

## ACTIVE REMEDIATION

### F.A.P. Plus™ Pump System Active pneumatic skimming system for product recovery

#### Application

- ❖ LNAPL Recovery.
- ❖ DNAPL Recovery.
- ❖ 2 inch or larger wells.
- ❖ Recover a wide range of products from light-end hydrocarbons to more viscous products such as #6 heating oils.

#### Description

The F.A.P. Plus™ Pump system is comprised of seven main components:

- F.A.P. Plus™ Pump ①
- Skimmer Assembly ②
- Well Clincher ③
- Filter/Regulator (not shown)
- Pneumatic Overfill Protection Device ④
- Electric Air Compressor (not shown)
- Hoses (not shown)

Options:

- SolarNAPL Compressor
- F.A.P. HF



**Tech Tip:** For recovery of sinkers, the DNAPL skimmer (TR-519) attaches to the bottom of the F.A.P. Plus™ Pump.

#### ■ F.A.P. Plus™ Pump (TR-516)

The F.A.P. Plus™ Pump consists of a flexible, special inner bladder and a flexible Buna-N® hose which forms the outer pump body. The integral controller is housed inside the stainless chamber and is factory preset for 15 cycles per minute. This provides the optimum pumping rate.

The pump operates by alternately inflating and deflating the annular space between the inner bladder and the outer hose. When compressed air is applied, the inner bladder collapses. When the air is exhausted, the inner bladder rebounds to its original shape thereby causing a suction which pulls fluid into the pump and up to the surface. The pump utilizes two check valves to maintain the suction and prevent the fluid from flowing back into the well. The pump is capable of producing a suction of 17 in of mercury for the recovery of viscous product and operation in deep wells up to 200 feet.

The F.A.P. Plus™ can operate dry or in the coiled position without damage. It may be installed at the surface in shallow well applications.

#### ■ Skimmer Assembly

The skimmer is attached to the bottom of the F.A.P. Plus™ pump and is used to separate the product from the water in the well. Depending on your site conditions, three types of skimmers are available: standard, high viscosity and density skimmers. The following table will help you select the proper skimmer for your site.

Viscosity	80 SSU or less		Higher than 80 SSU	
D from BW to PWI	≥ 24"	≥ 18"	≥ 18"	6"
Water Table Flu	< 36"	< 24"	< 30"	< 24"
Well Diameter	≥ 2"	≥ 2"	4"	2"
Part Number	TR-517	TR-51711	TR-70410	TR-702
Skimmer Type	Standard 36" travel	Standard 24" travel	High Viscosity	Density

**Tech Tip:** The high water shut off can be added to the TR-517, TR-51711 and the TR-70410 to insure water is not recovered should the water table change exceed the skimmer travel.

**Standard Skimmer (TR-517).** The standard skimmer is used to recover gasoline, jet fuel and most diesel fuels. It combines a density float, a special hydrophobic element, a product bypass, a hollow guide rod and a coiled hose. The center guide rod allows the skimmer to travel freely in

response to the water table changes. The skimmer is designed to float with the inlet positioned at the water/product interface automatically providing 36" of skimmer travel. The density float is used to position the special hydrophobic element — the skimmer inlet — at the product water interface. The hydrophobic element uses a special micron pore size that is based on surface tension, allowing only product to pass. A larger pore size is available for use with higher viscosity products such as weathered diesel. Pumping rates through the hydrophobic element will be approximately 100 gallons per day.

**Tech Tip:** The larger micron-sized elements may allow a small percentage of water to pass.

The bypass element is attached to the top of the hydrophobic element and allows the product to enter the skimmer directly when the product layer is greater than 2 inches. Recovery rates through the bypass element are approximately 300 gallons per day.

