.01	psi	(o)
Back pressure that must exist in tanker truck to equalize the pressure drop for a steady state condition	=	0.69	psi	(q)

Pressure drop (o) is far less than pressure drop (m)

Hence, initially, more flow would go to the tanker to equalize the pressure by creating the backpressure inside the tanker headspace which will reduce the forward flow through carbon beds. Therefore, the maximum total back pressure inside the storage tanks would be what has been calculated here, as represented by (n) above.


TANK 301
10'-1" DIA. x 17'-2" HIGH
MATL. A36 CARBON STEEL
TANK 101, 102 & 103
6' DIA. x 12'-2" HIGH
MATL. A36 CARBON STEEL
TANK 303
10'-1" DIA. x 17' HIGH
MATL. A36 CARBON STEEL
TANK 104
6'-6" DIA. x 18'-3" HIGH
MATL. A36 CARBON STEEL
HOSE
TO ATMOSPHERE
CARBON BEDS
BACK PRESSURE KNOCK-OUT
FA
TANKER TRUCK
TANKER OPERATION
TANK 101
TANK 102
TANK 103
TANK 104
TO INTERLOCK @ SOV-100
TANK 301
TANK 303
FROM ALL LEVEL ALARMS HIGH (LAH) AND LEVEL ALARMS HIGH-HIGH (LAHH)
AIR SUPPLY
DIKE WALL
DRUM PUMPING
LEGEND
BALL VALVE (NORMALLY OPEN)
BALL VALVE (NORMALLY CLOSED)
AIR OPERATED VALVE
SOLENOID VALVE
PRESSURE AND VACUUM RELIEF VALVE
EMERGENCY PRESSURE RELIEF VALVE
INTERLOCK
AIR OPERATED DIAPHRAGM PUMP
PRIMARY FLOW
SECONDARY FLOW
AIR SUPPLY LINE
CONTROL WIRING
FLANGE CONNECTION
BLIND FLANGE CONNECTION
HOSE CONNECTION
REDUCER
CAPPED CONNECTION
AOV AIR OPERATED VALVE
SOV SOLENOID OPERATED VALVE
FA FLAME ARRESTOR
HS HAND SWITCH
LI LEVEL INDICATOR
LT LEVEL TRANSMITTER
LAH LEVEL ALARM HIGH
LAHH LEVEL ALARM HIGH-HIGH
LSH LEVEL SWITCH HIGH
LSHH LEVEL SWITCH HIGH-HIGH
PSV-1 COMBINATION PRESSURE AND VACUUM RELIEF
PSV-2 EMERGENCY PRESSURE RELIEF
NOTES:
1. LSH(90%) AND/OR LSHH(95%), WHEN ACTIVATED DUE TO LIQUID LEVEL REACHING SET POINT IN ANY OF THE EIGHT RCRA TANKS, WILL CUT-OFF THE AIR SUPPLY TO THE ENTIRE TANK FARM AREA BY DEACTIVATING SUPPLY LINE SOLENOID, SOV-100, AND, THEREBY SHUTTING DOWN THE AIR SUPPLY VALVE, AOV-100, WHICH IN TURN SHUT DOWN ALL AIR OPERATED DIAPHRAGM PUMPS.
2. TANK HEIGHTS NOTED ARE BETWEEN TANGENT LINES ON THE SHELL.
3. TANK 104 HAS A DISH BOTTOM AND DISH TOP. ALL OTHER TANKS ARE WITH FLAT BOTTOM AND SLIGHT CONE ROOF
4. TYPICAL DRUM PUMPING FROM DRUMS TO TANKS, AND, TO AND FROM TANKERS TO TANKS AS SHOWN APPLY TO ALL TANKS.
REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
JOHN WILLIAM CALDWELL
03/23/10
DATE SIGNED
ARIZONA, U.S.A.
expires 9/30/12
REFERENCE DRAWINGS
REV. DESCRIPTION DRAWN BY DATE APPR. BY
D FOR RCRA PERMIT SUBMITTAL UPDATE K.M.C. 03-23-10 G.J.N.
C FOR RCRA PERMIT SUBMITTAL UPDATE K.M.C. 02-23-10 A.M.L.
B FOR RCRA PERMIT SUBMITTAL UPDATE K.M.C. 07-13-09 G.J.N.
A FOR RCRA PERMIT SUBMITTAL K.M.C. 12-19-07 A.M.L.
CleanHarbors
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1340 WEST LINCOLN STREET, PHOENIX, AZ 85007
RCRA TANK FARM
PIPING & INSTRUMENTATION DIAGRAM
DRAWING NO. PH-F-01
REV. D

