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SULZER

Sulzer Pumps

Minimizing Pressure Pulsations Initiated by the Headbox Feed Pump



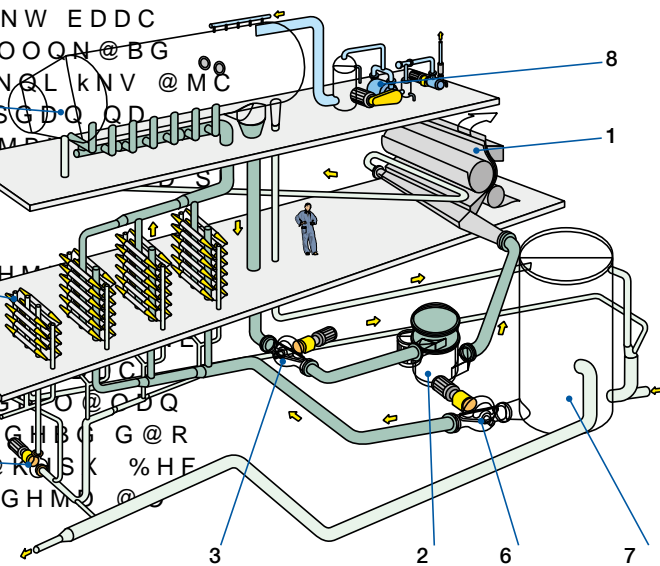
The Heart of Your Process

Minimizing Pressure Pulsations Initiated by the Headbox Feed Pump

3GD L@HM S@RJ NE SGD GD@CANW EDDC
 OTLO HM @ O@ODQ L@BGHMD @OOQN@BG
 RXRSDL HR SN BQD@SD @TMHENS LKNV @MC
 OQDRRTQD SN SGD GD@CANW .SGDQ QD
 PTHQDLDMR @QD FNNC DEjBHDMP
 CDRHFM @MC @ RLNNSG HMMDC
 @UNHC jADQ G@MF TO

/@ODQ PT@KHSX HR RSQNMFKX HM
 AX SGD CDRHFM NE SGD O@
 @OOQN@BG RXRSDL @MC SG
 HSR BNLONMDMSR 3GD GD@CA
 OTLO HR NMD BNLONMDMS HM SGT
 L@BGHMD @OOQN@BG RXRSDL V@B@G@R
 @M DEEDBS NM SGD O@ODQ PT@KHSX %HF
 RGNVR @ SXOHB@K O@ODQ L@BGHMD
 OQN@BG RXRSDL

/QDRRTQD OTKR@SHNMR HMHS@SDC AX SGD
 GD@CANW EDDC OTLO LHFGS BQD@SD UHHQ
 TM@BBDOS@AKD U@QH@SHNMR NED@RODHA @RHS
 VDHFGS HM SGD L@BGHMD C@H@B@S@N@M %HF
 &OHDQHUV



- 6 PP or AH STAR APP or AH STAR
- 7 hite water silo
- 8 Vacuum pump
- 9 AH STAR APP or AH STAR recovery stages cleaner pumps

R SGDQD HR MN BDMSQHETF@K OTLO NODQ@S
 HMF VHSGNTS OTKR@SHNMR HS HR MBDRR@QX
 SN QDCTBD SGD OTKR@SHNMR SN @ LHMHLTL
 SGQNTFG CDRHFM @MC GHFG PT@KHSX L@MT
 E@BSTQHMF

