

# Process, Plant and Equipment UP-TIME

From [www.feedforward.com.au](http://www.feedforward.com.au)

## Centrifugal Pump Problem & Answers

Published by

### Table of Contents

CHANGING THE SERVICE DUTY OF A PUMP.....	3
FLANGE BOLTING-UP PRACTICES.....	5
A BOLT IS NOT A BOLT.....	5
A GASKET IS NOT A GASKET.....	5
TIGHTENING THE BOLT AND NUT.....	7
BOLT THREAD SURFACE FINISH.....	7
BOLTING UP SEQUENCE.....	7
SHAFT SEALING WITH A PACKED GLAND.....	8
HOW COMPRESSED PACKING WORKS.....	8
CONSIDERATIONS WHEN USING PACKING.....	8
GOOD INSTALLATION PRACTICES.....	9
COMMISSIONING SHAFT PACKING.....	9
VIBRATION AND OUT-OF-BALANCE EQUIPMENT.....	10
CAUSES OF OUT-OF-BALANCE.....	10
REDUCING OUT-OF-BALANCE PROBLEMS.....	11
BALANCING ROTORS.....	11
GET MECHANICAL SEALS WORKING PROPERLY.....	12
WHAT CAUSES A MECHANICAL SEAL TO LEAK?.....	12
REQUIREMENTS FOR LONG MECHANICAL SEAL LIFE.....	13
a) ACHIEVE A HEALTHY LOCAL ENVIRONMENT.....	13
b) ACHIEVE PRECISION ASSEMBLY.....	13
c) ACHIEVE PRECISION RUNNING.....	13
ALTERNATIVES TO MECHANICAL SEALS.....	14
WHAT TO DO TO EXTEND SEAL LIFE.....	14

## Table of Contents (cont.)

<b>EFFECTS OF RUN CENTRIFUGAL PUMPS ON THE END OF THE CURVE.....</b>	15
<b>PUMP CURVES AND WHAT THEY MEAN.....</b>	15
<b>PUMP CAVITATION.....</b>	
. 16	
<b>EFFECTS OF 'RUNNING ON THE RIGHT'</b>	17
<b>CORRECTING THE SITUATION.....</b>	18
<b>NET POSITIVE SUCTION HEAD LOSSES.....</b>	19
<b>WHY YOU CAN SUCK THROUGH A STRAW.....</b>	19
<b>WHAT IS NPSH?.....</b>	
20	
<b>THE EFFECT OF GAS ENTRAINMENT ON NPSH.....</b>	21
<b>HOW TO OVERCOME NPSH PROBLEMS.....</b>	21
<b>VIBRATION AND ITS CONTROL.....</b>	22
<b>CORROSION IN AGITATED CONDITIONS.....</b>	25
<b>ISO-CORROSION CURVES.....</b>	25
<b>CORROSION BARRIER.....</b>	25
<b>PIPELINE EQUIPMENT.....</b>	26
<b>ALTERNATE MATERIALS.....</b>	
IN-SITU TESTING.....	27
<b>IMPORTANCE OF FIT, TOLERANCE AND CLEARANCE.....</b>	28
<b>FITTING TOLERANCED PARTS.....</b>	29
<b>ALWAYS MEASURE &amp; CHECK THE CLEARANCE.....</b>	30
<b>SHAFT ALIGNMENT ON PUMPS.....</b>	31
<b>THE CAUSES OF MISALIGNMENT.....</b>	32
<b>SHAFT COUPLING SELECTION ISSUES.....</b>	33
<b>CENTRIFUGAL PUMP CAVITATION.....</b>	34
<b>WHAT IS CAVITATION?.....</b>	
34	
<b>WHAT CAUSES THE PRESSURE TO DROP SO LOW?.....</b>	34
<b>HOW IS CAVITATION DAMAGE CAUSED?.....</b>	34

ENTRAINED GASES MAKE THE PROBLEM WORSE.....	35
WHAT CAN BE DONE TO REDUCE CAVITATION?.....	36
CENTRIFUGAL PUMP LIFE EXTENSION – THE VOLUTE.....	37
EFFECT OF PROCESS CHANGES ON ELECTRIC MOTORS.....	39
OPERATION OF AN INDUCTION ELECTRIC MOTOR.....	39
ELECTRIC MOTOR TORQUE AND POWER CHARACTERISTICS.....	40
EFFECTS ON THE MOTOR WHEN FLOW AND PRESSURE CHANGES.....	41
PROPER HANDLING OF MOTOR LOAD CHANGES.....	42
PUMP LIFE EXTENSION – THE IMPELLER.....	43
PURPOSE OF A CENTRIFUGAL IMPELLER.....	43
WHAT HAPPENS INSIDE THE IMPELLER?.....	44
PROPERTIES OF THE LIQUID.....	45
MODES OF CENTRIFUGAL PUMP IMPELLER FAILURE.....	46

## **Process, Plant and Equipment UP-TIME Presents**

From [www.feedforward.com.au](http://www.feedforward.com.au)