APPENDIX D-7

CONTAINMENT PALLET SPECIFICATIONS

New Pig

Your partner for a clean and safe workplace

1-800-HOT-HOGS® (468-4647)

Product Data Sheet

Item Number: PAK606

Item Name: PIG® Poly Spill Containment Pallet

Load Capacity UDL:

- 3000 lbs./each (1360.8 kg/each)

Sump Capacity:

- 66 gal./each (249.8 L/each)

Options Available:

Item #	Size	Color	Misc. Features	Amount	Length	Width	Height	Depth	Int. Dia.	Ext. Dia.	Weight	Qty/Pallet
PAK606-WOD	—	—	Without Drain	1 each	53" (134.6cm)	53" (134.6cm)	12" (30.5cm)	—	—	—	85lbs. (38.6kg)	9
PAK606-WD	—	—	With Drain	1 each	53" (134.6cm)	53" (134.6cm)	12" (30.5cm)	—	—	—	85lbs. (38.6kg)	9

Color: Black

Description:

A polyethylene sump with deck surface with room to store four 55-gallon drums. In the event of a leak, fluid is contained in the sump preventing contamination to surrounding environment.

Application:

Used for storing four 55-gallon drums.

Product Features:

PIG® Poly Spill Pallet helps you comply with containment regulations and store drums safely. Capture leaks, drips and spills to keep floors dry and workers safe.

- Standard-duty Pallet is strong enough to support four fully loaded drums
- Polyethylene construction resists UV rays, rust, corrosion and most chemicals
- Removable nonslip grates add surface traction; lift out for easy access to sump
- 4-way forklift entry allows access from any direction for easy movement (unloaded only)
- Black sidewalls hide grime

Composition:

- Sump - Linear Low-Density Polyethylene w/ UV Inhibitors
- Grate - Injection-Molded Polyethylene

This product helps you comply with:

Regulatory Citation	Summary
40 CFR 112.7	SPCC planning requirements state that facilities subject to these regulations must have written plans in place discussing the products, countermeasures and procedures that are in place, or will be taken by the facility to prevent discharge of oil into waters of the United States.
40 CFR 264.175	Hazardous waste containment systems must be free of structural cracks or gaps, be designed to keep spilled liquids from remaining in contact with the container, prevent run-on and "have sufficient capacity to contain 10% of the volume of the containers, or the volume of the largest container, whichever is greater."

Additional Specifications:

- Dimensions (Fork Pocket): 4" H x 14" W
- Distance Between Fork Pockets: 6"
- Dimensions (Drain Plug): 3/4" Dia. NPT
- Capacity: 4 Drums
- Dimensions (Grate): 48" L x 48" W
- Style: Standard

Disclaimers:

- **Flammables Notice:** If using this product with flammable liquids, please consider the regulations that apply to storage and handling of flammable liquids and the safety of this application, specifically flammable vapors, static discharge and heat sources. For further assistance, please call Technical Services.
- **Poly Drum Notice:** Not recommended for long term storage of poly drums.

PDS generated: Jul 14, 2008

One Pork Avenue, Tipton, PA 16684-0304 • 1-800-HOT-HOGS® (468-4647)
Fax: 1-800-621-PIGS® (621-7447) • Email: hothogs@newpig.com • Web: newpig.com

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New Pig

Your partner for a clean and safe workplace.
1-800-HOT-HOGS® (468-4647)

Chemical Compatibility Guide for:
Low Density Polyethylene Products

NOTICE:
This report is offered as a guide and was developed from information which, to the best of New Pig Corporation's knowledge, was reliable and accurate. Due to variables and conditions of application beyond New Pig Corporation's control, none of the data shown in this guide is to be construed as a guarantee, expressed, or implied. New Pig Corporation assumes no responsibility, obligation, or liability in conjunction with the use or misuse of the information.