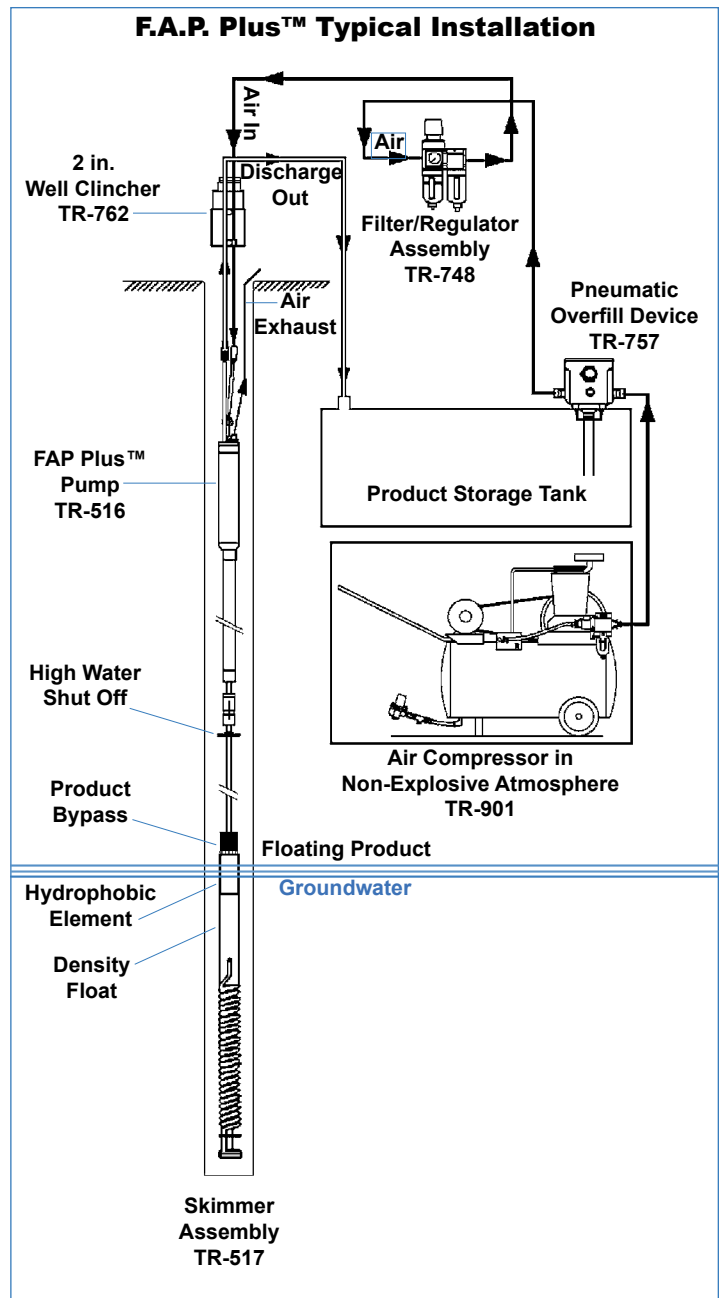
The complete skimmer element is connected to the bottom of the guide rod by a coiled polyurethane hose. This coiled hose can accommodate water level changes of up to 36 in automatically maintaining the skimmer intake at the water/product interface. A minimum distance of 24 in from the bottom of the well to the water/product interface is required when using the TR-517. The TR-51711 requires a minimum of 18 in and provides 24 in of travel.

The skimmer can also be configured as a passive device by attaching a quick connect canister on the bottom of the skimmer, providing greater flexibility for free product recovery projects. (see Passive Skimmer on page 9).

**Maintenance:** Biofouling may occur because the hydrophobic element is positioned at the air/product interface. If fouling occurs, the element can be cleaned using a soft brush or replaced by unthreading the bypass element and installing a new hydrophobic element.

**High Viscosity Skimmer (TR-70410).** This skimmer is used when the product has a viscosity higher than 80 SSU, such as oils. The 4 in high viscosity skimmer uses the same design as the TR-517, less the hydrophobic and bypass elements. The skimmer has a 30 in travel and a specific gravity of 0.95, allowing it to float at the water/product interface. The product collects on the top of the skimmer inlet and, from there, is pumped to the surface. In normal applications the skimmer will remove product down to a ¼ in to ½ in product layer. The skimmer can be adjusted in the field to remove the product even further and attain a thinner layer.

**Density Skimmers (TR-704, TR-706, TR-712).** Density skimmers are used when there is less than 18 inches of flu-



id from the bottom of the well to the water/product interface. These skimmers have a specific gravity of 0.95 and float in the water with the top inlet just above the product/water interface. The skimmers have an effective travel of 24 inches. The 2 in and 4 in sizes are for use in well casings with these nominal inside diameters. The 6 in and 12 in models are self-supporting and may be used in large diameter wells, open excavations and open water applications.

**High Water Shut Off (TR-51710).** This option can be used on all the rod skimmers, TR-517, TR-70410 and TR-51711. It is used when the water table changes are expected to exceed the travel of the skimmer. When the skimmer reaches its upper travel limit and is submerged in water, the pneumatic logic shuts down the pump and will restart the pump

when the skimmer returns to its normal operating position.