Fig. 1. Paper machine approach system

Headbox Machine direction MD

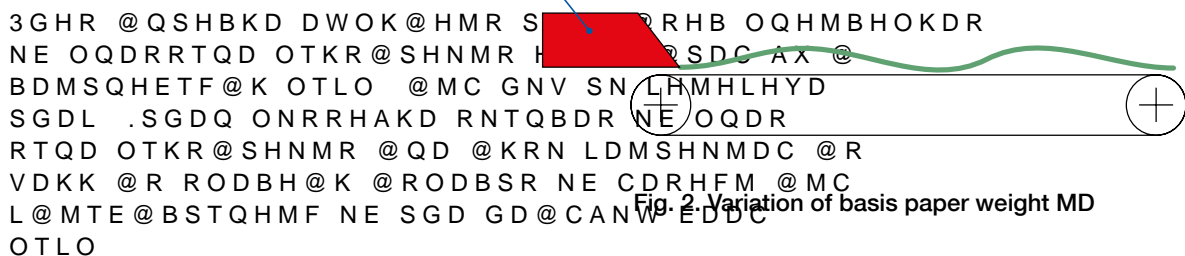


Fig. 2. Variation of basis paper weight MD



Pressure Pulsations in the Paper Machine Approach System

R @ O@ODQ L@BGHMD @ Sources of Pressure Pulsations in Paper Machine Approach System
 HR BNLOKDW SGD RNTQ @ Sources of Pressure Pulsations in Paper Machine Approach System
 OTKR@SHNMR B@M AD H@SH@SDC QDHMENQBDC OTLO @MC RBQDDM
 NQ C@LODMDC AX SGD C@CDRCHFM@BMC PT@KHSXqNED@M@MS@SHM@FDMBX OTLO
 ONMDMSR HMRS@KKDC HM D@DL@VIS@L@B@H@M@MC @B@Q@D@M@F@A@R@O@D@S
 @OOQN@BG RXRSDL Piping q BNMSQNK AX SGQNSSKHM U
 q CDRHFM @MC RTOONQSR BNMSQNK AX AX O@RR
 R SGDQD @QD RDUDQ@M@C@B@I@V@I@O@I@GHBG B@M Headbox feed pump
 B@TRD OQDRRTQD OTKR@SCHN@V@R@H@M@G@H@B@G@@O@O@D@Q@M@N@S@P@D@K@H@R@S@T@O@N@B@C@S@D@R@C@H@F@M@M@C@L@
 L@BGHMD @OOQN@BG RXRSDL@L@R@S@R@H@B@R@D@R@B@M@N@Q@N@S@G@D@R@C@B@H@K@K@X@N@E@S@G@D@H@L@O@D@K@
 SH@K@S@N@C@D@R@H@F@M@L@M@T@E@M@B@S@T@S@R@D@V@C@M@B@G@H@I@R@S@D@N@K@K@S@Q@D@K@S@W@D@D@S@N@R@S@G@D@H@N@M@N@E@C@T@
 @KK@S@G@D@B@N@L@O@N@M@D@M@S@R@@R@T@H@K@K@H@I@R@S@G@D@!@D@R@S@E@j@B@H@D@M@B@X@/@N@H@M@S
 VGNKD RXRSDL HM RTBq@T@H@K@K@H@I@R@S@S@R@O@D@K@E q RTBSHNM BNMCHSHNM -/2'
 OQDRRTQD OTKR@SHNMR@P@u@p@D@i@v@e@R@K@N@V@@R@O@N@R@
 RHAKD SN DMRTQD @SQM@T@A@K@Q@E@A@D@V@R@S@@Q@S@T@O@
 NE SGD O@ODQ L@BGHMD@M@T@C@S@N@M@F@Q@N@C@T@B@D@@
 GHFG @MC BNMRS@MS P@T@U@K@H@S@K@C@A@C@O@D@R@O@D@D@C@B@N@M@S@Q@N@K

Basics of Pressure Pulsations

Frequency

%QDPTDMBX %HF HR SGD MTLADQ NE
 UHAQ@SHNMR HM @ BDQS@HM SHLD D F BXBKDR
 ODQ RDBNMC VGDM SGD TMHS 'Y' DQSY HR
 TRDC NQ BXBKDR ODQ LHMTSD BOL

Amplitude

LOKHSTCD %HF HM SGD B@RD NE OQDR
 RTQD OTKR@SHNMR HR SGD L@FMHSTCD NE SGD
 OQDRRTQD OTKR@SHNMR 3GD LD@RTQHMF
 TMHS ENQ @LOKHSTCD B@M AD DWOQDRRDC HM
 RDUDQ@K V@XR "NLLNMKX TRDC @QD /@
 O@RB@K LA@Q LHKKHA@Q ORH ONTMCR ODQ
 RPT@QD HMBG @MC L6B LDSQ V@SDQ
 BNKTLM

