OIEC	Performance Test Procedure	NIOC Pars Oil and Gas Company

EQUIPMENT NAME: 130-P-101 A/B, 130-P-102 A/B/C

DOCUMENT TITLE: **Performance Test Procedure**

Code1	☐ (Approved) Vendor to submits " For Final" (No comment & release for manufacturing)
Code2	☐ (Approved with comments) : Vendor shall correct / revise & resubmit it as " For Final " (Released for manufacturing if change incorporated as indicated)
Code3	☐ (Commented) : Vendor shall correct / revise & resubmit . It as " For Approval" of the date specified : (Corrected documents to be resubmitted before starting manufacturing)
Code4	☐ Not Acceptable quality (Reject)
The above checking result by OIEC shall in no way relieve Vendor of any liability, obligation and responsibility out of the purchase order and the mutual agreement in writing	
OIEC – SP20 &21	Date: Dept: Signature:

Only for internal review

CV	**PI**	**EL**	**IN**	**ME**	**MA**
ST	**BU**	**PR**	**SA**	**HV**	**TL**

REV.	DATE	DESCRIPTION	PRE'D	CHK'D	APP'D
03	12-Nov-2012	Issue for Approval	R.Sohrabi	R.Sohrabi	J.seyedhamzeh
02	-	Issue for Approval	R.Sohrabi	R.Sohrabi	J.seyedhamzeh
01	15-Apr-2012	Issue for Approval	R.Sohrabi	Gr.Eslami	J.seyedhamzeh
00	17/12/11	Issue for Approval	R.Sohrabi	Gr.Eslami	J.seyedhamzeh

SOUTH PARS GAS FIELD
DEVELOPMENT (PHASES 20&21),
ASSALUYEH, IRAN
ONSHORE FACILITIES

CONTRACT NO.: POGC 572-88-35

REQ'N NO.: MR-SP2021-ON-MA-0910-0018

PETCO

ITEM NO.: 130-P-101 A/B, 130-P-102 A/B/C

DOCUMENT NO.: VP-SP2021-ON-MA-0910-0018-0007

VENDOR NAME: PETCO

PUMP & TURBINE CO.
R&D DEPARTMENT

Performance Test Procedure for Firefighting Pumps

Project NO: 90-1007

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Trend of Firefighting Pumps testing according to standard NFPA:

Functional testing and NPSH according to standards as follows:

A) Horizontal centrifugal pumps ISO 9906 Grade 1(HI 1.6)

B) Vertical centrifugal pumps ISO 9906 Grade 1(HI 2.6)

References:

1- NFPA20
2- ISO 9906
3- ISO 5167-1
4- ISO 1438-1
5- ISO 9104
6- ISO 3744
7- ISO 3746
8- Hydraulic Institute Standard thirteenth edition
9- UL 448

1- Important points that should be observed during testing:

A) Temperature of water using in pump testing should lower than 40 °C

B) Seal and bearings of the pump should be used in testing.

C) Testing should be executed in minimum six points as follows:

1- Shutoff

2- Minimum continuous Stable flow

3- Midway between minimum and rated flow

4- Rated flow

5- Best efficiency point

6- Maximum allowable flow (150% Rated flow)

D) Test point for rated flow should be performed at +/- 5% limitation of the rated flow.

E) After any disassembly for improvement of the power, NPSH, or mechanical correction, testing should be performed again.

F) For one step pumps, if pump disassembled only for impeller turning and impeller diameter decreased less than 5% of main diameter, again testing is not necessary.

G) For multistages pumps, testing should be performed after any turning.

2-Using fluids in testing:

For testing all pumps, cold and clean water is used under below characteristics:

Table no. 1)

Characteristics	**Unit**	**Max.**
Temperature	°C	40
Kinematic viscosity	m^2/s	1.75×10^{-6}
Density	Kg/m^3	1000
Non-absorbent free solid content	Kg/m^3	2.5
Dissolved solid content	Kg/m^3	50

3-Testing method:

1- Testing pump, according to hydraulic characteristics, has selected and installed on one of the existence circuits.