**Tech Tip:** It is important to ensure that water table level changes do not exceed the travel of the skimmer, or water could be collected. The High Water Shut Off, TR-51710, should be considered in these applications. When installing the system, it is also important to account for the rise in the water table due to removal of floating product. Water tables can rebound over 20% when product is removed.

■ **Well Clincher**

The Well Clincher has expandable, pass-through fittings for the air supply and fluid discharge hose, allowing the pump to be easily adjusted.

The Well Clincher seals the well from debris and is available for wells with diameters from 2 to 8 in.



Well clincher and filter regulator in simple field installation.

■ **Filter/Regulator**

The regulator allows the pump operating pressure to be set according to the depth of the pump. A minimum of 60 psi is required to operate the F.A.P. Plus™ pump properly. The filter regulator is included with each F.A.P. Plus™ pump.

■ **Pneumatic Overfill Protection Device**

This device is installed on the recovery tank or drum to prevent overflowing the product storage vessel. The overfill device is installed on the storage vessel and will thread into a standard 2 in bung. The main air is supplied to the inlet side of the overfill device and the outlet air supply to the F.A.P. Plus™ pump. The overfill device senses a pressure differential when the storage vessel is nearly full and shuts off the air supply to the F.A.P. Plus™ pump. The standard overfill device can be used with three F.A.P. Plus™ pumps. The TR-75711 is used with more than three F.A.P. Plus™ pumps.



TR-757

**Electro-Pneumatic Overfill Protection Device**

This device uses an intrinsically safe float sensor to shut off the air supply to the F.A.P. Plus™ pump. It includes a programmable 24 hour timer to allow on/off time settings in 15 minute increments. A 115 V power supply is required.

■ **Air Compressors and Membrane Dryer**

An electric, non-explosion-proof 2.5 hp, indoor-use air compressor producing 4.2 scfm is supplied with the standard F.A.P. Plus™ Pump System (TR-515). This compressor can be used with up to three F.A.P. Plus™ systems. A 5 hp compressor is available for use with more than three systems. If other air sources are used, they should include a 5 micron coalescing air filter. In freezing or high humidity conditions, an air dryer is required to avoid system damage. The Membrane Dryer (TR-749) is a good choice for use with the F.A.P.™ System. The F.A.P. Plus™ pump requires relatively dry air for optimum performance. Refer to line sizing chart on page 33.

■ **Hoses**

The standard hose size from the outlet side of the filter regulator to the F.A.P. Plus™ pump is a 1/4" Push-Lok™ fitting and a 3/8 in barb fitting on the air inlet side. The standard F.A.P. Plus™ fluid discharge line has a 3/8 in barb fitting. The hose sizes may have to be increased depending on the distance between the system components.

**How do I select the most appropriate skimming system?**

The most important elements in choosing the F.A.P. Plus™ system will be your water table fluctuations, product viscosity, type of product, well diameter and amount of product present. You can find the complete design data sheet on our web site to define all of your site conditions.

**Tech Tip:** The F.A.P. Plus™ requires a minimum of 60 psi for optimal performance

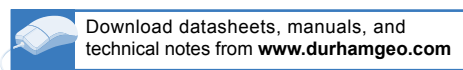
**Options**

■ **SolarNAPL** — Solar-powered air compressor configured to drive an optional F.A.P. Plus™ pump. See page 6 for details.

■ **F.A.P. HF** — To pump at higher flow rates (up to 2.2 gpm) with a suction of 17 in Hg at the inlet. See page 13 for details.