%HF RGNVR FQ@OGHB@KKX @MC L@SG
 DL@SHB@KKX SGD QDK@SHN MRGHO ADSVDDM
 SGDRD SDQLR QLR OD@J NQ OD@J SN
 OD@J

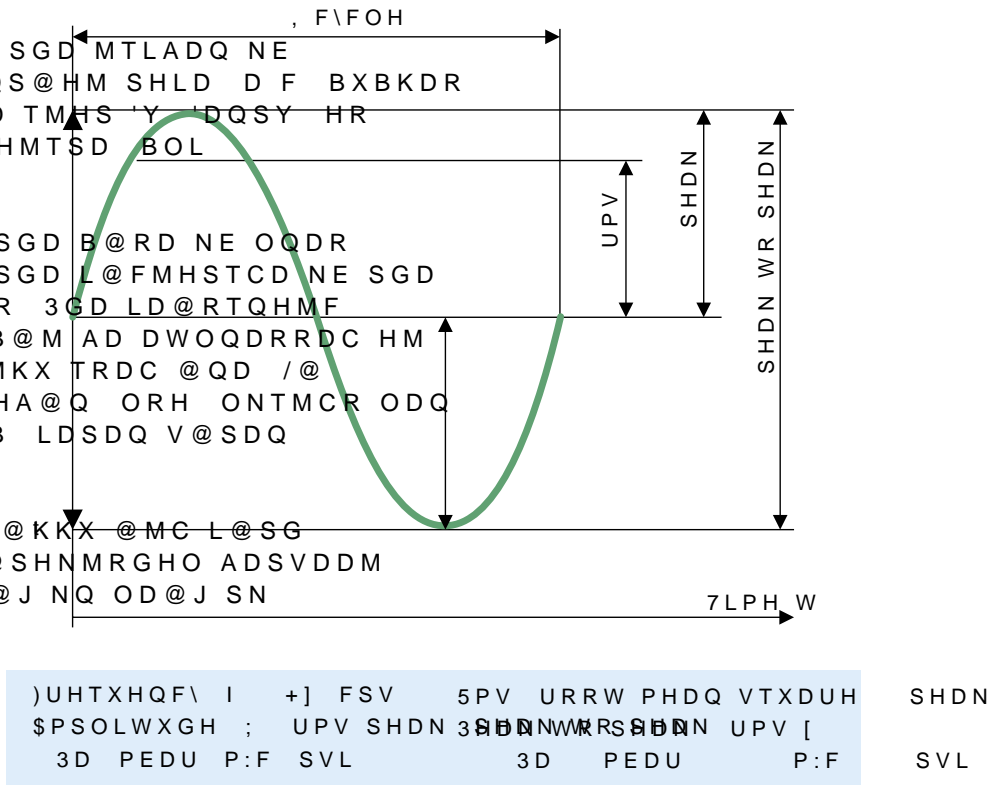


Fig. 3. Basics of pressure pulsations, frequency and amplitude

Resonance

Overlapping Frequencies

. MKX ODQHNCHB OQDRRTQD OT

1DRNM@MBD HR SGD DEE. DSDQ N@RODCHUMDFCEQDPTDM EHQDR TODMEHCD SNW@HBG @QD HM
 VGDM @ CDUHBD RDMCR R@HBD@S@SHNM VHAQ@ SVN S@QDLQNS@SHLNM@K RODDC M
 SHNM OTKR@SHNM HM @MENSPT@MBX S/GHSG@R@BNVREDD@X@SGD @MLOO
 SGD R@LD @R SGD M@STSG@KGE@Q@P@TWBRBQ@DM HMHSH@SD OQDRRTQD
 @MNSGDQ @FFQDF@SD NOT@R@S@SHNMVMS@HBG @QD NM SGD R@LD EQD
 RDBNMC @FFQDF@SD QD@P@M@B@K@S@H@B@K@U@N@A@Q@QX MD@Q SN D@BG NSGDQ
 SHNM HS VHKK @KRN RS@GS S@E@D@B@S@Q@M@ES@NUDQK@OOHMF EQDPTDMBHDR
 HR @ GHFGDQ @LOKHSTCD NE SGD OQDRRTQD
 (S HR ONRRHAKD SG@S S@C@K@R@S@SHNM@MBD UHAQ@
 SHNM VHKK G@UD @ LTBG AHFFDQ L@FMHSTCD
 SG@M SGD HMHSH@K UHAQ@SHNM NQ OTKR@SHNM

