PUMPING UNITS

- GENERAL SPECIFICATIONS
- EXAMPLES
- QUESTIONNAIRE

WELL SERVICE MANIFOLDS

- WELLTEST CHOKE MANIFOLDS
- MISCELLANEOUS MANIFOLDS
- WELLTEST DIVERTER MANIFOLDS
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- GAUGE TANKS
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- TRANSFER PUMPS
- CABS & ANALYSIS DEVICES
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- PACKAGED SOLUTIONS

PRODUCTION EQUIPMENT

- SEPARATION
- WATER FILTRATION
- MANIFOLDING


UNIT:N°4

SCOPE OF SUPPLY

The FCE scope of supply focuses on Medium and High Pressure pumping units required in the Oil & Gas and Industrial sectors.

Thanks to its expertise, FCE provides pumping units to client specifications. The packaging can be designed for mobile services or fixed installation and suitable for various operating and environmental conditions.

FCE units are mainly packaged with positive displacement pumps *(reciprocating and progressive cavity pumps)*. Gear pumps or even centrifugal pumps can also be unitised.

MARKETS SERVED

- Oil & Gas *(Largest market)*.
- Horizontal Drilling / Core Drilling.
- Sewer Cleaning / Industrial Jetting.
- Agriculture Spraying.
- Reverse Osmosis.
- General Industrial.

OIL & GAS APPLICATIONS

There are various applications where a FCE pump unit can be used such as:

- Pipeline transfer
  (crude oil, condensate, kerosene, water, etc.).
- Salt water disposal.
- Waste water injection.
- Methanol injection.
- Glycol circulation into dehydration units.
- Amine circulation into sweetening units.
- Hydraulic oil circulation into BOP control units.
- Lean oil circulation into LNG recovery absorbers.
- Slop oil recycling.
- Pipeline and well pressure test.
- Pipeline and well cleaning
  (water and additives).
- Brine injection *(well killing)*.
- Drilling Mud circulation.
- Welltesting
  (crude oil transfer, chemical injection).
- Etc.

PACKAGING DESIGN CRITERIA

FCE can provide pumping units per client specifications. However it is essential to specify several parameters:

Process Conditions:
- Required flow rates *(Min. & Max.)*.
- Required discharge pressure *(Min. & Max.)*.
- Available suction pressure.
- Fluid characteristics and temperature.

Environmental Conditions:
- Climate.
- Environmental regulations.
- Classified area *(explosion risks with flammable fluid)*.

Operating conditions:
- Type and frequency of operations.
- Fixed or mobile service.
- Available or supplied power.
- Operating modes *(ergonomic, maintenance, etc.)*.
- Lifting modes and available lifting devices.
- External connections *(process, power, ground, etc.)*.

Applicable norms:
- International standards.
- Client and project specifications.

Scope of supply:
- Equipment *(safety devices, prime movers, instruments, miscellaneous options, spare parts, etc.)*.
- Required test & inspection levels.
- Required documentation.
- Site commissioning, start-up assistance, training.
- Extended guarantee.
- Contract Incoterm *(EXW, FOB, CFR, etc.)*.
- Packing and shipment conditions.

FCE EXPERTISE

As a warranty, FCE fully controls the design, fabrication process and product traceability of its pumping units.

Each pumping unit is fully tested prior to shipment including safety device function test and recorded performance test.

Each pumping unit is serialised and fully documented including a customised operating & maintenance manual and a quality book c/w all certificates.

Site commissioning, training and start-up assistance by an FCE engineer are recommended.

HOW TO MAKE A CHOICE

Reciprocating Pumps:

Reciprocating pumps are used when it is impractical or impossible to use a centrifugal pump. Application is medium and high pressure.

Properly equipped, these pumps are suitable for corrosive, abrasive, viscous, flammable & extremely hot or cold fluids.

Advantages:
- Capable of extremely high pressure up to 10000 PSI.
- High mechanical efficiency *(85-90%)*.
- Flow capacity proportional to pump speed.
- Simple field maintenance procedure.

Disadvantages:
- Requires a pressure safety device.
- Higher NPSHr *(may require a booster pump)*.
- Pulsating flow creates vibrations.
- Minor leakage is part of normal operation.

Progressive Cavity Pumps:

These pumps are suitable for abrasive, corrosive, viscous, flammable and even multiphase fluids.

Advantages:
- Low NPSHr.
- Few pulsations.
- Bi-directional.

Disadvantages:
- Limited discharge pressure.
- Overall efficiency is affected by the pump speed.
- Horizontal lenght can make installation problematic.

Gear Pumps:

These pumps are suitable for corrosive and viscous fluids.

Advantages:
- Low NPSHr.
- Few pulsations.
- Compact.

Disadvantages:
- Discharge pressure and flow capacity limits.
- Not suitable for water and non lubricating fluids.

Centrifugal Pumps:

Centrifugal pumps are less costly and the most commonly used. These pumps are suitable for various fluids, even containing solid particles.

Advantages:
- Low NPSHr.
- Discharge pressure is automatically adjusted depending on the flow rate.

Disadvantages:
- Limited discharge pressure.
- Poor efficiency.
- Not really suitable for viscous fluids.