2- According to pump consumed power, electromotor is selected.

3- After Aligning, electromotor and pump will be fixed and clamped.

4- The circuit will be filled with fluid.

5- Pump will be started.

4-Pump Testing:

Rated flow testing-head, rated flow, power, rated flow -NPSHR and cycle were performed on pump and will be accounted from efficiency computations.

In addition to the said tests, that are functional tests, below tests will be performed according to need or customer's (employer's) request at running test, as follows:

Measuring of basic temperature of bearings

Vibration testing

Sound testing

After testing and related computations, functional graph of pump will be planned.

5-Rotation of speed of pump in testing:

Testing can be performed between ranges of 50% to 120% of pump angular velocity. But if cycle was changed more than 20% of pump angular velocity, computed efficiency is approximate.

For NPSH, cycle should be among 80% to 120%. For electromotor that has been installed with frequent convector system, Torque meter system measures the cycle. For other status optic Torque meter system is used. If pump in any cycles tested without pump cycle, computed amounts will be accounted according to some formulas as follows:

$$Q_2 = Q_1\left(\frac{n_2}{n_1}\right)$$

$$H_2 = H_1\left(\frac{n_2}{n_1}\right)^2$$

$$P_2 = P_1\left(\frac{n_2}{n_1}\right)^3$$

In opposite formula, observing the said case in the cycle, X=1.7,

$$NPSH_2 = NPSH_1\left(\frac{n_2}{n_1}\right)^x$$

Q at m^3/h P at KW

H at meter n at rpm

6- Equipment Used:

Equipment used for pumps test including

Flow meter for measuring pump flow rate

Differential pressure measuring for Measurement of Pump static head

Absolute pressure measuring for measurement of pump suction pressure at NPSHr test

Power analyzer or torque meter for measuring of pump power

Optical speed meter for measuring of pump revolution speed

7-Measuring pump rated flow:

As usual, for regulating pump flow, controlling tap that used in drive circuit will be opened or closed.

For rated flow measurement some equipment will be used as follows:

1) Electromagnetic flow meter

2) Thin plate weirs

3) Venturi tube or venture nozzle

4) Orifice plate

In these equipment, for devices that work with pressure difference method for rated flow measurement, standard ISO 5167-1 and for sharp overflow standard

ISO 1438-1 and for Electromagnetic flow meter standard ISO 9104 will be observed.

8-Measurement of Pump total head:

Pump total head will be calculated according its definition.

According to installation conditions of pump and circuit planning, pump total head can be computed separately, as input or output head, by computation of pressure difference between discharge and suction pressure.

For Grade 1 tests, four cavitations of symmetrical static pressure are performed around sections of drive and suction measurement that pressure measurement equipment install to exit direction of the said holes.

Section level of suction measurement:

Pressure measurement in suction should be in 2 times distance of pipe diameter of suction flange and should be fixed near pump flange. And minimum five diameter of straight pipe must be used in suction side without using any valve – elbow – Bend …

Section level of measurement:

Pressure measurement in discharge should be in 2 times distance of pipe diameter of discharge flange and should be fixed near pump flange. And minimum five diameter of straight pipe must be used in suction side without using any valve – elbow – Bend or other parts .

Pump total head will be computed under below formula:

Pd Fluid pressure in discharge Pipe

Ps Fluid pressure in suction Pipe

Vd Fluid speed in discharge pipe

Vs Fluid speed in suction Pipe

ΔZ Height difference of suction and discharge circuits

$$H_{total} = \frac{P_d - P_s}{\rho g} + \frac{V_d^2 - V_s^2}{2g} + \Delta Z$$

9-Measurement of pump input power P_{sh}:

Input power of the pump can be measured with two systems as follows:

A) Torque meter system that is fixed between electromotor or any other driver and pump, and measures transferred torque form motor to the pump and power can be measured under cycle measurement. Usually, this system is used for the pumps that their electromotor has been installed with frequent convector system**.**

