

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Accumulators

with type designation(s)

- 1 Quart 3000psi Accumulator, MBA01-03-**-N-O-1-A
- 1 Gallon 3000psi Accumulator, MBA04-03-**-N-O-1-A
- 2.5-15 Gallon 3000psi Bottom Repairable Accumulator, MBAXX-03-**-N-O-1-A
- 2.5-15 Gallon 3000psi Top Repairable Accumulator, MBTXX-03-**-N-O-1-A
- 2.5-15 Gallon 5000psi Bottom Repairable Accumulator, MBAXX-05-**-N-O-1-A
- 2.5-15 Gallon 5000psi Top Repairable Accumulator, MBTXX-05-**-N-O-1-A
- 2.5-15 Gallon 6000psi Bottom Repairable Accumulator, MBAXX-60-**-N-O-1-A
- 2.5-15 Gallon 6000psi Top Repairable Accumulator, MBTXX-60-**-N-O-1-A
- 2.5-15 Gallon 6500psi Bottom Repairable Accumulator, MBAXX-06-**-N-O-1-A
- 2.5-15 Gallon 6500psi Top Repairable Accumulator, MBTXX-06-**-N-O-1-A

Issued to

Servi Fluid Power Inc.
Katy TX, United States

is found to comply with

DNV-OS-E101 Drilling Plant October 2013
and Det Norske Veritas AS' understanding of the implementation and interpretation of:
PSA's "Regulations relating to design and outfitting of the facilities etc. in the petroleum
activities" (THE FACILITIES REGULATIONS), January 2011, Ch.VIII

Application :

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This Certificate is valid until **2018-12-31**.

Issued at **Houston** on **2014-11-21**

for **DNV GL**

DNV GL local station: **Approval CMC – Houston**

Approval Engineer: **M. Kevin Mandeville Jr.**

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Christian Nilsen
Team Lead

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Certificate No: **D-5931**
File No: **523.84**
Job Id: **262.1-018447-1**

The following design codes and standards were used as reference:

ASME *Boiler and Pressure Vessel Code*, Section VIII, Division1, 2013 Edition

Product description

3000 PSI BLADDER TYPE ACCUMULATOR

- 1 Quart Capacity
- 1 Gallon Capacity
- 2.5-15 Gallon Capacity, Top Repairable
- 2.5-15 Gallon Capacity, Bottom Repairable

5000 PSI BLADDER TYPE ACCUMULATOR

- 2.5-15 Gallon Capacity, Top Repairable
- 2.5-15 Gallon Capacity, Bottom Repairable

6000 PSI BLADDER TYPE ACCUMULATOR

- 2.5-15 Gallon Capacity, Top Repairable
- 2.5-15 Gallon Capacity, Bottom Repairable

6500 PSI BLADDER TYPE ACCUMULATOR

- 2.5-15 Gallon Capacity, Top Repairable
- 2.5-15 Gallon Capacity, Bottom Repairable

Application/Limitation

For Model Nos. MBA01-03-**-N-O-1-A

<u>Design Parameter</u>	<u>Value</u>	<u>Equivalent</u>
Max Internal Working Pressure	3,000 psi	206.8 bar
Max Internal Test Pressure	4,500 psi	310.3 bar
Min Design Temperature	-40 °F	- 40 °C
Max Design Temperature	200 °F	93 °C
Corrosion Allowance (Interior and exterior)	0 in	0 mm
Service	Standard	

For Model Nos. MBA04-03-**-N-O-1-A, MBAXX-03-**-N-O-1-A, and MBTXX-03-**-N-O-1-A,

<u>Design Parameter</u>	<u>Value</u>	<u>Equivalent</u>
Max Internal Working Pressure	3,000 psi	206.8 bar
Max Internal Test Pressure	4,500 psi	310.3 bar
Min Design Temperature	-50 °F	- 46 °C
Max Design Temperature	200 °F	93 °C
Corrosion Allowance (Interior and exterior)	0 in	0 mm
Service	Standard	

For Model No MBAXX-05-**-N-O-1-A, MBTXX-05-**-N-O-1-A,

<u>Design Parameter</u>	<u>Value</u>	<u>Equivalent</u>
Max Internal Working Pressure	5,000 psi	344.7 bar
Max Internal Test Pressure	7,500 psi	517.1 bar
Min Design Temperature	-40 °F	- 40 °C
Max Design Temperature	200 °F	93 °C
Corrosion Allowance (Interior and exterior)	0 in	0 mm
Service	Standard	