INDUSTRIAL APPLICATIONS
(Bare pump supply only)

Bare pumps for several applications

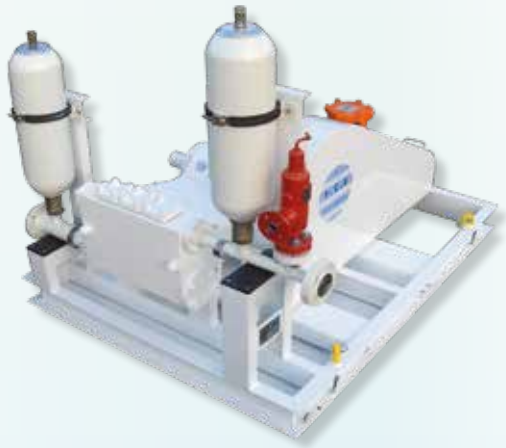
OIL & GAS APPLICATIONS
(Fixed pumping unit supply)

Crude Oil Transfer into pipeline
Reciprocating pump & Centrifugal booster pump unit
32 m^3/h x 76 bars *(4800 bbl/d x 1100 PSI)*
Zone-2 90 kW electric prime mover

Sewer Cleaning

Crude Oil Transfer into pipeline
Reciprocating pump unit *(2 x 100% capacity)*
33 m^3/h x 70 bars *(5000 bbl/d x 1000 PSI)*
Zone-2 90 kW electric prime mover

Light Duty Drilling
(water well and civil works)



Glycol Injection into gas pipeline
Reciprocating pump unit
4.5 m^3/h x 150 bars *(670 bbl/d x 2170 PSI)*
Zone-2 37 kW electric prime mover

OIL & GAS APPLICATIONS
(Mobile pumping unit supply)

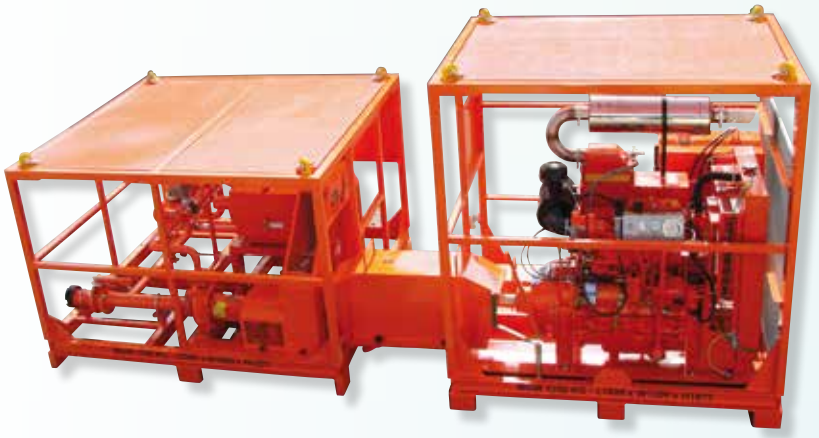
Crude Oil Transfer into pipeline
Reciprocating pump & Centrifugal booster pump unit
3800 bbl/d x 600 PSI
Non-Zoned 90 hp diesel engine prime mover

OIL & GAS APPLICATIONS
(Mobile pumping unit supply)

Crude Oil Transfer into pipeline
Reciprocating pump + centrifugal booster pumps
Hydraulic transmission
3800 bbl/d x 800 PSI
Atex Cat. 2 – 85 HP diesel engine prime mover

Crude Oil Transfer into pipeline
Reciprocating pumps + centrifugal booster pumps
5435 bbl/d x 1160 PSI
Electric drivers 110KW – Atex Cat. 2

Multi Service Mobile Pumping Unit
Reciprocating pump & Centrifugal booster pump unit
Hydraulic transmission - 630 bbl/d x 3000 PSI
Non-Zoned 85 hp diesel engine prime mover



Acidized Water Well Cleaning Unit
2 packs light reciprocating pump & booster pump unit
1710 bbl/d x 2000 PSI
Atex Cat. 2 – 85 HP diesel engine prime mover

Centrifugal transfer pump
5000 bbl/d x 800 PSI
Electric driver 110 KW – Atex Cat. 2

F.C.E Fluid Control Europe	**QUESTIONNAIRE** **RECIPROCATING PUMP**	Sales man	
		Phone No.	
		Fax	
		e-mail	

1	IDENTIFICATION	Company					Date		
2		Address							
3		Post code		City			Country		
4		Phone		Fax		Web site			
5		Contact				e-mail			
6		Request No.				Expected due date			
7	PROCESS REQUIREMENT	**Service:**	Continuous (>8h/day)			Intermittent (<8h/day)			
8		**Discharge Pressure:**	Maxi:		mini:	Average:			
9		**Suction Pressure:**	Maxi:		mini:	Average:			
10		**Pumping Temperature:**	Maxi:		mini:				
11		**Required Flow:**	Maxi:		mini:	Average:			
12		**Fluid pumped:**				**S.G. :**			
13		**Viscosity:**	SSU:		Cp:	Cs:			
14		**Abrasive content:**	Yes	No	**Solid size:**	**Content:**	%		
15		**Corrosive content:**	Yes	No	Type & concentration:				
16	PRODUCT SPECIFICATION & SCOPE OF SUPPLY	**Pump characteristics:**	Plunger		Piston	Number of cylinders:			
17			Other requirements:						
18		**Suction pipe:**	Size:	Flg Rating:		Length:	**NPSHa:**		
19		**Discharge pipe:**	Size:	Flg Rating:		Length:			
20		**Prime driver type:**	Thermic		Diesel:	Gasoline:	Gas:		
21			Electric		Speed:	Voltage:	Phases:	Hz:	
22			Hydraulic		Open loop:	Closed loop:	Max Pressure:		
23			Other		Specify:				
24			Required trade mark / model:						
25		**Transmission:**	V-belt		Gear reduc.	Other:			
26		**Basic accessories:**	Pulsation dampener:		Suction:	Discharge:			
27			Pressure safety Valve:		Suction:	Discharge:			
28		**Instrumentation:**	**Data**		**Function**				**Other requirements**
29		*I Indicator*	Suction Pressure		I T S R				
30		*T Transmitter*	Discharge Pressure		I T S R				
31		*S Switch*	Temperature		I T S R				
32		*R Recorder*	Flow		I T S R				
33			Other		I T S R				
34		**Base skid / Protection frame:**							
35		*(Specify your requirements)*							
36									
37		**Other equipment:**	Booster pump						
38		*(Specify your requirements)*	Suction manifold						
39			Discharge manifold						
40									
41	QUALITY	**NORMS:**	API 674		NACE MR01-75		Others:		
42		**CLASS:**	Std		Explosionproof		Others:		
43		**INSPECTION / QC:**	**Prestation**		**Inspection**		**Other requirements**		
44		*C Certified by Manufacturer*	Hydrostatic test		C W				
45		*W Third party Witnessed*	String test		C W				
46			Load test		C W				
47			Other		C W				
48	*REMARKS*								
49									
50									

