



## Surface Jet Pump (SJP) Handbook Request Form

Date of Request: \_\_\_\_\_

### General details

First Name: \_\_\_\_\_

Last Name: \_\_\_\_\_

Job Title: \_\_\_\_\_

Department: \_\_\_\_\_

Company: \_\_\_\_\_

### Contact details

Business Phone: \_\_\_\_\_

Mobile Phone: \_\_\_\_\_

Email: \_\_\_\_\_

Website address: \_\_\_\_\_

### Address

Building No./Name: \_\_\_\_\_

Street: \_\_\_\_\_

City: \_\_\_\_\_

State/Province: \_\_\_\_\_

Zip/Postal Code: \_\_\_\_\_

Country: \_\_\_\_\_

### Other

Where did you hear about this book? \_\_\_\_\_

\_\_\_\_\_

Approved by (*Official Use Only*): \_\_\_\_\_

### Notes

- Please complete all sections for a valid request, and email the completed form to [info@caltec.com](mailto:info@caltec.com)
- The form should be accompanied by a vcf card.
- Information provided to Caltec in this form shall be treated as confidential.
- By sending this form to Caltec, you confirm:
  - that the form has been filled in by the person named on the form;
  - that all information provided on the form is correct; and
  - agreement to be contacted for further information/verification purposes.
- Completing this form does not guarantee the approval of the request.

Caltec Limited, Medway Court, Cranfield, Bedford MK43 0FQ United Kingdom  
Tel: +44 (0)1234 750144 Fax: +44 (0)1234 751489 Email: [info@caltec.com](mailto:info@caltec.com) [www.caltec.com](http://www.caltec.com)

Caltec Ltd **Registered Office:** 4th Floor, 117 Jermyn Street, London, SW1Y 6HH **Registered Number:** 4386277

# Surface Jet Pumps (SJPs) for Enhanced Oil & Gas Production

Engineers' Handbook

First Edition 2014

Rev1.1

**Dr Najam Beg and Sacha Sarshar**

**Presented to** \_\_\_\_\_



## Table of Contents

<i>About This Book</i> .....	<i>i</i>
<i>About the Authors</i> .....	<i>ii</i>
<i>Acknowledgement</i> .....	<i>iii</i>

### **1.0 Introduction to Surface Jet Pump Technology**

1.1 What is a Surface Jet Pump?.....	2
1.2 Terminology.....	2
1.3 Principle of Operation.....	2
1.4 Various Forms and Sizes of SJP .....	3
1.5 SJP Flow Dynamics.....	4
1.6 Advantages of SJP Technology.....	5
1.7 Applications for SJP Technology.....	6

### **2.0 SJP Performance**

2.1 Performance of SJPs.....	8
2.2 Typical LP Characteristic Curve of SJPs .....	9
2.3 HP Nozzle : Pressure vs Flow Relationship for SJPs.....	10
2.4 Overall SJP Performance .....	11
2.5 Multi-Stage SJPs for High Compression Ratios.....	12
2.6 SJPs Connected in Parallel for High Turndown Conditions.....	12

### **3.0 Well Performance with SJPs**

3.1 Well Performance with SJPs.....	14
3.2 Effects of Field Depletion on Well Bore Pressure and Production .....	16
3.3 Inflow Performance & Changes to PI at Different Flow Rates & Wellhead Pressures.....	17

### **4.0 Gas Production / Pressure Boosting with SJPs**

4.1 Introduction to the Application .....	20
4.2 Production / Pressure Boosting Applications.....	21
4.3 Configuration of Gas Production Boosting Systems .....	22
4.4 Other Design and Operational Considerations.....	25
4.5 Case Studies .....	26

## 5.0 Multi-Phase Production Boosting with SJPs

5.1	Introduction to Multi-Phase Production Boosting.....	36
5.2	Typical Flow Schemes for Multi-Phase Production Boosting.....	37
5.3	I-SEP Multi-Phase Separator.....	39
5.4	Wellcom™ System.....	40
5.5	Performance of a Dual Wellcom™ System.....	41
5.6	Extra Production Gain with SJP System and Gas Lifted Wells.....	42
5.7	Case Studies.....	44

## 6.0 Well Liquid Loading and Revival

6.1	Causes of Liquid Loading.....	50
6.2	Signs of Liquid Loading and Solutions for Well De-liquification.....	50
6.3	Well Revival.....	51
6.4	Case Studies.....	53

## 7.0 Flare Gas Recovery Ejectors

7.1	Introduction to Flare Gas Recovery Ejectors.....	58
7.2	Case Studies.....	60

## 8.0 Subsea Applications

8.1	Introduction to Subsea SJP Technology.....	64
8.2	Subsea SJP Applications.....	65

## 9.0 How to Identify Potential Applications

9.1	How to Identify a Suitable SJP Location and a Candidate Well.....	68
9.2	Potential Sources of HP and LP Streams.....	70
9.3	Potential SJP Installation Locations.....	70
9.4	Possible Sources of HP fluid.....	71
9.5	How to Make an SJP Application Viable.....	71
9.6	Rules of Thumb for Gas Dominated Multi-Phase Production Boosting.....	72
9.7	Some Rules of Thumb for SJP Selection.....	73

## 10.0 Operational Issues

### Control & Instrumentation

10.1	Typical Instrumentation.....	76
10.2	SJP Control.....	76
10.3	Example - Control of Separator Pressure.....	78

<b>Noise and Noise Abatement</b>	
10.4	Introduction ..... 79
10.5	Typical Layout..... 81
10.6	Anti-Vibration Mounts ..... 81
10.7	Inline Silencers ..... 82
<b>Other Considerations</b>	
10.8	Hydrates ..... 83
10.9	Erosion / Sand Handling..... 83
10.10	Wax / Scale ..... 83
10.11	Start-up / Shutdown..... 84
10.12	Installation ..... 84
10.13	Maintenance..... 85
10.14	Safety ..... 85
<b>11.0 SJP Design</b>	
11.1	Process Design..... 88
11.2	SJP Designs - Fixed and Universal type ..... 89
11.3	Materials of Construction ..... 90
11.4	Mechanical Design ..... 90
<b>12.0 Construction and Test</b>	
12.1	Construction..... 94
12.2	Inspection and Tests..... 94
<b>13.0 Frequently Asked Questions</b>	
13.1	Frequently Asked Questions (FAQs) ..... 96
<b>14.0 Data Required for SJP Analysis</b>	
14.1	Quick Analysis / Screening ..... 102
14.2	Detailed Analysis ..... 102
14.3	Full Sizing..... 103
14.4	Quotation ..... 103
14.5	Questionnaire..... 103
<b>15.0 Worked Examples</b>	
15.1	Problems..... 106
15.2	SJP Performance Simulation Software ..... 109

**16.0 Further Reading**

16.1 References..... 112

**17.0 Appendix**

17.1 Abbreviations & Nomenclature..... 116