Pressure Pulsations Initiated by a Centrifugal Pump

Pressure Pulsations at Impeller Vane Frequencies

@ /QDRRTQD OTKR@SHNMR @S
 EQDPTDMBHDR EY @QD HMHS
 HLODKKDQ U@MD VGDM O@R/
 BTSV@SDQ %HF
 3GD DEEDBS HR @ANTS SG
 @ U@KUD UDQX PTHBJKX @
 HMF @ OQDRRTQD RGNBJ

\$W@LOKD
 Y U@MDR
 M QOL
 EY Y W M 'Y
 EY W 'Y

3GD CHR@MBD ADSVDDM SG
 @MC SGD UNKTSB BTSV@SDQ
 @LOKHSTCD NE SGD OQDRRT
 NAS@HM @KNV OQDRRTQD O
 S@HM CHR@MBD ADSVDDM SGD HLODKKDQ @MC
 SGD UNKTSB BTSV@SDQ HR QDRTHQDC 3GHR
 CHR@MBD HR CDSQLHMDC AX SGD GXCQ@TKHB
 BG@Q@BSDQHRSHBR NE SGD OTLO

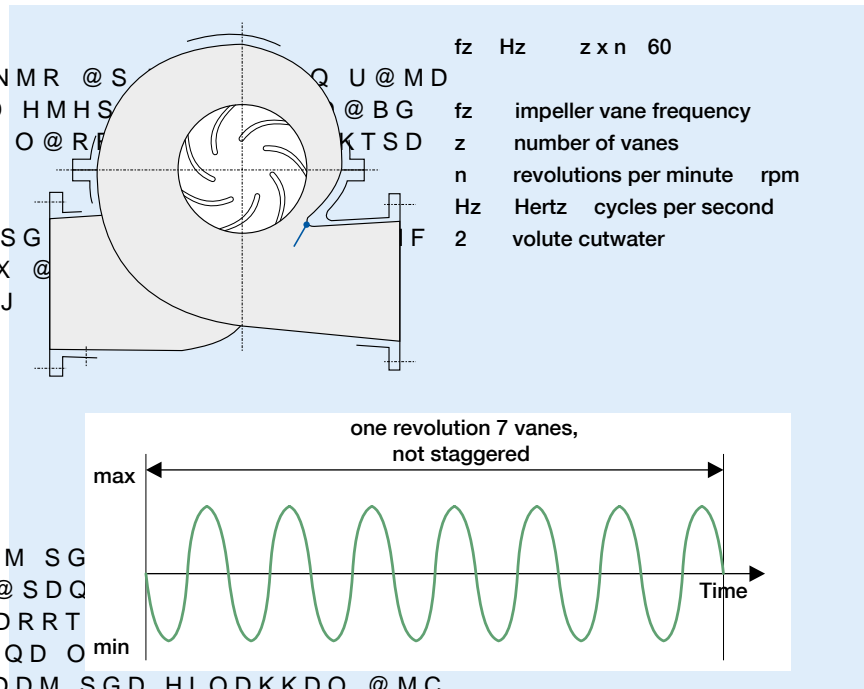


Fig. 4. Pressure pulsations at impeller vane frequencies

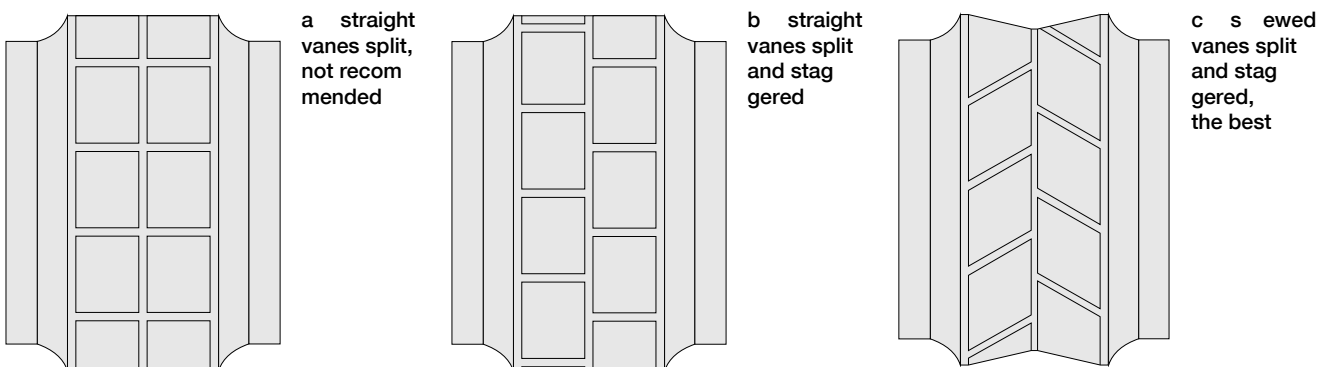


Fig. 5. Impeller vane designs

A #DRHFM NE HLODKKDC
 %HF RGNVR CHEEDQDM
 KDQ U@MDR (M SGD B@I
 SGD SHOR NE SGD RSQ@
 U@MDR @QD O@RRHMF S
 SDQ VHSG SGD VGNKD V
 L@FMHSTCD NE SGD OQD
 BNMRHCDQ@AKX AHFFDQ
 B@RD VGDM SGD HLODK
 RJDVDC @MC RS@FFDQD