Quality document No. :	FO-098 A rev.2	

NB: Please use this questionnaire for quotation request

WELLTEST CHOKE MANIFOLDS

DESCRIPTION

The Choke Manifold is used to control the well flow rate through a calibrated choke bean or adjustable choke. It also reduces the pressure before the flow enters the processing equipment. Dual flow paths allow fast choke changes without flow interruption.

The basic features include 4 API gate valves *(5 with by-pass line)* and ½" ports for fluid sampling and well flow monitoring.

Both rectangular and diamond shapes are available.

Unionised plug valve models for both standard and sour gas service are also available in 2" nominal size *(1" max orifice)* and 3" nominal size *(2" max orifice)*.

Each manifold is skid mounted with 4 lift points and 2 forklift pockets.

5-Valve 3" rectangular choke manifold

PROCESS & DESIGN DATA

- API6A and NACE MR01-75 for sour gas service.
- Nominal line size..... : 3" *(with 2" max orifice)*.
- Standard rating..... : 5000 / 10000 / 15000 PSI.
- Temperature rating..... : -29°C to 121°C.
- Inspection level per API.... : PSL2.

OPTIONS

- 2" and 4" nominal line size on customer request.
- Wide variety of chokes.
- Low temperature service *(up to -46°C)*.
- High temperature service *(up to +177°C)*.
- Specific inspection level on customer request *(PSL3, PED certification & CE marking, etc.)*.
- DNV 2.7.3 certified skid.

Specific layouts such as vertical manifolds and other integrated functions can be supplied on request.

4-Valve 3" diamond choke manifold

WEIGHTS & DIMENSIONS

Rectangular type CM with API 6A gate valves - Model RGV

Size & Rating	3 1/8" 5000 PSI	3 1/16" 10000 PSI	3 1/16" 15000 PSI
Length in mm	2200	2500	2500
Width in mm	1900	2000	2000
Height in mm	1100	1100	1200
Weight in kg 4V	2400	2700	3800
Weight in kg 5V	2550	3000	4200

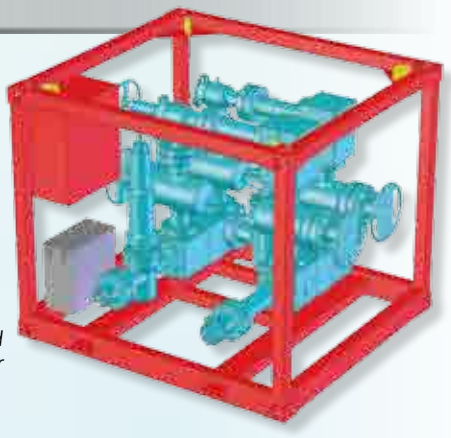
Diamond type CM with API 6A gate valves - Model DGV

Size & Rating	3 1/8" 5000 PSI	3 1/16" 10000 PSI	3 1/16" 15000 PSI
Length in mm	1900	2100	2100
Width in mm	1900	2100	2100
Height in mm	1000	1100	1200
Weight in kg	1800	2500	3400

MISCELLANEOUS MANIFOLDS

Configurations can be built to customer requirements and according to specific applications such as:

- Welltest vertical choke manifolds with ESDV and data header.
- Welltest by-pass manifolds.
- Welltest BS&W manifolds.
- Drilling Stand pipe manifolds.
- Frac Flowback manifolds.
- Gravel Pack / Squeeze manifolds.
- Etc.



Welltest vertical choke manifold with ESDV and data header

WELL SERVICE MANIFOLDS

WELLTEST DIVERTER MANIFOLDS

DESCRIPTION

Diverter manifolds are generally used downstream of separators, surge and gauge tanks.

Oil diverters consist of 5 ball valves, 2 inlets and 3 outlets.

Gas diverters consist of 2 ball valves, 1 inlet and 2 outlets.

Each manifold is skid mounted with 4 lift points and 2 forklift pockets.

2-Valve x 3" gas diverter manifold with check valve

PROCESS & DESIGN DATA

- ANSI B31.3 / NACE MR01- 75 for sour gas service.
- Standard nominal size..... : 3".
- Pressure rating..... : 1440 PSI at 38 °C.
- Temperature rating: ..... : -29 °C to 121 °C.

5-Valve x 4" oil diverter manifold

OPTIONS

- Other sizes on request *(2", 4", 6" etc.)*.
- Other pressure ratings on request.
- Other configurations and layouts on request.
- Double block and bleed valves.
- Additional check valve.
- Low temperature service *(up to -46 °C)*.
- High temperature service *(up to +177 °C)*.
- PED certification *(CE marking)*.
- DNV 2.7.3 certified skid.

