

**MLVT
DESIGN PACKAGE**

BUILT FOR



I. TANK DESIGN AND CERTIFICATION

PILLAR STRUCTURAL ENGINEERING

March 28, 2013

Well Water Solutions and Rental, Inc.
2130 W. 40th
Casper, WY 82604
Attn: Sean Lovelace

Re: Portable Frac Tank Certification – Pinned Seams

Dear Mr. Lovelace:

Per your request our office has performed a structural analysis of the portable frac tanks as well as the associated accessories. This analysis was performed to determine that the tanks meet the required strength criteria under operating conditions according to the AISC Manual of Steel Construction.

The tanks range in diameter from 81 to 156 feet and are 11 feet, 8 inches in height and are designed to store water. They are constructed of individual steel reinforced panels that are connected together with a patent pending steel pin system.

The tanks are constructed of the following materials:

- Tank Panels – ASTM A36, 36 ksi Steel Plate
- Horizontal & Vertical Framing – ASTM A500, Grade B, 46 ksi Structural Steel Tubing
- Connecting Pins - ASTM A36, 36 ksi Steel Round Bar

Our office has determined that the portable frac tanks, as described herein, are capable of supporting the operating load conditions in conformance with the AISC Manual of Steel Construction.

Calculations of this analysis can be provided upon request.

If you have any questions or require additional information please contact our office.

Sincerely,

J. Brendan Bummer, P.E.
Pillar Structural Engineering



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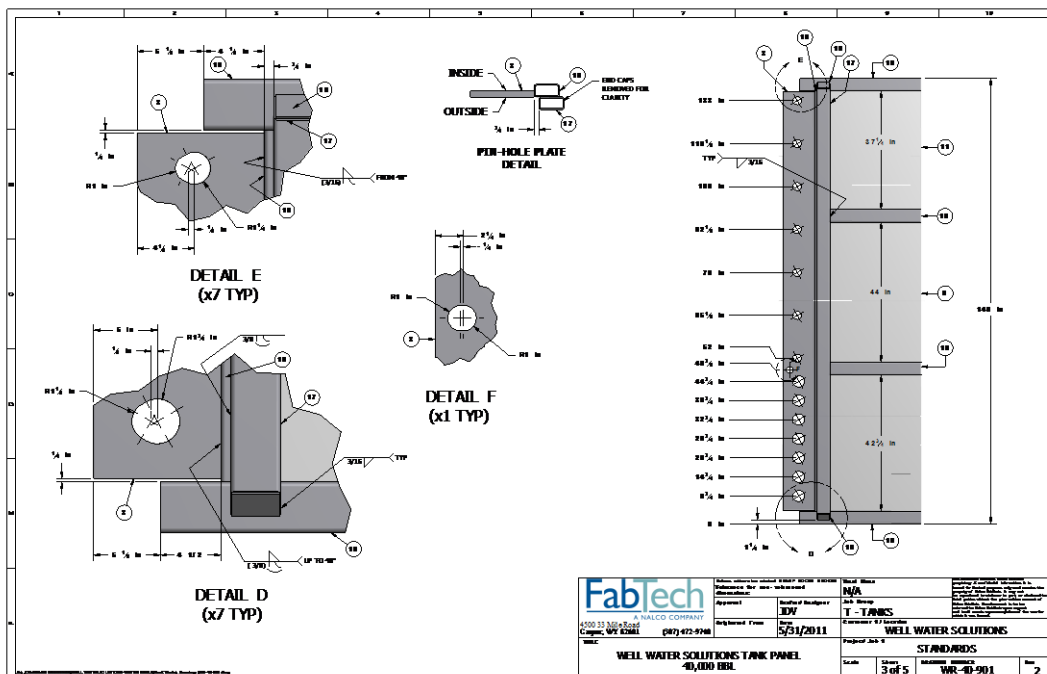
DETAIL A