For Model No MBAXX-60-**-N-O-1-A, MBTXX-60-**-N-O-1-A,

<u>Design Parameter</u>	<u>Value</u>	<u>Equivalent</u>
Max Internal Working Pressure	6,000 psi	413.7 bar
Max Internal Test Pressure	9,750 psi	672.2 bar
Min Design Temperature	-40 °F	- 40 °C
Max Design Temperature	200 °F	93 °C
Corrosion Allowance (Interior and exterior)	0 in	0 mm
Service	Standard	

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For Model No MBAXX-06-**-N-O-1-A, MBTXX-06-**-N-O-1-A,

Design Parameter	Value	Equivalent
Max Internal Working Pressure	6,500 psi	448.2 bar
Max Internal Test Pressure	9,750 psi	672.2 bar
Min Design Temperature	-40 °F	- 40 °C
Max Design Temperature	200 °F	93 °C
Corrosion Allowance (Interior and exterior)	0 in	0 mm
Service	Standard	

Note: Bladder Accumulators are not approved for external gauge pressure.

Model Number Explanation:

For MB(Y)(XX)-(PP)-(**)-N-O-1-A, the following table applies

Variable	Value	Meaning
Y, Top/ Bottom repairable	A	Bottom Repairable
	T	Top Repairable
XX, Size	01	1 Quart
	04	1 Gallon
	10	2.5 Gallon
	20	5.0 Gallon
	37	10.0 Gallon
	42	11.0 Gallon
	57	15.0 Gallon
PP, Pressure	03	3000 PSI working pressure
	05	5000 PSI working pressure
	60	6000 PSI working pressure
	06	6500 PSI working pressure
**, Fluid Port Options	FP10-NE1H	1-1/4" NPT, in AISI 4140
	FP10-NG1H	2" NPT, in AISI 4140
	FP10-SL1H	1-7/8" SAE, in AISI 4140
	FP10-FA1H	2" Code 61 SAE Flange
	FP10-FB1H	1-1/2" Code 62 SAE Flange, in AISI 4140
	FP10-FE1H	1" Code 61 SAE Flange
	FP10-NE2H	1-1/4" NPT, in 316/316L SST
	FP10-NG2H	2" NPT, in 316/316L SST
	FP10-SL2H	1-7/8" SAE, in 316/316L SST
	FP10-FA2H	2" Code 61 SAE Flange, in 316/316L SST
	FP10-FB2H	1-1/2" Code 62 SAE Flange, in 316/316L SST
	FP10-FE2H	1" Code 61 SAE Flange, in 316/316L SST
	FP10-NE3H	1-1/4" NPT, in 17-4PH SST
	FP10-NG3H	2" NPT, in 17-4PH SST
	FP10-SL3H	1-7/8" SAE, in 17-4PH SST
	FP10-FA3H	2" Code 61 SAE Flange, in 17-4PH SST
	FP10-FB3H	1-1/2" Code 62 SAE Flange, in 17-4PH SST
	FP10-FD3H	1-1/2" Code 62 SAE W/Subseal in 17-4PH SST
	FP10-FE3H	1" Code 61 SAE Flange, in 17-4PH SST
	FPO1-NC1H	1 Quart Fluid Port, 3000psi, 1" NPT
FPO1-ND1H	1 Quart Fluid Port, 3000psi, 3/4" NPT	
FPO1-SJ1H	1 Quart Fluid Port, 3000psi, 1-5/16"-12UN SAE	
FPO4-FC1H	1 Gal. Fluid Port, 3000psi, 1-1/4" Code 61 SAE Flange	
FPO4-NE1H	1 Gallon Fluid Port, 3000psi, 1-1/4" NPT	
FPO4-SK1H	1 Gallon Fluid Port, 3000psi, 1-5/8"-12UN SAE	
FPO1-NC2H	1 Quart Fluid Port, 3000psi, 1" NPT, in 316/316L SST	
FPO1-ND2H	1 Quart Fluid Port, 3000psi, 3/4" NPT, in	

