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2500 HP Frac Pump Unit w/ 3512C Engine

1.0 General Unit Specification

This technical specification covers the construction and design requirements for a **2500 HP Trailer-Mounted Frac Pumping** unit capable of performing general pressure pumping well service operations in ambient conditions of 12°F (-11°C) to 115 °F (46 °C).

This technical specification also covers the completion, warranty, and service agreement to accompany the delivery of any quantity of this unit. All specifications as listed in this Revision are subject to change or clarification as requested by the customer.

1.1 Unit Operational Limits

The unit, as specified, will be capable of pumping the following pressures and rates:

- Maximum working pressure: **15,000 PSI**
- Maximum working rate: **17 BPM**

1.2 Unit Dimensions & Permitting

The unit dimensions (excluding the customer supplied tractor) will be within:

- Length: 44’-0” (14 meters)
- Width: 8’-6” (2.6 meters)
- Height: 12’-0” (4.1 meters)
- Weight: 68,000 lbs (24,384 kgs)

The unit/tractor combination will comply with all US & TX DOT regulations for unit dimensions, but may exceed the standard 80,000 lbs vehicular weight allowed depending on customer tractor utilized. Axle loading will be properly distributed to allow overweight/oversize permitting in the continental United States (should it be necessary) and compliance with US Federal Bridge Law.

The unit systems are detailed as follows:

2.0 Equipment Systems

2.1 Trailer Specifications

The trailer will be a heavy duty, mobile, multi-purpose platform that will include the following features and compliances:

- Single drop trailer frame
- US and TX DOT Compliant for On-Road Transportation
- A36 Steel Beam/Frame Construction (at minimum) w/ frame members built on 35" centers
- Heavy duty 2" King Pin with 3/8" Bolster Plate mounted to receive a 52" tall 5th-wheel hitch
- 83" King Pin turning radius
- Standard tractor air "glad-hands" and electrical connectors accessible at the front of trailer
- Sealed electrical wiring and protected air-lines
- Dual Axle Tandem w/ 25,000 lb rated axles and 25,000 lb rated Monopivot Air-Ride Suspensions
- 16 ½" x 7" S Cam Brakes w/ ABS system installed on rear axle
- Eight (8) 11R22.5 Tires
- Eight (8) 8.25 x 22.5, 10-Hole, Hub Piloted Aluminum Wheels (weight savings)
- Holland Mark V Heavy Duty Landing Gear, manual 2-speed gearbox crank
- DOT compliant vehicle lighting and conspicuity marking
- Heavy duty rubber Mud-Flaps installed on rear axle
- Heavy duty fenders

2.2 Power Units/Drivetrains

2.2.1 Primary Drive Engine

Installed on the trailer frame will be one (1) 3512C Caterpillar Tier 2 Diesel Engine rated at 2500 BHP @ 1900 RPM. It will be mounted to allow ease of access to oil-fill ports, filters, and service points. This engine will be accessorized and installed to drive the down-hole pumping process as follows:

- 24 VDC ECM and electronics
- 24 VDC 60 Amp Alternator
- SAE 0 Flywheel housing w/ flexplate drive
- Hydraulic starter powered by tractor mounted wet-kit
- Spin-on Fuel Filtration System
- Spin-on Water Filtration System
- Spin-on Lube Oil Filtration System
- Customer designated safety derates included in Engine Calibration
- Caterpillar supplied heavy duty air cleaner assembly w/ restriction indicators
- Dual carbon steel mufflers w/ spark arrestors and carbon steel rain caps
- Heavy duty muffler brackets suitable for rough terrain
- Stainless steel flex connector from turbo exhaust connection to muffler intake
- TH55-E70 Caterpillar Transmission mounted to flywheel housing with the following gear ratios:
    - 1st Gear - 6.25 : 1
    - 2nd Gear - 4.59 : 1
    - 3rd Gear - 3.38 : 1
    - 4th Gear - 2.48 : 1
    - 5th Gear - 1.83 : 1
    - 6th Gear - 1.36 : 1

- 7th Gear- 1.00 : 1
- Reverse - (Blocked)

- Spin-on Transmission Oil Filtration System
- Heavy duty GWB 390.65 output connection
- Output brake option built into transmission
- "Wishbone" style transmission cradle mount for proper weight distribution
- One-piece heavy duty GWB-type driveshaft assembly
- Horizontal 3-point mount Radiator/Cooling Assembly with sections for the following:
  - Engine Jacket Water System (Air to Water)
  - SCAC (Separate Circuit After Cooler) System (Air to Air)
  - Hydraulics Cooling Core (Air to Oil)
  - Power End Lube Cooling Core (Air to Oil)
  - Fuel Cooler Core (Air to Fuel)

2.2.2 Fuel System

This unit will be equipped with a diesel fuel storage and distribution system with the following specifications:

- Two (2) 150 Gallon Fuel Tanks configured as follows:
  - Polished aluminum construction
  - 26" diameter cylindrical build w/ capped ends
  - Fuel cooling core included in fuel return lines
  - 1-1/2" Drain valves on tank ends
  - 1-1/2" equalizing crossover between tanks
  - Tank breather fittings
  - Filtration screen installed in fill necks
  - Fuel level sender unit