Power is computed according to below formula:

$$P_{sh} = T \times \omega$$

B) Electromotor consumed power is measured by Power Analyzer system or Voltage Meter.

$$P_{sh} = P_{e.m} \times \eta_{e.m} = (\sqrt{3} VI Cos\varphi) \times \eta_{e.m}$$

Pump efficiency is accounted

$$\eta_{pump} = \frac{\rho g Q H}{P_{sh}}$$

10-Cavitation Testing:

In cavitaton testing only studied pump functional parameters (rated flow, head and efficiency) and other effects of cavitation (sound, vibration, materials damage and ….) will be measured (according to standard ISO 9906)

Cavitation testing has performed under purpose of prevention of pumps gradual corrosion for computing NPSHR.

Cavitation in testing can be appeared under two statuses:

1- Decreasing head or efficiency in fixed rated flow.

2- Decreasing rated flow or efficiency in fixed head.

According to high precise in first status, in this unit testing, head decreasing is fixed in rated flow.

Testing Method:

Test performed in a way that circuit suction pressure is decreasing gradually up to 3% drop of the Pump total head. Suction pressure is the base of NPSHR computation. NPSHR can be accounted under below formula that Pv is vapor pressure of fluid:

$$NPSHR = \frac{P_s}{\rho g} + \frac{V_s^2}{2g} - \frac{P_v}{\rho g}$$

Tolerance limitation for NPSHR:

NPSHR= +3% or +0.15m

Important points:

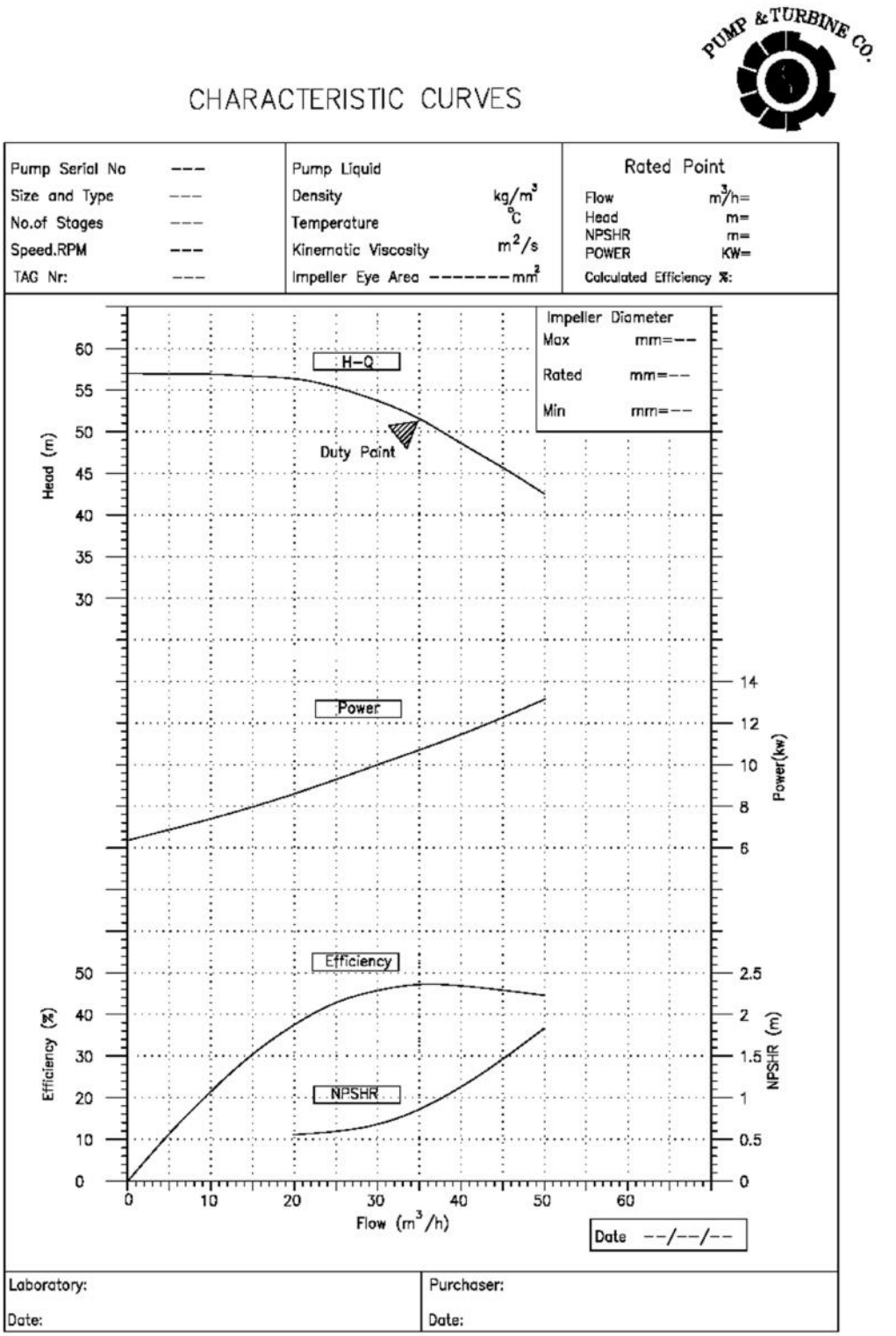
A) Cavitations testing is performed with cold and clean water and will be accounted for other fluids according to tables no. 1 and 2.