Double-block & bleed x 6" gas diverter manifold

WEIGHTS & DIMENSIONS

Model	*Length in mm*	*Width in mm*	*Height in mm*	*Weight in kg*
2-valve 3'' gas manifold	1500	500	550	320
2-valve 4'' gas manifold	1900	600	560	550
5-valve 3'' oil manifold	2150	800	550	660
5-valve 4'' oil manifold	2765	900	560	1240

WELL SERVICE MANIFOLDS

DRILLING CHOKE MANIFOLDS

DESCRIPTION

The Drilling Choke Manifold is used to control the drilling fluid from the well whilst drilling. Each manifold is built to the customers required layout and generally allows flow through 2 or 3 adjustable Chokes. These are all equipped with heavy duty and wear resistant trims operated from a remote hydraulic control panel.

The basic features include API gate valves and necessary ports with instruments for flow monitoring.

PROCESS & DESIGN DATA

API6A and NACE MR01-75 for sour gas service.
Nominal line size..... : 3" & 4".
Standard rating..... : 5000 / 10000 / 15000 PSI.
Temperature rating..... : -29 °C to 121 °C.
Inspection level per API..... : PSL2.

OPTIONS

- Low temperature service *(up to -46 °C)*.
- High temperature service *(up to +177 °C)*.
- Specific inspection level on customer request *(PSL3, PED certification & CE marking, etc.)*.
- DNV 2.7.3 certified skid.

4"1/16 5000 PSI Drilling Choke Manifold with solid buffer chamber

INLINE SAND FILTERS / PLUG CATCHERS

Various Inline Sand Filter configurations and pressure ratings are available depending on the application and process conditions.

FLOWBACK INLINE SAND FILTER

- Suitable to H2S service per NACE MR01-75 standards.
- API6A and API14E for erosion limiting velocities.
- DNV 2.7.1 certified skid.
- Primarily liquid flow applications.
- 2" line liquid flow capacity 4300 bbl/d (28.6 m3/h)
- 10000 psi Pressure Rating.
- Quad filterpup configuration with Relief line and by-pass.
- Flow direction from inside to outside.
- 100 to 150-micron cutout (screen fitted with rupture disc).

PRODUCTION INLINE SAND FILTER

- Suitable to H2S service per NACE MR01-75 standards.
- ANSI B31-3.
- Multiphase flow applications.
- 2" line liquid flow capacity 3000 bbl/d (20 m3/h)
- 3" line liquid flow capacity 6300 bbl/d (42 m3/h)
- Gas flow capacity depending on operating conditions (C.F.).
- 600 to 2500 psi Pressure Rating.
- Dual filterpup configuration with by-pass.
- Both flow directions available.
- 50 to 600-micron cut-out.

HORIZONTAL PLUG CATCHER (FOR LARGER PARTICLE SIZES)

- Suitable to H2S service per NACE MR01-75 standards.
- API6A and API14E for erosion limiting velocities.
- DNV 2.7.3 certified skid.
- CE Marking and PED compliance as an option.
- Multiphase flow applications.
- 10 000 bbl/d liquid x 35 MMscf/d of gas.
- 10 000 psi Pressure Rating.
- Dual flow path configuration with by-pass.
- API flanged gate valve assembly.
- Flow direction from inside to outside.
- Fast and easy screen removal.
- 1 to 6 mm cutout (screen fitted with rupture disc).
- DP gauge and inlet/outlet pressure gauges

OPTIONS: Consult factory

SOLIDS REMOVAL EQUIPMENT

FILTER PUPS

DESCRIPTION

The filter pup consists of an inline removable screen and outer unionised (602, 1002 and 1502) "casing", allowing solid particles removal from the well effluent with fluid flow from outside the screen to the inside. The filter pup is supplied with adaptors to match the line size.

Because of its limited retention volume, the filter pup is generally used for temporary operations. However, skid mounted combinations including a number of filters and suitable inlet/outlet manifolding can be supplied at client request.

PROCESS & DESIGN DATA

- ANSI B31.3, Standard service.
- Pressure rating..... : 5000 / 10000 PSI.
- Temperature rating..... : -29°C to 121°C.
- Filtration cut-out..... : 300 and 800 microns.

OPTIONS

- "In" to "Out" flow direction.
- Other sizes and pressure ratings on request.
- Other filtration cut-outs on request *(50 to 1000 microns)*.
- Low temperature service *(up to -46°C)*.
- High temperature service *(up to +177°C)*.
- NACE MR01-75 for sour gas service.
- Skid mounted combinations at customer request.

2-STAGE DUAL POT SAND FILTERS

DESCRIPTION

Principle of operation

The Dual Pot Sand Filter is designed to remove solid particles from well effluent. Located after the flowhead, it protects downstream equipment against erosion.
The 2-SF (2 - Stage Filtration) dual pot sand filter offers many advantages when compared to conventional models:
The first stage filtration is achieved by centrifugal separation whilst the second stage filtration employs an advanced removable screen to perform a mechanical cut-out. The vessels are fitted with a removable wear sleeve and the necessary nozzles for flushing with water.
As the fluid flows from outside to inside the screen, the flow area is not obstructed by the sand accumulation, providing a longer operating time compared to competitors.

Configuration

- Dual pot layout in 10' skid footprint.
- $3^{1/16}$" 10000 PSI 9-Valve process manifold including by-pass.
- $2^{1/16}$" 10000 PSI Drain manifold with 1" orifice adjustable choke.
- $2^{1/16}$" 10000 PSI Flushing system for reverse flow cleaning as an option.
- Removable wear sleeve to protect the body against erosion.
- Removable screen in different cutout sizes.
- DP gauge 0-1500 psi (electronic transmitter in option).
- Pressure gauge on inlet, outlet and each pot.
- Tool box.