- Tank fill-necks accessible from the ground for filling
- Tanks “soft” mounted to unit via rubber lined straps and cradles

2.2.3 Power Take-Offs

Bolted to the front “fan drive wheel” output flange of the engine crankshaft will be a 200 HP short driveshaft assembly complete with U-Joints. This direct-drive “PTO” arrangement will couple to and drive a two-pump hydraulic pump stack. This engine driven pump stack will drive the radiator/cooling assembly fan circuit and a hydraulic oil cooling loop. PTO driveshaft details are:

- 12 Bolt yoked flange bolted to engine crankshaft off front of engine
- 20” Driveshaft length w/ slip joint included
- Standard yoked companion flange w/ adapter to mate to hydraulic pump shaft

Installed on the top PTO port of the transmission shall be the power-end lube gear pump.

2.2.5 Hydraulics System

Hydraulic power will be installed on this unit with circuits to drive the following items:

- One (1) Radiator/Cooling Assembly Fan
- One (1) Hydraulic oil cooling loop

Features of the hydraulic system to include:

- Sauer-Danfoss or Bosch Rexroth hydraulic components
- Pressure compensated piston hydraulic pump technology
- Pressure taps and pressure tap fittings at all hydraulic pump suctions & case drain fittings
- Closed loop circuits w/ speed and pressure controls integral w/ hydraulic pumps
- Common hydraulic reservoir equipped as follows:
    - Carbon steel construction
    - Internal baffling to stabilize hydraulic fluid returns and suctions

- Removable suction strainer assemblies
- Return filtration manifold accessible for servicing
- Level gauge visible from ground
- Oil temperature sensor
- Filtered fill port
- Filtered breather cap
- Clean out covers/manway access

- All hosing, fittings, and tubing necessary to complete the system. Hoses will be pressure rated rubber "Aeroquip" or "Gates" hydraulic hose line. All standard cleanliness and "pigging" procedures will be followed in hose construction and installation.

The installation of the hydraulics system will be performed in a clean environment. The system design will minimize risk for contamination and failure as much as practicable, yet afford complete diagnostic interface through quick-disconnect pressure taps at component orifices. All hydraulic fluid will be filtered during the initial system fill process. The hydraulic reservoir will be installed to apply as much NPSH to hydraulic pump suctions as possible. During startup all component case drain pressures will be monitored to insure correctness of installation and health of the system.

2.3 Pressure Pumping Equipment

2.3.1 Quintuplex High Pressure Service Pump

Installed at the rear of the unit will be one (1) new SPM QWS-2500SD Quintuplex Pump or Gardner Denver GD2500HD Quintuplex Pump configured as follows:

- 4" Plungers (or customer selection)
- 6" Suction Manifold w/ Victaulic connections
- 6.353 : 1 gear reducer ratio
- GWB 390.60 Series heavy duty input flange
- Two (2) 3" 1502 threaded female discharge flange connections
- Two (2) 2" 1502 threaded female gauge connections for pressure transducer and relief
- Power End case breather cap

2.3.2 Power End Lube System

A power end lube system will be installed per SPM/Gardner Denver recommendations to supply lubrication to pump power frames and power frame internals. It will meet the following specifications:

- Gear type pump supplying lubrication at 60 GPM @ 150 psi to the PE Lube inlet port
- Lubrication Reservoir configured as follows:
  - Carbon Steel Construction
  - 150 gallon capacity
  - Sloped bottom w/ drain ports for easy water drainage
  - Internal baffling to stabilize gear oil returns and suctions
  - Removable suction strainer assembly
  - Spin-on filter manifold accessible for servicing
  - Level gauge visible from side of the unit
  - Oil temperature sensor
  - Filtered fill port
  - Filtered breather cap
  - Clean out covers/manway access
- Dry-sump system
- PE Lube manifold w/ pressure and temperature senders

2.3.3 Plunger Lube System

An automatic plunger greasing system will be installed to lubricate the plungers of the Quintuplex pump. This will be a Bekamax type grease pump with the following features:

- Individual positive displacement pump element for each plunger
- Automatically engages when transmission is put into gear
- Automatic grease delivery protocol based on plunger cycles

- Weather-tight enclosure
- Remote grease-fill bulkhead fittings installed to maintain cleanliness
- Grease reservoir level and grease pump operation visible from operator area
- Mounted to rubber isolated backing plate per manufacturer requirements

2.3.4 Low Pressure Discharge Manifold

Installed on the downhole pump will be a 6" "Zoomie" suction manifold w/ 6" victaulic groove connection on the intake.

2.3.5 High Pressure Discharge Manifold

Installed on the 3" discharge flanges of the downhole pump will be a common wrap around "Bridle-Type" downhole discharge manifold comprised of high pressure 3" 1502 field iron.

At the rear of the manifold will be a swing down joint and swivel for downhole connection.