This listing was prepared to provide guidance to the chemical compatibility of New Pig Corporation containment pallets and decks, containers and other polyethylene products.

Polyethylene is susceptible to some chemicals. These chemicals may cause stress cracking, swelling, oxidation, or may permeate the polyethylene. These actions may reduce the physical properties of polyethylene containers.

Stress cracking: Some surface-active chemicals can accelerate the cracking of polyethylene when it is under stress.

Absorption / Swelling: Certain types of chemicals will absorb or swell polyethylene to varying degrees. In some cases, a loss of physical properties may occur. Use of chemicals that may affect polyethylene in this manner will depend upon the performance requirements of the application.

Oxidation: Some aqueous solution of materials with an oxidizing action will attack polyethylene. Short-term containment of these chemicals may not significantly affect the polyethylene. However, long-term storage of high temperature chemicals should be approached with caution.

Chemical	Rating	Chemical	Rating
Acetaldehyde (40%)	L	Hydrogen Bromide (10%)	L
Acetamide	L	Hydrogen Peroxide (90%)	L
Acetic Acid (50%)	L	Hydrogen Phosphide (100%)	L
Acetic Acid Anhydride	S	Hydroquinone	L
Acetic Ether	S	Hydrogen Sulfide	L
Acetone	L	Hypochlorous Acid	L
Acetylene Tetrabromide	S	Inks	L
Acrylic Emulsions	S	Iodine (Alc. Sol.) Conc.	L
Acrylonitrile	L	Iron Salts	L
Adipic Acid	L	Iso-Octane	S
Aliphatic Hydrocarbons (Hexane, Octane, Hexene, Octene, etc.)	L	Isopropyle Acetate	L
Alkaline	L	Isopropyl Alcohol	L
Allyl Alcohol (96%)	L	Isopropyl Ether	N
Alum (Aqueous Solutions)	L	Jet Fuel	S
Aluminum Chloride (20%)	L	Kerosene	S
Aluminum Fluoride	L	Lactic Acid (All concentrations)	L
Aluminum Hydrogen Solution (10%)	L	Lanolin	L
Aluminum Hydroxide	L	Latex	L
Alums (All types)	L	Lead Salts	L
Ammonia (Anhydrous)	L	Lead Acetate Sat'd	L
Ammonia (Aqueous)	L	Lime	L
Ammonia (100% dry gas)	L	Linseed Oil	L
Ammonium Salts	L	Lithium Salts	L
Ammonium Acetate	L	Lube Oil	L