PROCESS & DESIGN DATA

- Suitable to H2S service per NACE MR01-75 standards.
- API6A and API14E for erosion limiting velocities.
- Pressure rating: 10000 psi (15000 psi on request).
- DNV 2.7.1 certified skid.
- CE Marking and PED compliance.
- Multiphase flow applications.
- 5000 bbl/d liquid flowrate x 35 MMscf/d gas flowrate.
- 200-micron standard cutout (50 to 800-micron)

MAIN ADVANTAGES COMPARED TO A CONVENTIONAL UNIT

- Longer flowing time between pot switchover operations.
- Quicker screen changeout operation.
- Higher admissible differential pressure.
- Less frequent screen plugging with swirling flow.
- Less frequent or no screen removal with reverse flushing (optional).
- Transportation in its operating position (safer handling).
- Erosion protection of the body near the pot inlet.
- Ergonomic layout with process valves on same side.
- Easier access around the skid that improves safety.
- More compact rig-up and easier installation onto a trailer.

OPTIONS: Consult factory

9-valve dual pot sand filter

Wear sleeve

WELLTESTING EQUIPMENT

FLOWHEADS

DESCRIPTION

The flowhead is used as a temporary wellhead on a drilling rig. FCE offers a compact light weight unitized flowhead fitted with:

- 2 1/16" kill wing gate valve & a 2" Fig.1502F connection.
- 3 1/16" flow wing gate valve & a 3" Fig.1502M connection.
- 3" upper and lower Kelly valves.
- 400 000 lbs Swivel allowing the test string to rotate.
- 4½ " IF bottom sub connection c/w test cap.
- 5¾" - 4 Otis ACME box lift sub top connection c/w pin and collar test cap.

The flowhead is supplied with its own lift sub and can be unitised with its own transport skid.

The flow wing gate valve is fitted with a hydraulic actuator and can be used as an ESD valve.

OPTIONS

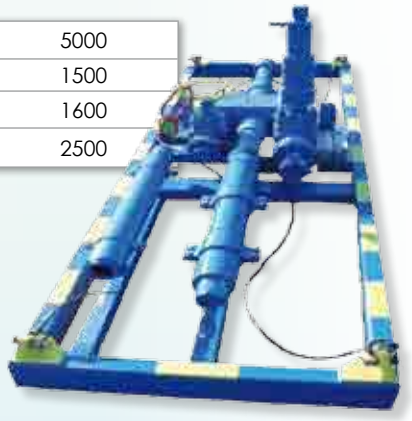
- 250 000 lbs Swivel.
- Low temperature service *(up to -46°C)*.
- High temperature service *(up to +177°C)*.
- Other top and bottom connections on request.
- "Stiff" Joint
- Check valve on kill wing.
- Specific inspection level on customer request. *(PSL3, PED certification & CE marking, etc.)*.
- DNV 2.7.3 certified skid.

PROCESS & DESIGN DATA

API 6A / NACE MR 01-75 for sour gas
Design pressure ..... : 10 000 PSI.
Design temperature ..... : -29°C to 121°C.
Wing valve hyd. operating pressure ..... : 6000 PSI max.
Inspection level ..... : PSL2.

WEIGHTS & DIMENSIONS *(with transport skid)*

Length in mm	5000
Width in mm	1500
Height in mm	1600
Weight in kg	2500



WELLTESTING EQUIPMENT

ESDV'S & CONTROL SYSTEMS

DESCRIPTION

Emergency ShutDown Valves *(ESDV)* for well testing applications are generally reverse acting gate valves equipped with a hydraulic linear actuator *(occasionally pneumatic)* and complete with the required x-overs. In offshore applications this valve may be incorporated into a flowhead, but for land use, it is normally skid mounted and installed close to the wellhead. Actuators are fail close, usually single acting with hydraulic pressure to open and spring assist to close upon the loss of hydraulic pressure.

The ESD Panel, in its more basic form, consists of a small hydraulic oil tank, an air driven hydraulic pump providing opening pressure via a hose to the ESDV and a hydraulic circuit to permit "push button" ESDV closure.

The panel will receive its "process" signal from upstream high or low pressure switches *(or pilots)* or from additional inputs.

OPTIONS

- 2" or 4" ESD valve size.
- Low temperature service *(up to -46°C)*.
- High temperature service *(up to +177°C)*.
- Hand pump.
- Additional pumps.
- Additional process inputs *(fusible plug/fire detection, gas alarms, etc.)* up to a Full Blown "Process Panel".
- Specific inspection level on customer request. *(PSL3, PED certification & CE marking, etc.)*.
- DNV 2.7.3 certified skid.

PROCESS & DESIGN DATA

API6A and NACE MR01-75 for sour gas service.
Nominal line size ..... : 3"
Standard rating ..... : 5000 / 10000 / 15000 PSI.
Temperature rating ..... : -29°C to 121°C.
Inspection level per API ..... : PSL2.

WEIGHTS & DIMENSIONS

Length in mm	1200
Width in mm	500
Height in mm	1660
Weight in kg	610

3 1/8" x 5000 PSI ESD Valve c/w portable control panel

DESCRIPTION

Test separators are 3-phase *(gas, oil and water)* vessels fully equipped with pressure and level controls, liquid flowmeters, gas flow recorder, gauges and shrinkage tester.

FCE offers the most commonly used sizes:

- Horizontal 1440 PSI - 42" x 15'.
- Horizontal 1440 PSI - 42" x 10'.
- Horizontal 600 PSI - 42" x 10'.

Other sizes and pressure ratings, either horizontal or vertical design, can be supplied to client request.