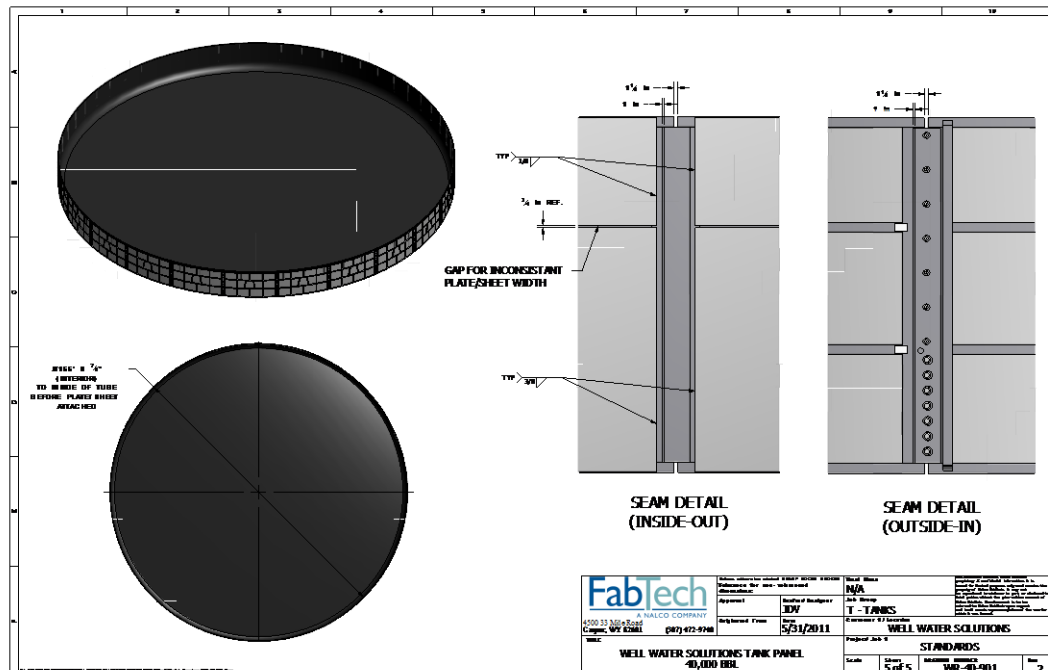
DETAIL B

DETAIL C

2" DIA PIN DETAIL (TYP)

3" DIA PIN DETAIL (TYP)





II. TANK ERECTION OPERATIONS MANUAL

A. PRE CHECKS

1. Fill out JSA prior to any work commencing
2. Confirm tank location and inspect for proper compliance.
3. Check ditches for proper construction.
4. Check weather conditions for the entire day to assure there will be proper weather conditions. If wind exceeds 15-20 MPH consider stopping work or consider deploying liner once all but one tank panels have been erected to provide a satisfactory wind block.
5. Confirm compaction tests are complete and satisfactory.

B. TOOLS, MATERIALS, and EQUIPMENT

1. Hard Hat
2. FRC Clothing
3. Gloves and Safety Glasses
4. Fall Arrest Gear
5. Box Knife
6. Drills with Deep Well Sockets
7. Telehandler Attachment
8. Telehandler (9,000 lb. or larger)
9. Optional Telehandler Man Basket
10. Man Lift

C. TANK ERECTION PROCEDURE

1. Check ditches, find center, and paint the ring for the tank. 40K 156', 30K 135', 20K 108', 10K 82'.
2. Once the ring is painted make a mark 15' out from the ring around the outside. This mark is used as a reference point to assure there is enough liner to go over the tank walls of 12 feet tall once the walls are placed.
3. Unroll and pull out the 10 ounce geotextile to all sides of the ring. Ensure the center mark labeled on the geotextile is in the center of the tank. Adjust the geotextile if necessary.
4. Once the geo is laid out and free of large wrinkles unroll and pull the liner out past the edges of the geo, all layers should overlap each other and liner should extend past the 15' mark. Once you have ensured the geo and liner are square and centered it is ok to then begin to fill the ditches with water. (Never walk on liner that has no geotextile underneath of it.) (Make sure boots are clean and free of rocks before walking on any liner.)
5. Once the geo and liner are pulled out, begin to set the ring by first folding the geo and the liner back onto itself to expose the tank diameter line for the tank panel ring.
6. Put telehandler attachment on telehandler and use to place your first panel on the line and secure it place with secondary equipment. (Remove round bar holding forks onto telehandler and reinsert through custom attachment and resecure bar to carriage.)
7. Continue to set panels in a counter clockwise fashion by placing the female holes of the new panel onto the male pins of the previous panel. Set the rest of the ring in this same manner. (At each panel joint secure a 16 ounce geotextile strip to top pin of the panel and drape to the inside of the tank. Spray glue or tape in place on the interior joint to provide added liner protection at these points.)
8. Hang one to two fill lines and secure them with ratchet straps to give the water trucks a place to continue filling the tank as the remainder of the panels are erected.
9. Once there are enough panels (about half) in place for the tank to hold itself erect, begin pulling liner up the wall and placing temporary clips to hold in place. Ensure that the person in the man basket has on the appropriate fall arrest gear.
10. Before setting the last panel hang the manifold and connect the suction line and strainer box. (Make sure suction hose is connected in a straight alignment to assure good suction.)
11. Set the last panel of the tank.