Chemical	Rating	Chemical	Rating
Ammonium Acetate	L	Magnesium Salts	L
Ammonium Bifluoride	L	Magnesium Carbonate	L
Ammonium Carbonate (50%)	L	Magnesium Hydroxide	L
Ammonium Chloride	L	Magnesium Nitrate	L
Ammonium Hydrogen Fluoride (50%)	L	Magnesium Oxide	L
Ammonium Hydroxide	L	Magnesium Sulfate	L
Ammonium Metaphosphate Sat'd	L	Maleic Acid	L
Ammonium Nitrate (10%)	L	Malic Acid (1%)	L
Ammonium Nitrate Sat'd	L	Mercuric Salts	L
Ammonium Persulfate Sat'd	L	Mercurous Salts	L
Ammonium Phosphate	L	Mercury	L
Ammonium Sulfate (10%)	L	Methanol	L
Ammonium Sulfate Sat'd	L	Methyl Acetate	L
Ammonium Sulfide Sat'd	L	Methyl Alcohol (100%)	L
Ammonium Thiocyanate Sat'd	L	Methyl Amine (32%)	L
Amyl Acetate	L	Methyl Bromide	N
Amyl Alcohol (100%)	L	Methyl Chloride	N
Amyl Chloride	N	Methylene Chloride	N
Aniline (100%)	S	Methyl Ethyl Ketone	S
Aniline Hydrochloride	S	Methyl Isobutyl Ketone	S
Animal Fats	L	Methyl Isopropyl Ketone	S
Anti-Freeze	L	Methyl Sulfate	L
Antimony Salts	L	Methyl Sulfonic Acid (All conc.)	L
Antimony Trichloride (90%)	L	Milk	L
Aqua Regia	N	Mineral Oils	L
Aqueous Salt Solutions (NaCl)	L	Molasses	L
Aqueous Alkalies (NaOH)	L	Monochloroacetic Acid Ethyl Ester	L
Arsenic Acid	L	Monochloroacetic Acid Methyl Ester	L
Arsenic Salts	L	Morpholin	L
Barium Salts	L	Mowilith D	L
Barium Carbonate	L	Naphtha	S
Barium Chloride	L	Napthalene	S
Barium Cyanide	L	Nickel Salts	L
Barium Sulfide	L	Nicotine Dilute	L
Battery Fluid, Acid	S	Nicotinic Acid	L
Beef Tallow Emulsion, Sulfonated	L	Nitric Acid <50%	L
Beer	L	Nitrobenzene	S
Benzaldehyde	L	Nitrotoluene	S
Benzene	L	Octyl Cresol	L
Benzene Sulfonic Acid	S	Oils and Fats	L
Benzoic Acid	L	Oleic Acid (All concentrations)	L
Benzyl Alcohol	L	Oleum Conc.	N
Benzyl Chloroformate	L	Olive Oil	L
Bismuth Salts	L	Orange Extract	L
Bleach Lye (15%)	S	Oxalic Acid (All concentrations)	L
Black Liquor	L	Palmitic Acid	N
Borax Cold Sat'd	L	Palm Oil	S
Boric Acid Dilute	L	Paraffin Emulsions	L
Boric Acid Conc.	L	Paraffin Oil	L
Bromine, Liquid	N	Perchloric Acid (50%)	L
Bromine, Water	N	Perchloroethylene	N
Bromobenzene	N	Petroleum	L
Bromoform	N	Petroleum Ether	S
Butadiene	L	Phenol (10%)	S
Butane	L	Phenylhydrazine	N

Chemical	Rating	Chemical	Rating
Butanediol (100%)	L	Phosphoric Acid (All conc.)	L
Butanol	L	Phosphorous Chlorides	S
Butyl Acetate	L	Phosphorous (Yellow 100%)	L
Butyl Alcohol (100%)	L	Phosphorous Pentoxide	L
Butylene	N	Photographic Solutions	L
Butylene Glycol	L	Phthalic Acid (All concentrations)	L
Butylene Liquid	N	Phthalic Anhydride	L
Butyl Phenol	N	Pickling Baths	
Butyric Acid	L	Sulfuric Acid	L
Calcium Carbonate	L	Hydrochloric Acid	L
Calcium Chloride	L	Picric Acid (1%)	L
Calcium Hydroxide	L	Plating Solutions	
Calcium Hypochlorite	L	Brass	
Calcium Nitrate (50%)	L	Cadmium	L
Calcium Sulfate	L	Copper	L
Camphor Oil	N	Gold	L
Carbon Bisulfide	N	Indium	L
Carbon Disulfide	N	Lead	L
Carbonic Acid (AQ. CO2)	L	Nickel	L
Carbon Monoxide	L	Rhodium	L
Carbon Tetrachloride	N	Silver	L
Castor Oil Conc.	L	Tin	L
Caustic (Aqueous)	L	Potassium / Aluminum Sulfates (50%)	L
Caustic Potash Sol. (50%)	L	Potassium Bichromate	L
Caustic Soda Sol. (10%)	L	Potassium Borate (10%)	L
Chloral Hydrate	L	Potassium Bromide	L
Chloroethanol	L	Potassium Chlorate	L
Chloric Acid (10%)	L	Potassium Chloride	L
Chloracetic Acid	L	Potassium Chromate	L
Chlorobenzene	S	Potassium Cyanide	L
Chloroform	N	Potassium Dichromate (40%)	L
Chloromethane	N	Potassium Ferri / Ferro Cyanide Sat'd	L
Chlorosulfonic Acid (100%)	N	Potassium Fluoride	L
Chrome Alum Sat'd	L	Potassium Hydroxide	L
Chromic Acid (50%)	S	Potassium Iodide	L
Cider	L	Potassium Nitrate Sat'd	L
Citric Acid (All Concentrations)	L	Potassium Perborate Sat'd	L
Clorox Bleach	L	Potassium Perchlorate	L
Coconut Oil Alcohols	L	Potassium Permanganate	L
Cola Concentrates	L	Potassium Persulfate Sat'd	L
Compressed Air Conditioning Oil	L	Potassium Phosphates	L
Copper Salts	L	Potassium Sulfate	L
Copper Cyanide	L	Propanol	L
Copper Nitrate	L	Propionic Acid (50%)	L
Copper Sulfate	L	Propyl Alcohol	L
Corn Oil	L	Propylene Dichloride (100%)	L
Cottonseed Oil	L	Propylene Glycol	L
Cresol (90%)	L	Propylene Oxide	L
Cresylic Acid	L	Pyridine	S
Crotonic Aldehyde	L	Rayon Coagulation Salts	L
Cuprous Chloride Sat'd	L	Rust Inhibitors	L
Cyclohexane	L	Sea Water	L
Cyclohexanol	L	Selenic Acid	L
Cyclohexanone	S	Sewage	L