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Variable	Value	Meaning
		316/316L SST
	FP01-SJ2H	1 Quart Fluid Port, 3000psi, 1-5/16"-12UN SAE, in 316/316L SST
	FP04-FC2H	1 Gal. Fluid Port, 3000psi, 1-1/4" Code 61 SAE Flange, in 316/316L SST
	FP04-NE2H	1 Gallon Fluid Port, 3000psi, 1-1/4" NPT, in 316/316L SST
	FP04-SK2H	1 Gallon Fluid Port, 3000psi, 1-5/8"-12UN SAE, in 316/316L SST
	FP01-NC3H	1 Quart Fluid Port, 3000psi, 1" NPT, in 17-4PH SST
	FP01-ND3H	1 Quart Fluid Port, 3000psi, 3/4" NPT, in 17-4PH SST
	FP01-SJ3H	1 Quart Fluid Port, 3000psi, 1-5/16"-12UN SAE, in 17-4PH SST
	FP04-FC3H	1 Gal. Fluid Port, 3000psi, 1-1/4" Code 61 SAE Flange, in 17-4PH SST
	FP04-NE3H	1 Gallon Fluid Port, 3000psi, 1-1/4" NPT, in 17-4PH SST
	FP04-SK3H	1 Gallon Fluid Port, 3000psi, 1-5/8"-12UN SAE, in 17-4PH SST
N, Bladder Material	<i>Not evaluated</i>	
O, Service	O	Oil
	W	Water
1, Fluid Port, AE Ring, Locknut material, Valve Stem	1	Carbon Steel
	2	Stainless Steel
A, Approval Options	D	ASME & DNV GL
	E	ASME & DNV GL & ABS
	H	ASME & DNV GL & ABS & CE

Type Approval documentation

- Drawings

Drawing No.	Rev.	Description	Status
MBA-004	A	2.5-15 Gallon 6500psi Bottom Repairable Accumulator	AP
SHXX-06O1A	A	2.5-15 Gallon Bottom Repairable Shell, 6666psi, App 22	AP
AR10-XX	B	2.5-15 Gallon Ring	AP
FP10-FD3H	B	2.5-15 Gallon Fluid Port Body, 1-1/2" Code 62 w/ Sub Seal	AP
FP10-FBXX	C	2.5-15 Gallon Fluid Port Body, 1.5" Code 62	AP
FP10-NEXX	C	2.5-15 Gallon Fluid Port Body, 1-1/4" NPT	AP
FP10-NGXX	C	2.5-15 Gallon Fluid Port Body, 2" NPT 6500 psi	AP
FP10-SLXX	C	2.5-15 Gallon Fluid Port Body, 1-7/8" – 12UN SAE 6500psi	AP
LN10-XX	C	2.5-15 Gallon Locknut	AP
TA10-XX	C	2.5-15 Gallon Top Repairable Adaptor	AP
VS10-5-XX	B	2.5-15 Gallon Valve Stem, Bottom Repairable, 6500psi, 2"	AP
MBT-004	A	2.5-15 Gallon 6500psi Top Repairable Accumulator	AP
SHTXX-06O1A	B	2.5-15 Gallon Top Repairable Shell, 6666psi, App 22	AP
MBT-003	A	2.5-15 Gallon 6000psi Top Repairable Accumulator	AP
VS10-T-5-XX	C	2.5-15 Gallon Valve Stem, Top Repairable, 6500psi	AP
MBA-003	A	2.5-15 Gallon 6000psi Bottom Repairable Accumulator	AP
MBA-002	A	2.5-15 Gallon 5000psi Bottom Repairable Accumulator	AP
MBT-002	A	2.5-15 Gallon 5000psi Top Repairable Accumulator	AP
MBA-001	B	2.5-15 Gallon 3000psi Bottom Repairable Accumulator	AP

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Drawing No.	Rev.	Description	Status
SHXX-03O1A	B	2.5-15 Gallon Bottom Repairable Shell, 3000psi	AP
VS10-XX	B	2.5-15 Gallon Valve Stem, 3000psi	AP
MBT-001	B	2.5-15 Gallon 3000psi Top Repairable Accumulator	AP
SHTXX-03O1A	B	2.5-15 Gallon Top Repairable Shell, 3000psi	AP
MBA-005	A	1 Gallon Accumulator, 3000psi 2pc Stem	AP
SH04-03O1A	A	1 Gallon Accumulator Shell, 3000psi	AP
VS04-2P-XX	B	1 Gallon Valve Stem, 3000psi	AP
AR04-XX	B	1 Gallon Ring	AP
FP10-FAXX	D	2.5-15 Gallon Fluid Port, SAE 2" Code 61, 3000 psi	AP
FP10-FEXX	A	2.5-15 Gallon Fluid Port, SAE 1" Code 61, 3000 psi	AP
FP04-FCXX	B	1 Gallon Fluid Port Body, 1-1/4" Code 61 Split Flange	AP
FP04-NEXX	B	1 Gallon Fluid Port Body, 3000psi, 1-1/4" NPT	AP
FP04-SKXX	B	1 Gallon SAE Fluid Port, 1-5/8" – 12UN SAE	AP
LN04-XX	B	1 Gallon Locknut	AP
MBA-006	A	1 Quart Accumulator, 3000psi	AP
SH01-03O1A	A	1 Quart Accumulator Shell, 3000psi	AP
VS1P-XX	B	1PT-1QT Valve Stem, 3000psi	AP
AR01-XX	B	1QT Ring	AP
FP01-NDXX	B	1QT Fluid Port, 3000psi, 1"NPT	AP
FP01-NCXX	B	1QT Fluid Port, 3000psi, 3/4" NPT	AP
FP01-SJXX	B	1QT Fluid Port, 3000psi, 1-5/16" – 12UN SAE	AP
LN01-XX	B	1QT Locknut	AP