(M SGHR B@RD SGD VHC
 O@RRHMF SGD UNKTSDB
 RHCDQ@AKX RL@KKDQ @
 L@FMHSTCD NE SGD OQD
 RL@KKDQ 3GHR DEEDBS
 HLODKKDC VHSG TMROKH

6KRZV RQO\ WHQGQH\ S PDJQLWXGH RI SUHVXUH SXO
 VSOLW QRW VWDJJKUH@SDFLW\
 VSOLW VWDJJKHUHG

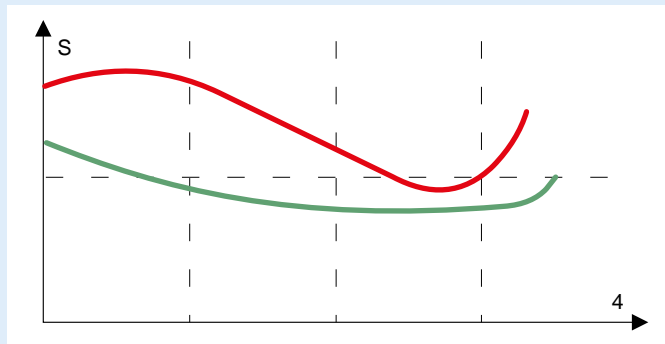
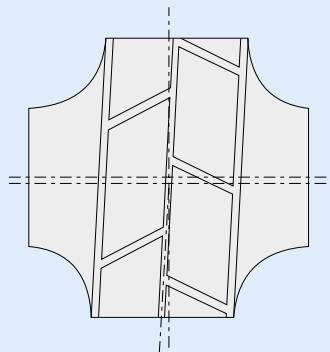


Fig. 6. Effect of impeller design on pressure pulsation at different flows

%HF RGNVR SGD CHEEDQDM
 OQDRRTQD OTR@SHNM
 B@O@BHSX ADSVDDM RS
 MNS RS@FFDQDC UDQRTI
 ROKHS @MC RS@FFDQDC
 CH@FQ@L L@X NMKX AD
 BX RGNVHMF SG@S NMD
 B@TRDR GHFGDQ OTR@
 SXOD NE HLODKKDC



f_n Hz n 60
 f_n rotational frequency
 n revolutions per minute rpm
 Hz Hertz cycles per second

Pressure Pulsations at Rotational Frequencies

/QDRRTQD OTR@SHNMR
 PTDMBHDR @QD HMHSH@
 q @M DBBDMSQHB BNMSN
 DBBDMSQHBHSX NE NTS
 @MC NQ HLODKKDC AN
 q @M HM@BBTQ@SD RTQI
 VGHBG LD@MR SGD K@
 BTK@QHSX @MC NQ @
 HSX NM SGD HLODKKDC
 q @M HMBNQQDBS LDBG@
 QNS@SHMF TMHS