The iron manifold will be secured on "soft" mounts of hard rubber-lined steel Behringer clamps. The discharge manifold will be readily accessible from ground level at the back of the unit.

2.3.6 Gauge Manifold

Installed on the two (2) high pressure 2" gauge connections on the top side of the fluid end will be the following high pressure components:

- One (1) 2" 1502 Integral Pop-Off Valve w/ (MxF) hammer end
- One (1) Electrical Pressure Transducer w/ hammer collar

2.4 Fluid Handling System

2.4.3 Low Pressure Piping

The low pressure piping system of this unit will be constructed as follows:

- Standard SCH40 Pipe & Fittings, Carbon Steel
- Standard 150lb weld neck flanges
- Welding & weld testing performed per fabricator pipe welding specs
- All butterfly valves to have steel bodies, buna seals, SS stems
- All piping runs properly braced

The suction/boost manifold of the Quintuplex Pump will be piped as follows:

- The suction end facing the rear of the unit will be connected to the 6” Zoomie manifold via a single pipe run secured to the suction manifold by Victaulic clamp. The pipe run will extend to the rear of the trailer and will bull-head into a 6” pipe manifold with two (2) 4” Figure 207 hammer union connections isolated by two (2) 4” butterfly valves, manually actuated.

2.5 Control System

2.5.1 Operator Console

Installed in the middle of the unit on the road side, between the transmission and Quintuplex pump, will be an operator console that allows the unit operator to control the unit systems. The operator console specification is as follows:

- Stainless Steel construction
- Accessible from the ground
- Wiring terminal backboard with all unit circuitry included

2.5.3 Control Panel

The unit panel will be of stainless steel construction with etched labeling of all control components. All wiring and hosing entry into the console/panel will be bulkheaded, sealed, and labeled using mil-spec bayonet connectors, industrial JIC bulkhead fittings, quick disconnect or autoclave fluid fittings, and Rox-Tec type gasketed bulkhead seals.

Installed in the control panel(s) will be the following control and feedback options:

- One (1) Unit Power Switch
- One (1) engine key-switch (On-Off)
- One (1) engine start switches (Momentary On)
- One (1) engine digital data J1939 display
- Two (1) fuel tank level gauge
- One (1) engine throttle (potentiometer type)
- One (1) emergency kill switch (covered w/ red toggle switch guard)
- One (1) transmission shifter switch (N-7-6-5-4-3-2-1 shift protocol)
- One (1) engine diagnostic connector
- One (1) transmission pressure gauge
- One (1) transmission temperature gauge
- One (1) Power-End Lube pressure gauge
- One (1) Power-End Lube temperature gauge
- One (1) Power-End Lube warning system (light & alarm)
- One (1) general open loop hydraulic pressure gauge
- Two (2) hydraulic pressure gauges for radiator fan drive circuit
- One (1) hydraulic temperature gauge (oil reservoir temperature)
- One (1) work light toggle switch (On-Off)
- One (1) overpressure shutdown re-set toggle switch w/ LED’s
- One (1) Digital Data acquisition system (as specified by customer)

2.7 Equipment & Parts Stowage

The unit will be equipped with the following equipment and parts storage:

- One (1) 24” wide x 24” deep x 18” tall junk basket for pump tool storage on rear of unit
- One (1) 36” wide x 18” tall x 18” deep toolbox for general tool storage

3.0 Unit Completion & Delivery

3.1 Customer Paint Scheme

The unit will be painted with the industrial paint scheme as specified by the customer.

3.2 Unit Lighting

The unit will be equipped with adequate work lights placed strategically on the unit to illuminate the unit work zones and surrounding area.

3.3 General Assembly Practices

The following general procedures will be used in the design and assembly of this unit:

- All hosing or wiring in contact with any metallic surface will be protected with rub guard(s)
- All hosing or wiring in close proximity with hot surfaces (i.e. engine exhaust manifold) will be secured to a heat-shielded cable mount
- All fuel lines will be shielded, secured, and routed to avoid any rubs or contacts
- All hosing systems will be produced and recorded as system kits, and are re-producible
- All wiring systems will be produced as molded cables and recorded as system kits
- All hosing and wiring will be labeled or tagged on both ends for easy identification
- Grade 8 or Grade 10.9 marked bolting and hardware will be used for unit assembly
- Trace-able quality documents will be maintained for assembly process and components

3.4 Unit Documentation

The following documentation will be provided with each unit:

- Two (2) bound paper copies of the Unit Operations and Service Manual
- Two (2) electronic copies (on CD) of the Unit Operations and Service Manual
- A complete unit BOM/Catalog included in Operations and Service Manual for quick reference and procurement of replacement parts

3.5 Warranty & Service

Each unit will be covered under a 1yr manufacturer's warranty. This warranty coverage will apply to all defective components or flaws in workmanship, or any inherently poor design or installation practices.

Manufacturer Field Service Support will be extended to cover all warranty events within the 1yr warranty period, and will be available throughout the life of the unit for service events as they occur.