12. Begin setting the permanent clips by adjusting liner in a straight and loose manner to allow for tightening as water is added to the tank. Ensure that personnel setting the clips are wearing the proper fall arrest gear.
13. When the liner is adjusted correctly place 2 clips per panel and tighten down the bolts with impact drills.
14. Continue setting clips in the manner until all clips are placed. (It is very critical to have around 12"-16" of water before all clips are installed, or monitor the tank closely until that amount of water is in the tank.)
15. If water is an issue and there is not 12" or more leave every other panels' clips off. This will break any vacuum created from wind and will assure the liner not shift. Once the required amount of water is in the tank it then needs to be fully clipped.
16. Once clips are set trim back the excess liner and discard.
17. Hang all remaining plumbing and secure with ratchet straps.
18. Walk location and pick up ALL trash.
19. Secure all materials and trash to be removed from location and leave location.

III. SITE PREPERATION AND GROUND REQUIREMENTS

The location where the tank and liner shall be erected shall meet or exceed the following criteria:

1. Sub grade shall be to 95% compaction and plus or minus 2% of optimum moisture. Various testing methods can be used to determine that the site compaction is sufficient.
2. Tank location shall meet all regulatory set backs required.
3. Tank location shall not have more than a one percent grade from one side to the other side.
4. Prepared ground shall be free of any debris other than native soil and or base used to build location. If a sand bed is not used for liner protection a minimum of a 10 ounce nonwoven geotextile will need to be laid on the surface prior to liner installation to provide adequate liner protection.
5. If trenches are to be dug to gather the water and provide a more efficient suction point to empty the tank the following requirements must be meet:
 - A. Contractors must follow all regulatory requirements including but not limited to "Call Before You Dig."
 - B. Trenches will be no more than 24 inches in depth
 - C. Trench edges will be made adequately smooth and rounded as to provide no liner stress points.
 - D. Trenches shall start a minimum of 5 feet away from tank walls

IV. MINIMUM LINER AND GEOTEXTILE REQUIREMENTS

A. Liners installed in the tank must meet or exceed all the K30B Specifications listed below.

DURA•SKRIM® K30B, K36B & K45B



Scrim Reinforced Polyethylene - NSF/ANSI Standard 61 Certified

PRO-FORMA DATA SHEET

PROPERTIES	TEST METHOD	DURA•SKRIM K30B		DURA•SKRIM K36B		DURA•SKRIM K45B	
		Minimum Roll Averages	Typical Roll Averages	Minimum Roll Averages	Typical Roll Averages	Minimum Roll Averages	Typical Roll Averages
APPEARANCE		Black	Black	Black	Black	Black	Black
THICKNESS		27 mil	30 mil	32 mil	36 mil	40 mil	45 mil
WEIGHT LBS/MSF, (OZ/YD ²)		116 (16.7)	125 (18.0)	136 (19.6)	155 (22.3)	175 (25.2)	200 (28.8)
CONSTRUCTION		Dense scrim reinforced polyethylene					
*PLY ADHESION - LBF/IN	ASTM D 6636	17 or FTB	20 or FTB	21 or FTB	28 or FTB	24 or FTB	32 or FTB
TENSILE STRENGTH - LBF/IN	ASTM D 7003	165 MD 159 TD	182 MD 170 TD	170 MD 166 TD	186 MD 175 TD	178 MD 170 TD	195 MD 180 TD
TENSILE ELONGATION AT BREAK % (FILM BREAK)	ASTM D 7003	480 MD 430 TD	540 MD 500 TD	500 MD 450 TD	575 MD 520 TD	520 MD 470 TD	590 MD 550 TD
TENSILE ELONGATION AT BREAK % (SCRIM BREAK)	ASTM D 7003	32 MD 32 TD	35 MD 35 TD	32 MD 32 TD	35 MD 35 TD	32 MD 32 TD	35 MD 35 TD
TONGUE TEAR STRENGTH - LBF	ASTM D 5884	185 MD 160 TD	195 MD 185 TD	160 MD 120 TD	180 MD 140 TD	140 MD 120 TD	175 MD 145 TD
GRAB TENSILE - LBF (SCRIM BREAK)	ASTM D 7004	260 MD 245 TD	270 MD 255 TD	280 MD 270 TD	300 MD 290 TD	260 MD 245 TD	270 MD 255 TD
GRAB TENSILE ELONGATION AT BREAK % (SCRIM BREAK)	ASTM D 7004	25	32	25	32	25	32
HIGH PRESSURE OIT (HPOIT)	ASTM D 5885	1000 min	2400 min	1000 min	2400 min	1000 min	2400 min
PUNCTURE RESISTANCE - LBF	ASTM D 4833	85	100	110	120	120	133
MAXIMUM USE TEMPERATURE		180° F		180° F		180° F	
MINIMUM USE TEMPERATURE		-70° F		-70° F		-70° F	