Chemical	Rating	Chemical	Rating
Detergents, General	L	Shortening	L
Developers, Photographic	L	Silicic Acid	L
Dextrin Sat'd	L	Silicone Oil	L
Dextrose Sat'd	L	Silver Salts	L
Diazo Salts	L	Silver Nitrate	L
Dibutyl Ether	N	Soda Solution (All concentrations)	L
Dibutyl Phthalate	S	Soda Ash	L
Dibutyl Sebacate	S	Sodium Salts	L
Dichloracetic Acid	S	Sodium Acetate Sat'd	L
Dichloroacetic Acid, Methyl Ester	L	Sodium Acrylates	L
Dichlorobenzene, Liquid	N	Sodium Benzoate	L
Dichloroethylene	N	Sodium Bicarbonate	L
Diesel Fuel	S	Sodium Bisulfate (10%)	L
Diesel Oil	S	Sodium Bisulfite	L
Diethylene Glycol	L	Sodium Bromate	S
Diethanolamine	S	Sodium Bromide	L
Diethyl Carbonate	L	Sodium Bromide Dilute Solution	L
Diglycolic Acid (30%)	L	Sodium Carbonate	L
Di-Isobutyl Ketone	S	Sodium Chlorate	L
Dimethylamine	S	Sodium Chloride	L
Dimethyl Formamide	S	Sodium Chlorite	L
Dinonyl Phthalate	N	Sodium Chromate	L
Dioctyl Phthalate	N	Sodium Disulfite	L
Dioxane	L	Sodium Dithionite (10%)	L
Diphenyl Oxide	N	Sodium Ferricyanide	L
Disodium Phosphate	L	Sodium Ferrocyanide Sat'd	L
Electrolyte	L	Sodium Fluoride Sat'd	L
Emulsions, Photographic	L	Sodium Hydroxide Conc.	L
Ethanol	L	Sodium Hypochlorite	L
Ether	N	Sodium Iodine	L
Ethyl Acetate (100%)	S	Sodium Nitrate	L
Ethyl Alcohol	L	Sodium Oxalate	L
Ethyl Butyrate	S	Sodium Persulfate	L
Ethyl Chloride	N	Sodium Phosphate	L
Ethyl Ether	N	Sodium Silicate	L
Ethylene Chloride	N	Sodium Sulfate	L
Ethylene Chlorohydrin	L	Sodium Sulfide	L
Ethylene Diamine	L	Sodium Sulfite	L
Ethylene Dichloride	N	Sodium Sulfonates	L
Ethylene Glycol	L	Sodium Thiosulfate	L
Ethylene Oxide	N	Spindle Oil	N
Fatty Acids	L	Stannic Salts	L
Fatty Alcohol Sulfonate	L	Stannous Salts	L
Ferric Salts	L	Starch Solution Sat'd	L
Ferric Sulfate	L	Stearic Acid (All concentrations)	L
Ferrous Salts	L	Succinic Acid	L
Ferrous Sulfate	L	Sugar Solutions	
Fertilizer Salts	L	Glucose	L
Fish Solubles	L	Lactose	L
Fluoboric Acid	L	Sucrose, Etc.	L
Fluosilicic Acid (All concentrations)	L	Sulfur	L
Formaldehyde (40%)	L	Sulfuric Acid (98%)	S
Formamide	L	Sulfuric Acid, Fuming	N
Formic Acid (All concentrations)	L	Sulfurous Acid	L
Fruit Pulp	L	Sulfuryl Chloride	N