PROCESS & DESIGN DATA

- API 12J / ASME VIII div.1 / ANSI B31-3.
  NACE MR01-75 for sour gas.
- Design temperature..... : -29°C to 100°C.

Size & Rating	*600 PSI 42"x10'*	*1440 PSI 42"x10'*	*1440 PSI 42"x15'*
Design Press.	600 PSI	1345 PSI	1345 PSI
Gas capacity	33.2 MMscf/d	44.8 MMscf/d	56.0 MMscf/d
Oil capacity	9430 bbl/d	8870 bbl/d	13210 bbl/d
Water capacity	2650 bbl/d	2060 bbl/d	3080 bbl/d
Total liquid cap.	12080 bbl/d	10930 bbl/d	16290 bbl/d

Note 1:
The design pressure is given for Max temp. of 100°C *(212°F)*. 1440 PSI design pressure is limited to 38°C *(100°F)* by the flange rating of 600#RF on those separators.

Note 2:
The flow rates given are nominal capacities for:

- 1 minute retention time for liquids.
- Oil/Gas interface at vessel centreline.
- Water/Oil interface at LC nozzle elevation.
- Gas S.G. of 0.7.
- Gas temperature of 54°C.

Flow capacities will vary depending on level adjustment and process conditions.

WEIGHTS & DIMENSIONS

Size & Rating	*600 PSI 42"x10'*	*1440 PSI 42"x10'*	*1440 PSI 42"x15'*
Length in mm	6058	6058	7530
Width in mm	2438	2438	2438
Height in mm	2590	2590	2590
Weight in kg	11200	14200	16900

Note: dimensions are given for skid design with ISO blocks.

OPTIONS

- Low temperature to -46°C.
- LSH / LSL nozzles / alarms for EPF purposes.
- Various liquid flowmeter types & brands.
- Various valves and component brands.
- Various adders on request *(Check valves, instruments, etc.)*.
- Additional 2'' or 3'' gas measuring line.
- DNV 2.7.1 certified skid.
- ASME U-stamp or PED certification *(CE Marking)*.
- Data Acquisition System and sensors.

Test separator 42" x 10' x 600 PSI

Test separator 600 x 2000 x 5 to 35 bar

Test separator 42" x 15' x 1440 PSI

INDIRECT HEATERS

DESCRIPTION

Indirect heaters help prevent wax formation in downstream equipment and also hydrate formation at choke valves. Where required it can also assist in breaking down any emulsions by reducing oil viscosity.

FCE offers the following standard heaters:

- 2.0 MMBTU/h Natural Draft Indirect Heater.
- 0.5 to 2.0 MMBTU/h Forced Draft Indirect Heater.
- 0.8 to 2.8 MMBTU/h Forced Draft Indirect Heater.

The Natural Draft version is fully pneumatically controlled whilst the Forced Draft versions are equipped with an electrically powered burner.

PROCESS & DESIGN DATA

- API 12K / ANSI B31-3 / NACE MR01-75 for sour gas.
- Design temperature.... : -29°C to 100°C.
- Standard 2-stage coil.. : 3" 5000 PSI x 3" 2500 PSI.

WEIGHTS & DIMENSIONS

Size & Rating	*2.0 MM btu/h ND*	*2.0 MM btu/h FD*	*2.8 MM btu/h FD*
Length in mm	6058	6058	7500
Width in mm	2438	2438	2438
Height in mm	2800	2800	2800
Weight in kg	11000	12000	14000

OPTIONS

- Other coil pressure ratings and sizes.
- Other manifold pressure ratings.
- Standard service.
- DNV 2.7.1 certified skid.
- PED certification *(CE marking)*.

GAUGE TANKS

DESCRIPTION

The Gauge tank is an atmospheric tank, used for meter calibration. The tank is fitted with inlet/outlet/drain butterfly valves, gauge hatches, a flame arrestor on the vent line and graduated sight glasses.

Gauge tanks are of dual compartment construction with available capacities of 2 x 50 bbl or 2 x 100 bbl.

WEIGHTS & DIMENSION

Model	*2 x 50 bbl*	*2 x 100 bbl*
Length in mm	3920	6720
Width in mm	2410	2410
Height in mm	3324	3324
Weight in kg	4300	6800

2 x 100 BBL Gauge Tank

MISCELLANEOUS TANKS

Miscellaneous tanks for different applications can be supplied to customer requirements:

- Skid mounted temporary storage tanks.
- Utility tanks *(fuel, water, etc.)*.
- Indirect heater fuel tanks.
- Sand recovery tanks *(for sand filter unit)*.
- Etc.

Oil tank 40' x 60 m³

SURGE TANKS

DESCRIPTION

Surge tank is generally used in the presence of H2S and sited between the separator and burners. It allows batch flow regulation, degassing at low pressure and can also be used as a pressurised gauge tank.

The vessel can be fitted with LSL and LSH providing a pneumatic signal for an alarm horn or external control.

FCE offers two models:

- 100 bbl single compartment.
- 2 x 50 bbl dual compartment.

PROCESS & DESIGN DATA

- ASME VIII div.1 / ANSI B31-3 / NACE MR01-75.
- Design temperature..... : -29°C to 100°C.
- Standard pressure..... : 50, 100 or 150 PSI.
- Net batch capacity..... : 100 bbl or 2 x 50 bbl.

WEIGHTS & DIMENSIONS

(For 150 PSI version and horizontal position)

Model	*2 x 50 bbl*	*100 bbl*
Length in mm	7450	7450
Width in mm	2500	2500
Height in mm	2750	2750
Weight in kg	14450	14050

OPTIONS

- Lower capacity on request.
- LSHH / LSLL nozzles / alarms for EPF purpose.
- Low temperature service to -40°C.
- Various valves and component brands.
- Various adders on request *(Check valves, instruments, etc.)*.
- Additional gas measuring run *(4" standard or other sizes)*.
- DNV 2.7.3 or 2.7.1 certified skid.
- ASME U-stamp or PED certification *(CE marking)*.