*Raven modified QC procedure

PRO-FORMA Sheet Contents:

The data listed in this Pro-Forma data sheet is representative of initial production runs. These values may be revised at anytime without notice as additional test data becomes available.



DURA•SKRIM® K30B, K36B and K45B are linear low density polyethylene geomembranes reinforced with a heavy dense scrim reinforcement. In addition to excellent dimensional stability the K-Series reinforcement provides unmatched tear and tensile strength. DURA•SKRIM® K-Series membranes are formulated with thermal and UV stabilizers to assure a long service life.

Note: To the best of our knowledge, unless otherwise stated, these are typical property values and are intended as guides only, not as specification limits. Chemical resistance, odor transmission, longevity as well as other performance criteria is not implied or given and actual testing must be performed for applicability in specific applications and/or conditions. RAVEN INDUSTRIES MAKES NO WARRANTIES AS TO THE FITNESS FOR A SPECIFIC USE OR MERCHANTABILITY OF PRODUCTS REFERRED TO, no guarantee of satisfactory results from reliance upon contained information or recommendations and disclaims all liability for resulting loss or damage. Limited Warranty available at www.RavenEFD.com



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Scan QR Code to download current technical data sheets via the Raven website.

B. Nonwoven Geotextiles must have a minimum weight classification of 10 ounce per square yard.

V. LINER QUALITY CONTROL

1. Manufacturer of liner rolls must manufacture a minimum of 25,000,000 million square feet a year and be
2. Liner rolls must be wrapped with geotextile and heat shrink plastic as a protective measure.
3. Manufacturer must test welded seams for proper strength and keep on file. Also they must adhere to all requirements set forth by liner producer.
4. Forklift operators need to be trained to use the forklift and use extreme care when moving liners around.
5. Visual inspections are done every time a liner is handled to check for damage.
6. If damage
5. Installation precautions are listed above in Operations Manual.

VI. TANK PANEL INSPECTION AND TESTING

- A. Every time a tank is erected the setup crews need to visually inspect each panel that is set for damages. If damages are encountered crews must stop work and consult with the design engineer for instructions.
- B. Panels must get a detailed (MPI) magnetic particle inspection by a certified inspector once every fifty sets or upon visual damage, before being able to go back onto service.

The MLVT design package must be certified and sealed by a Licensed Professional Engineer stating that the design specifications are adequate to withstand the loads resulting from using the tank. The Licensed Professional Engineer must either be licensed in Colorado or the state where the MLVT was designed or manufactured. The design package must include the following components:

1. Detailed tank design.
2. Specific tank installation and assembly procedures.
3. Documentation of appropriate site conditions for installation, which includes grades, bedding material, and potential weather impact.
4. Appropriate site preparation.
5. The required liner material and minimum thickness for the application along with applicable standards.
6. Liner installation procedures and quality control measures.
7. Periodic testing or reinspection requirements including what to perform, when to perform, and testing guidelines/protocols.
8. Detailed Standard Operating Procedures (SOP) for all of the above items.