Chemical	Rating	Chemical	Rating
Fuel Oil	L	Tallow	L
Furfural (100%)	L	Tannic Acid	L
Furfuryl Alcohol	N	Tanning Extracts	L
Gallic Acid Sat'd	L	Tartaric Acid Sat'd	L
Gasoline	L	Tetrachloroethane	N
Gasohol	L	Tetrachloroethylene	N
Gelatine	L	Tetraethyl Lead	L
Gin	L	Tetrahydrofurane	N
Gluconic Acid (All concentrations)	L	Tetrahydronaphthalene	N
Glucose	L	Thionyl Chloride	N
Glycerine	L	Tin Salts	L
Glycol	L	Titanium Salts	S
Glycol Ethers	L	Toluene	S
Glycolic Acid (All conc.)	L	Toluene Sulfonic Acid (All conc.)	S
Grape Sugar Sat'd Aq.	L	Transformer Oil	L
Heptane	L	Tributylphosphate	L
Hexane	L	Trichloroacetic Acid	S
Hexanol Tert	L	Trichloroethane	N
Hydrazine (35%)	L	Trichloroethylene	N
Hydrazine Hydrate	L	Tricresyl Phosphate	L
Hydrazine Hydrochloride	L	Triethanolamine	L
Hydrosulfite (10%)	L	Trioctyl Phosphate	N
Hydroxylamine Sulfate	L	Trisodium Phosphate Sat'd	L
Hydriodic Acid (All conc.)	L	Turpentine Oil	N
Hydrobromic Acid (50%)	L	Urea	L
Hydrocyanic Acid Sat'd	L	Urine	L
Hydrochloric Acid (All conc.)	L	Vegetable Oils	L
Hydrofluoric Acid (All conc.)	L	Vinegar	L
Hydrofluorosilicic Acid (All conc.)	L	Vanilla Extract	L
		Wax Alcohol	N
		Wetting Agents	L
		Whiskey	L
		White Acid (75%)	L
		Wine	L
		Xylene	N
		Yeast	L
		Zinc Salts	L
		Zinc Sulfate	L

KEY:

L = Containers should be suitable for long term storage of the substances, under the conditions specified.

S = These substances may adversely affect the polyethylene. New Pig Corporation containers may be suitable for storage of up to one year. The user should perform qualification tests before or during usage of the container.

N = These substances aggressively attack polyethylene or have vapor pressures incompatible with the containers. Do not use polyethylene containers in these applications.

Note: Use judgment as to use of product. Is it for short or long term use when using L, S, or N? (Example: Drum Fluids normally for short term use.)

For additional assistance, please contact New Pig Technical Services at 1-800-HOT-HOGS® (468-4647).

100% Money-Back Guarantee

If you're not happy with a product, for any reason, we'll refund every penny of your purchase price. That means we'll refund all sales taxes, shipping costs, and any other incidentals - without tacking on a restocking fee or any other surprise charges. You get ALL your money back. Period.

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PALLETS

TOUGH JOB
POLY-SPILLPALLET™ 2000

Optional tarp available (Product No. 5063).

This secondary containment system is engineered to meet the rigors of today's regulatory environment. With 100% polyethylene, it provides excellent chemical resistance.

Optional tarp for outdoor storage and drain hole with plug available.

- Meets EPA 40 CFR 264.175
- Holds up to 2,000 lbs UDL
- Forkliftable
- Removable grates for easy cleaning

LOW-PROFILE IN-LINE
POLY-SPILLPALLET™ 3000

WHERE NO DRUM STORAGE HAS GONE BEFORE.