2x50 BBL, dual compartiment, 2 phase, 150 PSI

2x50 BBL, dual compartiment, 2 phase, 150 PSI

2x50 BBL, dual compartiment, 2 phase, 250 PSI, with centrifugal pump integrated

2x20 BBL, dual compartiment 2 phase, 150 PSI, compact for vertical transportation

DESCRIPTION

Transfer pump allows the transfer of oil from a tank to a burner or to an existing flowline and even to a tank trailer.

FCE offers a basic 4000 bbl/d x 300 PSI **progressive cavity pump** unit that covers the majority of the applications used and is able to transfer a wide variety of fluids. Each skid unit is fitted with 4 lifting points and 2 forklift pockets.

Available versions are:

SD-S: non-zoned diesel engine driven.

SE-Z: zone-2 electric motor driven *(50 Hz-240 Vac)*.

Other solutions with **centrifugal pumps** for high flowrate and non viscous fluids or **gear pumps** for viscous and self lubricating fluids can also be designed to client request. **Reciprocating pumps** for high/medium discharge pressure can also be supplied *(see pump units - page 8)*.

PROCESS & DESIGN DATA

ANSI B31-3 / API 676
H2S service up to 200 ppm.
Design temperature..... : -29°C to +80°C (-20°F to +176°F).
Nominal Capacity..... : 4000 bbl/d x 300 PSI.

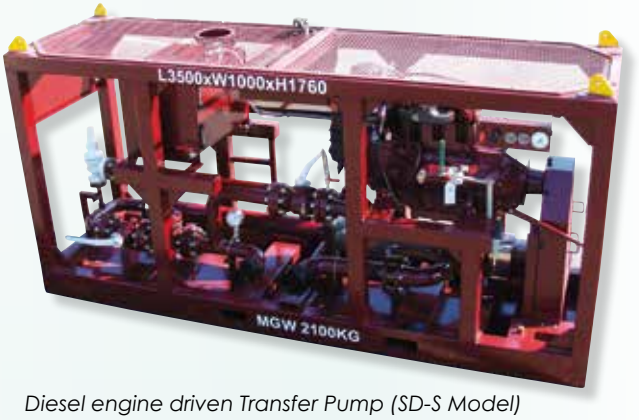
OPTIONS

- H2S service up to and above 500 ppm.
- Electric set for use with Variable Frequency Drive (SE-Z only).
- DNV 2.7.3 certified skid.

WEIGHTS & DIMENSIONS

Model	SD-S	SE-Z
Length in mm	3500	3500
Width in mm	1000	1000
Height in mm	1760	1560
Weight in kg	2100	2000

Electric motor driven Transfer Pump (SE-Z Model)



Diesel engine driven Transfer Pump (SD-S Model)

Electric motor driven Transfer Pump (SE-Z Model)

Diesel engine driven Transfer Pump (SD-S Model)

CABS

Operator cabs are available as non-zoned safe area based on standard ISO containers 10', 20' or 40' and equipped as laboratory, workshop, office, utilities house *(c/w generator and air compressor)* or a combined arrangement.

Cabs are built to customer requirements including insulation, furniture, electrical & pneumatic systems, air conditioning, etc. A specific structure, other than a container base, can also be designed / supplied at client request.

FLUID ANALYSIS DEVICES

Fluid analysis devices are normally supplied loose in order to allow fluid sampling and simple analysis on site of various hydrocarbon criteria:

Pressure
- DWT *(Dead Weight Tester)* for calibration purposes.
- Pressure Recorders *(one-pen or multi-pen)*.

Oil Gravity
- A range of hydrometers with sample cylinders.
- Electric powered gravitometer.

Gas gravity
- Ranarex electric driven gravitometer.

BSW *(Basic Sediment & Water)*
- Hand driven centrifuge c/w set of cone glasses.
- Electric powered centrifuge *(as an alternative)*.

PH analysis
- A range of PH papers.
- Electric driven instruments for manual sampling.

Salinity kit *(refractometer)*
Hand held spectrometer.

Gas detection
Multigas detector with bellows pump to determine H2S and CO2 presence c/w a range of sample tubes to cover main gas constituents.

Viscosity
Electric driven viscometer.

Sampling
Equipment is required to enable full PVT / other analysis to be undertaken in a laboratory.
FCE can thus provide oil sample bottles, gas sample bottles and the required transfer bench.

Dead Weight Tester

Electric centrifuge

Gas gravitometer

Hand-held refractometer

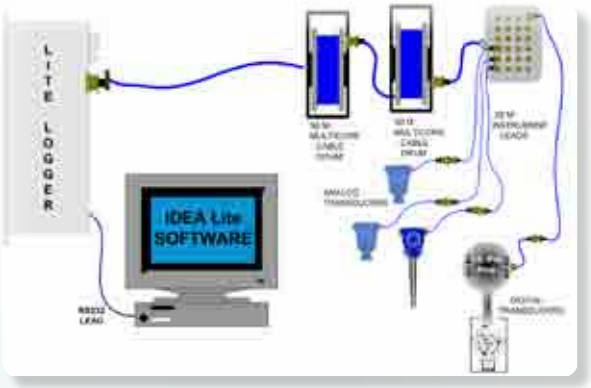
WELLTESTING EQUIPMENT
DATA ACQUISITION SYSTEMS

The Data Acquisition Systems and sensors integrated by FCE are selected from recognized partners & suppliers.
The systems consist of:

- Various sensors *(PT, DPT, TT, FQT)*.
- Sensor cables & terminal junction block*(s)*.
- Multicore cable reel*(s)* from terminal block*(s)* to logger.
- Data logger to interface with client computer*(s)*.
- Windows® based Software & dongle.
- Training directly supported by the system designer.