SPECIFICATIONS	
<b>TR-516 F.A.P. Plus™ Pump System</b>	
Size and Weight	1.75 in OD by 59 in long. 6 lb
Air Requirements	0.5 cfm at 100 psig (2.8 dm <sup>3</sup> at 690 kPa)
Operating Pressure	60 to 100 psig
Pump Capacity	15 - 20 gal/hr at 10 ft DTH 10 - 15 gal/hr at 100 ft TDH <i>Based on gasoline through 3/8 in ID hose.</i>
Max. Viscosity	Contact Factory
Suction	17 in Hg
Materials	Flexible Buna-N® (outer bladder) Tygon® Special (inner bladder) Brass, stainless steel
Air Supply to Pump	1/4 in OD polyethylene
Fluid Discharge	3/8 in ID Buna-N® hose
<b>TR-517 F.A.P. Plus™ Skimmer</b>	
Size	1 3/4 in OD x 67 in long. Fits 2 in and larger wells
Materials	UHMW polyethylene, stainless steel, urethane tubing, hydrophobic material, nitrophenyl float, brass fittings and PVC
Float	UHMW polyethylene, S.G. 0.95 Up to 36 in effective travel
<b>TR-702/704/706/712 F.A.P.™ Density Skimmers</b>	
Sizes (Diameter)	1.65, 3.5, 5.5, or 11.5 in
Materials	
Float	UHMW polyethylene, S.G. 0.95
Inlet Screen	Stainless Steel Mesh
Coil	Polyurethane tubing
Effective Travel	up to 24 in
<b>TR-757 All-Pneumatic Overfill Protection Device</b>	
Size	4 x 4 x 20 in
Enclosure	Fiberglass
<b>TR-758 Electro-Pneumatic Overfill Protection Device</b>	
Enclosure	NEMA 4 rating; solid state GEM Pak® circuitry. 8 x 6 x 4 in
Pneumatic Valve	23 scfm at 100 psi
Float Switch	Intrinsically safe; w/ 100 ft cable
Voltage	110 V (ac)
Power Cord	8 ft
Timer	Provides 24 hr time-delay operation
<b>TR-748 Filter Regulator</b>	
Filter	Coalescing, 5 micron with auto drain
<b>TR-762/764/766/768 Well Clincher</b>	
Materials	PVC flat top cap with plastic fittings
<b>TR-901 Air Compressor</b>	
Size	2.5 hp, 4.2 cfm oil lubricated. 115 or 230 V. 20 gal, ASME code steel tank

ORDERING INFORMATION		
TR-515	2 in F.A.P. Plus™ Pump System. Includes: Pump, F.A.P. Plus™ Skimmer, 2.5 hp compressor, 2 in Well Clincher, Pneumatic Overfill Protection Device. 50 ft suspension kit.	175 lb
TR-51504	4 in F.A.P. Plus™ Pump System. Includes: Pump, F.A.P. Plus™ Skimmer, 2.5 hp compressor, 4 in Well Clincher, Pneumatic Overfill Protection Device. 50 ft suspension kit.	175 lb
TR-51506	6 in F.A.P. Plus™ Pump System. Includes: Pump, F.A.P. Plus™ Skimmer, 2.5 hp compressor, 6 in Well Clincher, Pneumatic Overfill Protection Device. 50 ft suspension kit.	175 lb
TR-514	2 in F.A.P. Pump System. Same as TR-515 without compressor	25 lb
TR-5104	4 in F.A.P. Pump System. Same as TR-51504 without compressor	25 lb
TR-5106	6 in F.A.P. Pump System. Same as TR-51506 without compressor	25 lb
<b>Components:</b>		
TR-516	F.A.P. Plus™ Pump and Filter Regulator	12 lb
TR-517	F.A.P. Plus™ Skimmer, 36 in travel. Minimum depth of 24 in required*	5 lb
TR-51718	F.A.P. Plus™ Skimmer, 18 in travel. Minimum depth of 14 in required*	5 lb
TR-51711	F.A.P. Plus™ Skimmer, 24 in Travel. Minimum depth of 18 in required*	5 lb
TR-51710	High-Water Shut-Off	3 lb
TR-702	F.A.P. Plus™ Density Skimmer (1.65 in dia.)	3 lb
TR-704	F.A.P. Plus™ Density Skimmer (3.5 in dia.)	3 lb
TR-706	F.A.P. Plus™ Density Skimmer (5.5 in dia.)	3 lb
TR-712	F.A.P. Plus™ Density Skimmer (11.5 in dia.)	3 lb
TR-70410	4" High Viscosity Density Rod Skimmer (30 in Travel)	8 lb
TR-519	DNAPL Skimmer	4 lb
TR-757	Pneumatic Overfill Protection Device	4 lb
TR-75711	Pneumatic Overfill Protection Device for 3 or more pumps	8 lb
TR-758	Electro-Pneumatic Overfill Protection Device with 24 hr programmable timer	10 lb
TR-762	2 in Well Clincher	1 lb
TR-764	4 in Well Clincher	1 lb
TR-766	6 in Well Clincher	1 lb
TR-768	8 in Well Clincher	1 lb
TR-748	Filter / Regulator	2 lb
TR-734	3/8 in ID Buna-N® hose	.25 lb
TR-735	1/4 in OD polyethylene tubing	.25 lb
TR-732	1/2 in Buna-N® hose	.25 lb
918702	Suspension Cable	.25 lb
TR-749	Membrane Dryer. Reduces dew point to -4°F	9 lb
TR-901	Air Compressor, 2.5 hp	150 lb
903801	Hydrophobic Replacement Element (std.)	3 lb
903801B	250-micron Hydrophobic Element	1 lb



\* from bottom of well to product/water interface.