• Calculations

Document No.	Rev	Description
-	0	Accumulator Shell Calculations, 2.5-15 Gal. Shell, BR, 6666psi MAWP
-	0	Accumulator Shell Calculations, 2.5-15 Gal. Shell, TR, 6666psi MAWP
-	0	Accumulator Shell Calculations, 2.5-15 Gal. Shell, BR, 3000psi MAWP
-	0	Accumulator Shell Calculations, 2.5-15 Gal. Shell, TR, 3000psi MAWP
-	0	Accumulator Shell Calculations, 1 Gallon Shell, 3000psi MAWP
-	0	Accumulator Shell Calculations, 1 Quart Shell, 3000psi MAWP
-	B	Pressure Retaining Parts Calcs, TR & BR, MAWP 6500 psi @200°F
-	B	Pressure Retaining Parts Calcs, TR & BR, MAWP 6000 psi @200°F
-	B	Pressure Retaining Parts Calcs, TR & BR, MAWP 5000 psi @200°F
-	B	Pressure Retaining Parts Calcs, TR & BR, MAWP 3000 psi @200°F
-	A	Pressure Retaining Parts Calcs, 1 Gallon Acc., MAWP 3000 psi @200°F
-	A	Pressure Retaining Parts Calcs, 1 Quart Acc., MAWP 3000 psi @200°F

• Materials

<u>Item:</u>	<u>Material Specification:</u>	<u>Min. Yield Strength</u>	<u>Charpy V-notch</u>
Shells, 1Gal., 2.5-15 Gallon 3K (TR & BR) models	ASME SA-372, Grade E, Class 70	70ksi	20ft-lb @-65°F
Shells, 1Qt 3K and remaining 6666psi models	ASME SA-372, Grade E, Class 70	70ksi	20ft-lb @-40°F
AE Ring, Fluid Body Ports, Locknuts, Valve Stem	AISI 4140	60ksi	20ft-lb @-50°F
AE Ring, Fluid Body Ports, Locknuts, Valve Stem	ASME SA-316/316L Stainless	36ksi	Exempt
AE Ring, Fluid Body Ports	17-4 PH SST	105ksi	20ft-lb @-50°F

Tests carried out

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The following burst pressure tests were carried out to validate a 5000psi shell:

File Name	Report No.	Date
ZP-OD229-124-20L-34.5MPA-YEAR2009.PDF	HBT2009-140	2009-06-25
ZP-OD168-9.4-4L-34MPA-YEAR2009.pdf	HBT2009-141	2009-11-2
TTHP-OD168-7.8-4L-25MPA-YEAR2007.pdf	HBT2007-113	2007-12-9

In addition, the justification is under the excel file "Burst Pressure Extrapolation Table.xlsx"
This will be combined with hydrostatic testing of each accumulator.

Marking of product

For traceability, the following marking is to be carried out on each product:

1. Serial No.
2. Manufacturer's Name or Trademark
3. Additional marking at the manufacturer's discretion

Certificate Retention Survey

For retention of the Type Approval Certificate, DNV's surveyor shall perform a survey every second year in accordance with DNV's Standard for Certification No. 1.2.

Other conditions/comments

- Manufacture and Examination of integrally forged cylinder to be in accordance with the requirements of ASME 2013 BPVC Sec. VIII Div. 1, Mandatory Appendix 22
- Data report must include "Constructed in Conformance with Mandatory Appendix 22, Integrally Forged Vessels"
- Hydrostatic test requirements can be waived for the end fittings when these are manufactured under surveillance through an appropriate quality control system and full traceability is imposed on the critical pressure components as per DNV Fax, ref. number OFF-0028-97, Dated 1997-10-20. This waiver only applies to the accumulators when they are used per the scope of DNV-OS-E101 and will be part of a system with subsequent commissioning and/or operation testing.
- DNV Ref. Project No. PP117159

END OF CERTIFICATE