Optional tarp available (Product No. 5062).

Storing drums in-line near the wall, between columns, and in all those spaces you thought were unusable. Optional tarp for outdoor storage, and optional drain.

- Holds four 55-gallon drums
- Non-skid, removable grates
- 66-gallon sump capacity meets EPA 40 CFR 264.175
- 100% polyethylene
- Low 12" profile
- Holds up to 3,000 lbs UDL wt.
- Raised edge on back and sides helps orient barrels on pallet

POLY-SLIM-LINE™ 6000

SUM IS IN.

Optional tarp available (Product No. 5061)

Poly-Slim-Line 6000 offers all of the same advantages as our Poly-SpillPallet6000...and more! This addition to our pallet family features a low, 12" profile and a UDL load bearin capacity of 6000 lbs. Optional drain.

POLY-SPILLPALLET™6000

DESIGNED TO HOLD THE HEAVY LOAD.

Optional tarp available (Prod. No. 5064).

Rated at 6,000 lbs. UDL weight with a 83-gallon sump capacity that meets EPA 40 CFR 264.175. Square 50" x 50" footprint saves space yet easily holds four 55-gallon drums. Includes the same rugged features as the 2000. Optional drain.

- Two removable grates hold up to 6,000 lbs. of UDL wt.

- Forkliftable from all sides

SPECIFICATIONS		
	POLY-SPILL PALLET™ 2000	**IN-LINE POLY-SPILLPALLET™3000**
Product No.	**5253-YE**	**5102-YE**
Dimentions	53.5" l x 29" w x 17" h 136 cm x 74 cm x 43 cm	98" lx 25.25" w x 12" h 249 cm x 64 cm x 30 cm
Weight	63 lbs./ 28.35 kg	80 lbs./ 36 kg
Load Bearing Capacity UDL	2000 lbs./ 900 kg	3000 lbs. / 1350 kg
Sump Capacity	58 gal./ 220.4 liters	66 gal./ 250.8 liters
Regulations	EPA 40 CFR 264.175	EPA 40 CFR 264.175

SPECIFICATIONS		
	POLY-SLIM-LINE™ 6000	**POLY-SPILLPALLET™6000**
Product No.	**5400-YE**	**5001-YE**
Dimentions	54" lx 54" w x 12" h 137 cm x 137 cm x 30 cm	50" l x 50" w x 17" h 127 cm x 127 cm x 43 cm
Weight	91 lbs. / 41 kg	88 lbs./ 40 kg
Load Bearing Capacity UDL	6000 lbs. / 2700 kg	6000 lbs. / 2700 kg
Sump Capacity	66 gal. / 250.8 liters	83 gal./ 315.4 liters
Regulations	EPA 40 CFR 264.175	EPA 40 CFR 264.175

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APPENDIX D-8

CITY OF PHOENIX FIRE DEPARTMENT PETITION OF APPEAL

City of Phoenix

PHOENIX FIRE DEPARTMENT
Fire Prevention Section
150 South 12th Street
Phoenix Arizona 85034-2301
(602) 262-6771 FAX: (602) 271-9243

Petition of Appeal to the Fire Marshal

All appeals shall be detailed on this form. Supporting data may be attached and submitted if desired however, all entries and statements on this form shall be complete. Incomplete forms will not be accepted.

INTERNAL USE:		
Log Number: FPAP 90001	Date Logged Out:	Date Logged In: 1/12/2009
Case/KIVA Number:	Hearing Date:	Hearing Time:
Engineer/FPS Familiar with Project: Winters	Occupancy Type:	Compliance Date:

Business/Occupancy Name: Clean Harbors Phoenix, LLC	Address: 1340 West Lincoln Street, Phoenix, AZ, 85007
Business Owner's or Corporate Agent's Name: Clean Harbors Phoenix, LLC	Mailing Address: 1340 West Lincoln Street, Phoenix, AZ, 85007
Tenant's Name: Clean Harbors Phoenix, LLC	Mailing Address: 1340 West Lincoln Street, Phoenix, AZ, 85007
Appellant's Name: Joe Christopher	Mailing Address: 1737 East Dennil Street, Wilmington, CA, 90744

This appeal applies to (Check one):

☐ A project in the plans review stage. Building Safety Log No. _____

☐ An alleged Fire Code violation.