B) In multistage pumps, head drop will be used after first impeller.

C) NPSHr test shall be done at rated and 150% rated capacity

11- Appendix:

A) Test Curve Format



B) Data report Format

Technical Department	Heavy Duty Pumps and Water Turbine Mfg.CO.	PETCO
Form NO:		
Date:	Pump Test Sheet	

PUMP TEST SHEET:				Sheet Number:				Nature of test: Performance			
Purchaser:											
	Type:			Manufacturer's Order Number				Order Number:		Inlet Dia.: DN	
Pump										Outlet Dia.: DN	
										Impeller Dia.:	
Guaranteed values	Volume rate of flow(QG): m3/hr			Speed of rotation(nsp): rpm				Power input(PG): kw			
	Total head(HG): m			Efficiency(ηG): %				NPSHr: m			
Pumped liquid	Temperature(t): °C			Vapour pressure(Pv): bara				Kinematic viscosity(v): m2/s			
	Density(ρ): Kg/m3							Degree of acidity(pH):			
Motor	Manufacturer			Power				No. of phases:		Voltage: V	
				kw				Speed: rpm		Current: A	
Measuring method		flow rate	Inlet Head	Outlet Head		NPSH		Torque	Power	Speed	Gear
	Method used	Magnetic	Absolute	Diffrential gage		Absolute		-	Analyzer	laseric	-
	Constant	-	-	-		-		-	-	-	-
Test conditions	Ambient temperature: °C		Barometric pressure: Bar					Head correction to		Inlet	
	Temperature of test liquid: °C							reference plane		Outlet	

Results of measurement		Units	1	2	3	4	5	6	7	8
	Speed of rotation	rpm								
Rate of flow	Reading	mbar								
	Measured flow	m^3/hr								
Head	Differential Pressure reading	bar								
	Differential head	m								
	Δv2/2g	m								
	Pump total head	m								
	Suc. Press. during cavitation	bara								
	NPSH	m								
Power	Voltage	Volt								
	Current	A								
	Power factor	PF								
	Motor power input	KW								
	Motor efficiency	%								
	Motor power output	KW								
Values referred to specified speed of rotation	Volume rate of flow	m^3/hr								
	Total head	m								
	Power(test water)	KW								
	Power(operating fluid)	KW								
	Pump Efficiency	%								
	NPSH	m								

Notes:	Date:	Chief of test	Representative of the purchaser	third party:

C) Schematic of test bed