### **Pumping Types Explained**

Published by

#### **CHANGING THE SERVICE DUTY OF A PUMP**

..... 2

#### **CHANGING THE SERVICE DUTY OF A PUMP**

..... 2

#### **EFFECTS OF RUN CENTRIFUGAL PUMPS ON THE END OF THE CURVE**

..... 4

#### **PUMP CURVES AND WHAT THEY MEAN**

..... 4

#### **PUMP CAVITATION**

..... 5

#### **EFFECTS OF 'RUNNING ON THE RIGHT'**

..... 6

#### **CORRECTING THE SITUATION**

..... 7

#### **EXPERIENCES WITH MAGNETIC DRIVE (MAGDRIVE) PUMPS**

..... 8

#### **PROBLEMS WITH PERISTALTIC (HOSE) PUMPS.**

..... 11

## **HELICAL ROTOR PUMPS – BENEFITS AND LIMITATIONS.**

.....	<b>13</b>
<b>BENEFITS OF HELICAL ROTOR</b>	
PUMPS.....	13
<b>LIMITATIONS OF HELICAL ROTOR</b>	
PUMPS.....	14
<b>GEAR PUMP OPERATION &amp;</b>	
<b>MAINTENANCE.....</b>	<b>15</b>
<b>GEAR PUMP</b>	
DESIGN.....	15
<b>GEAR PUMP</b>	
USES.....	16
<b>GEAR PUMP INSTALLATIONS</b>	
.....	17
<b>MAINTENANCE</b>	
ISSUES.....	17
<b>METERING &amp; DOSING PUMP</b>	
<b>OPERATION.....</b>	<b>18</b>
<b>TYPES OF METERING AND DOSING PUMPS</b>	
.....	18
<b>DOSING SYSTEM DESIGN AND</b>	
INSTALLATION.....	19
<b>ISSUES WITH EACH TYPE OF</b>	
PUMP.....	20
<b>CALIBRATION.....</b>	
.....	21

## **Process, Plant and Equipment UP-TIME Presents**

From [www.feedforward.com.au](http://www.feedforward.com.au)

## **Pumping Basics**

Published by

### **CHANGING THE SERVICE DUTY OF A PUMP**

.....	<b>3</b>
<b>SHAFT SEALING WITH A PACKED</b>	
<b>GLAND.....</b>	<b>5</b>
HOW COMPRESSED PACKING	
WORKS.....	5
CONSIDERATIONS WHEN USING	
PACKING.....	.5
GOOD INSTALLATION PRACTICES	
.....	6
COMMISSIONING SHAFT PACKING	
.....	6
<b>GET MECHANICAL SEALS WORKING</b>	
<b>PROPERLY.....</b>	<b>7</b>
WHAT CAUSES A MECHANICAL SEAL TO	
LEAK?.....	7
REQUIREMENTS FOR LONG MECHANICAL SEAL LIFE	
.....	8

<i>a) ACHIEVE A HEALTHY LOCAL ENVIRONMENT</i>	.....8
<i>b) ACHIEVE PRECISION ASSEMBLY</i>	.....8
<i>c) ACHIEVE PRECISION RUNNING.</i>	.....8
ALTERNATIVES TO MECHANICAL SEALS	.....9
WHAT TO DO TO EXTEND SEAL LIFE.	.....9
<b>EFFECTS OF RUN CENTRIFUGAL PUMPS ON THE END OF THE CURVE</b>	
.....10	
PUMP CURVES AND WHAT THEY MEAN	.....10
PUMP CAVITATION	.....11
EFFECTS OF 'RUNNING ON THE RIGHT'	.....12
CORRECTING THE SITUATION	.....13
<b>NET POSITIVE SUCTION HEAD LOSSES</b> .....14	
WHY YOU CAN SUCK THROUGH A STRAW	.....14
WHAT IS NPSH?	.....15
THE EFFECT OF GAS ENTRAINMENT ON NPSH	.....16
HOW TO OVERCOME NPSH PROBLEMS	.....16
<b>TOC Continued next page</b>	
Postal Address: FEED FORWARD PUBLICATIONS, PO Box 578, BENTLEY, West Australia, 6102. E-mail Address: feedforward@bigpond.com	
Because the authors and publisher do not know the context in which the information presented in the flyer is to be used they accept no responsibility for the consequences of using the information contained or implied in any articles.	
<b>PUMPING BASICS TABLE OF CONTENTS CONT.</b>	
<b>SIZING LIQUID FLOW PIPELINES</b>	
EASILY.....17	
NECESSARY REQUIREMENTS TO SIZE A PIPELINE	.....17
HOW TO CALCULATE PIPE SIZE	.....18
WHERE PRESSURE LOSSES COME FROM IN PIPES	.....19
MINIMISE FRICTION IN PIPELINE CONSTRUCTION	.....20
<b>CENTRIFUGAL PUMP CAVITATION</b>	
.....21	
WHAT IS CAVITATION?	.....21
WHAT CAUSES THE PRESSURE TO DROP SO LOW?	.....21
HOW IS CAVITATION DAMAGE CAUSED?	.....21
ENTRAINED GASES MAKE THE PROBLEM WORSE.	.....22

WHAT CAN BE DONE TO REDUCE CAVITATION?	23
<b>HOW FLUIDS FLOW IN PIPES</b>	<b>24</b>
THE PIPE WALL.....	.....
.24	
FRICTION AND THE LAMINAR SUB LAYER	24
VISCOSITY AND DENSITY EFFECTS	25
VELOCITY EFFECTS	25
MINOR LOSSES IN PIPE	
FITTINGS.....	.....
GAS FLOW.....	.....
.....26	
<b>STATIC ELECTRICITY BASICS.</b>	<b>27</b>
HOW DOES STATIC OCCUR?.....	.....
CONTROL OF STATIC	27
ON-GOING MAINTENANCE.....	.....
.28	
<b>MOVING SLURRIES ABOUT.</b>	<b>29</b>
REQUIREMENTS WHEN MOVING SLURRY.	29
ISSUES TO CONSIDER WHEN MOVING A SLURRY.	30