An appeal is hereby made to the Fire Marshal for a deviation from Section Chp. 44 unknown of the Phoenix Fire Code
Briefly state the requirements being appealed.

Clean Harbors Phoenix, LLC is a hazardous waste Treatment, Storage and Disposal Facility (TSDF) that stores a variety of hazardous wastes compatibly within its waste storage units. One waste stream in particular are chemical lab packs. Lab packs are individual containers of compatible chemicals packaged inside of an outer container (DOT approved drum) that bears a packing slip attached to identify the inventory inside. The individual chemicals inside are surrounded by absorbent media

State in detail what is proposed in lieu of literal compliance with the Fire Code:

Lab packs contain among other chemicals, hazardous waste classified as " Dangerous When Wet" (DWW). These items are currently stored in waste management unit CSA VI, inside of water proof storage containers. Clean Harbors Phoenix is proposing to store DWW lab packs inside of the other waste management units compatibly with other chemicals where sprinklers are the primary fire suppression device. The DWW material inside of the drums is protected from potential sprinkler activity by both the outer container and the absorbent media inside

Appellant's Signature: Joe Christopher	Title: Compliance Manager	Phone Number: 310-233-3499
Building Owner's Signature: Joe Christopher FOR CLEAN Harbors		Building Owner's Phone Number: 310-233-3499

INTERNAL USE:

Decision of the Fire Marshal

☐ Approved ☑ Approved with Stipulations

☐ Denied ☑ See Attachment

Fire Department Official:	Date: 2/23/09

DISTRIBUTION WHITE - Applicant File YELLOW - Applicant BLUE - Fire Prevention *WEB - 3 Completed Signed Forms Scanned for Submission

To find out about Phoenix construction code adoption news and to research your permits or projects, please visit http://www.phoenix.gov/DEVSERV

City Of Phoenix

Fire Department

200 W. Washington St.
Phoenix, Arizona 85003

Receipt # 09-0002331 **Payment Receipt**
Permit # FPAP 90001 Date Paid 12-JAN-09 Print Date 12-JAN-09
Name: CLEAN HARBORS APPE L - HAZ. STORAGE

Permit Address	1340 W LINCOLN ST. PHOENIX AZ 85007-3420

Project 03-3713
CLEAN HARBORS

Fee/Payment Detail

FPAPPEAL	APPEAL TO THE FIRE MARSHAL	$250.00
CHECK	0701026128 REF: PAYOR: CLEAN HARBORS	$250.00

Payment Totals

Fees Remaining on This Item:	$0.00	Fees:	$250.00
Web Inspection Key:		Amount Received:	$250.00
Cashier:	CMCC	Change Due:	$0.00

This Plan Review application will expire 180 days after the plan review is completed.

City of Phoenix

FIRE PREVENTION DIVISION
PETITION OF APPEAL TO THE FIRE MARSHAL

Date:: 02-20-09
FPAP
Kiva #: FPAP 90001

Name: Clean Harbors Phoenix. LLC
Address: 1340 W. Lincoln Street

APPROVED WITH STIPULATIONS

We are in receipt of your appeal and supporting documentation dated January 12, 2009 for the above address. It is our understanding that you have requested that the water reactive materials stored in your facility be relocated to an area protected by an automatic fire sprinkler system in their original lab pack containers without placing them into a second water proof container. We conducted some research on the lab packs used for this type of materials and have found that they have safeguards for the material being stored designed into them and that the lab pack itself meets the criteria for water tight containers. Based on this information your appeal is being approved with the following stipulations:

1. All other requirements of the Phoenix fire Code are to be followed.
2. DOT compliant lab packs are used to store the Dangerous when Wet (DWW) materials

Approved by
Joe McElvaney
Lead Fire Protection Engineer

Prepared by
Bob Winters
Fire Protection Engineer

150 South 12th Street • Phoenix, Arizona 85034-2301 • 602-262-6771 • FAX: 602-271-9243 • TTY: 602-495-5555