The software is particularly designed for well service operations. It allows real time reading, input for flow and pressure variables, and tailored report formats can be generated during the job.

Major partner: FARDUX *(Wellwise Group, UK)*.



Main characteristics & options

- Intrinsically safe system with safety barriers.
- Basic 12-channel logger for normal welltesting.
- Alternate 24-channel logger for EPF.

WELLTESTING EQUIPMENT
PACKAGED SOLUTIONS

Mobile Testing Units *(MTU)*:
Where reduced logistics are a concern, Mobile Testing Units offer efficient solutions providing fast movement and rig-up / rig-down operations with a minimum number of vehicles.

Trailer mounted MTU *(and even truck mounted units)* are designed to suit road conditions in respect to admissible axle loads and area of operation. Safe areas, easy, safe access to equipment and efficient layout storage are always considered in the design.

Several combined options of MTU can be studied in regard to field conditions and operation philosophies including:

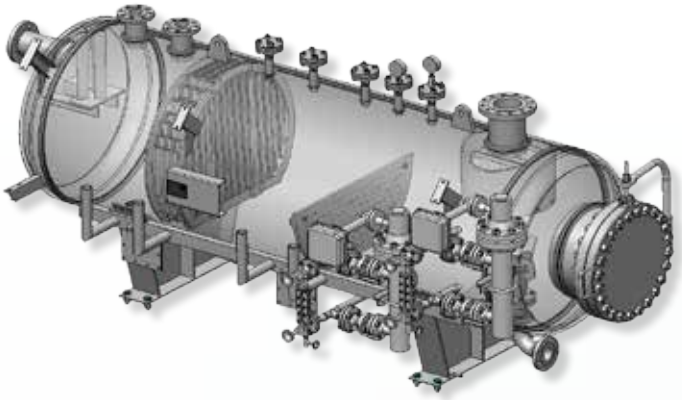
- Processing equipment.
- Fluid storage and transfer.
- Interconnecting elements.
- Cab, workshop, utilities & accommodation.
- Data Acquisition System.

Extended Welltest:
Extended Welltest operations may require specific design and sizing of process equipment as well as additional controls and back-up facilities in order to meet expected performance and the required safety level.

FCE designs and provides complete or partial packaged solutions to suit customer requirements including basic and detailed engineering *(HAZOP, PFD, PID, etc.)* as required.

Based on welltesting separator expertise, FCE has the capacity to design and provide 2-phase and 3-phase production separators on a case by case basis.

The scope of supply can be extended to small packages with onsite start-up assistance.



Separator Vessel 1200 x 5000 x 10 bar

Production Separator 1500 x 6000 x 10 bar with Vertical Degasser 1200 x 3124 x 10 bar

Internal element (coalescing plate, demister, antisurge plate)

WATER FILTRATION

DESCRIPTION

Water injection into the well is often required in oil and gas fields in order to optimise the reservoir pressure capacity and to reduce formation damage.

The water will be filtered prior to injection.

FCE Filtration Units are specifically designed for High Pressure and Low Filtration Cut-outs down to 2 µ.

The unit consists of 2 pots in parallel allowing fast switchover and cartridge changeout whilst flowing, and is equipped with a 5-valve compact manifold, a centralised control panel with DP gauge and 3" unionised connections.

Each pot is internally protected with an erosion and corrosion resistant fibre glass lining.

PROCESS & DESIGN DATA

- ASME VIII Div.1 guidance, ANSI B31-3.
- Design Pressure..... : 3000 PSI / 5000 PSI.
- Design Temperature..... : -29°C to 121°C.
- Liquid flow capacity..... : 20000 bbl/d.
- Filtration cut-out..... : from 2 to 20 µ.

OPTIONS

- Other filtration cut-outs on request.
- Other flow capacities on request.
- DNV 2.7.3 or 2.7.1 certified skid.

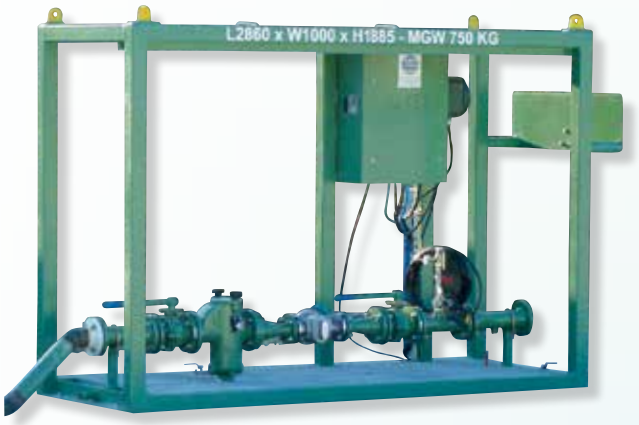
WEIGHTS & DIMENSIONS

Model	DFU-01	DFU-02
Pressure rating	3000 PSI	5000 PSI
Length in mm	3000	3000
Width in mm	1900	1900
Height in mm	2650	2650
Weight in kg	5000	6000

3000 PSI Water Filtration Unit

MANIFOLDING

On a case by case basis, FCE can design and supply specific manifolds and skid units for various applications to customer requirements related to fluid control, metering and analysis.



Oil metering skid 20m3/h, DN 3", class 150

Gas metering and pressure control skid 1440 PSI