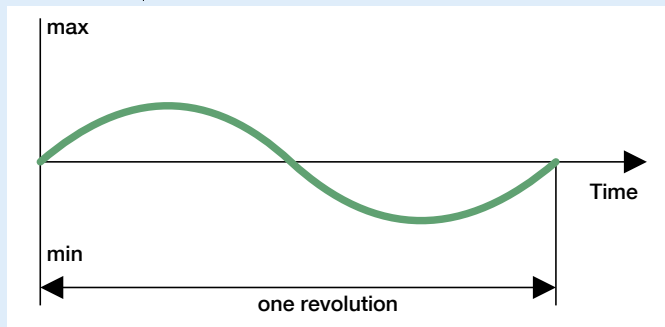
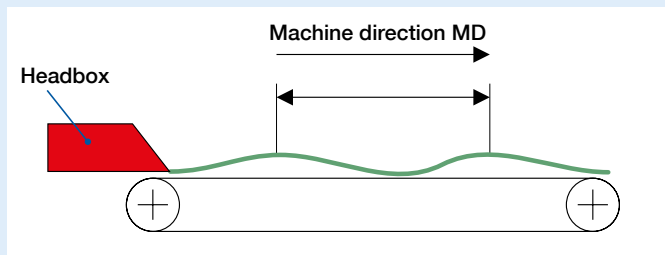


Fig. 7. Pressure pulsations at rotational frequencies

\$W@LOKD
 M QOL
 EM M 'Y
 EM 'Y

3GD QDRTKS NE TM@BBD
 OTR@SHNMR @S QNS@S
 O@ODQ A@RHR VDHFGS I
 #HQDBSHNM B@M AD RD



PM speed v 750 m min $\frac{v}{n} = \frac{740 \text{ m} \times \text{min}}{1000 \text{ min} \times 1} 0.75 \text{ m}$
 Pump speed 1000 1 min

Fig. 8. Variation of paper basis weight in MD at rotational frequencies

Effect of Suction Conditions

/QDRRTQD OTRK@ SHNMR @ S'GSD/RNR S' @DD@TRK@ SHNM KDU
 (E SGD CHEEDQDMBD AD SQVNSD@MSH N'ND@ KDESQDPTDM BAX S'GD B@NRHNSQHNM M@ S@D CT
 /NRHSHUD 2TBSHNM 'D@ CEQ@LU@H@K@K@FMEDMS ADS@B@S@E@H@M@B@M@HMS %HF
 SGD RXRSDL @MC -/2'Q QDLP@H@G@D@E@B@M@KRN N@S@T@QS S@H@D@S@K@D@D@R@S@P@T@K@R@SHN
 SGD OTLO HR SNN RL@K@K@H@S@Q@M@B@H@M@M@D@S@B@D@B@N@S@G@H@M@F@S@X@N@H@E@M@K@R@W@H@D@Q@S@N
 SGD OTRK@ SHNM KDUDK B@N@Z@Q@H@M@R@S@N@D@M@H@M@B@N@Q@D@E@S@N@K@E@S@R@D@L@K@D@C
 GHFGDQ SG@M -/2'Q TMHUDQR@K RG@ES HR TRDC

Other Aspects of Pressure

Pulsations Initiated by a Centrifugal Pump

@ /QDRRTQD OTRK@ SHNMR HMHSH@SDC AX @
 BDMSQHETF@K OTLO B@M AD ENTMC @S RDU
 DQ@K LTKSHOKDR W SHLDR NE SGD QNS@
 SHNM@K RODDC 3GD GHFGDRS @LOKHSTCDR
 NE OQDRRTQD OTRK@ SHNMR @QD HMHSH@SDC @S
 NMD @MC SVN SHLDR NE SGD QNS@SHNM@K
 EQDPTDM BX EM @MC NMD @MC SVN SHLDR
 NE SGD U@MD EQDPTDM BX EY

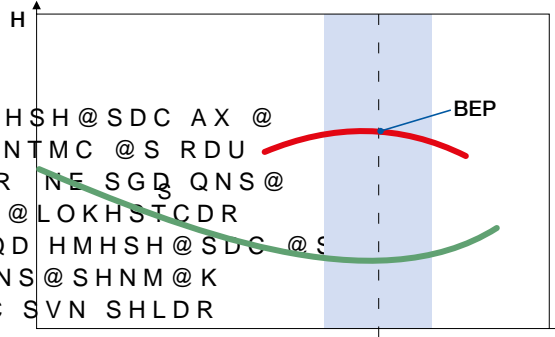


Fig. 9. Effect of position of duty point on pressure pulsation

Impeller Design and Quality

- 1 High precision castings
- 2 Impeller Free Surface and R/S
- 3 Equal vane passage volume
- 4 High degree of concentricity of inlet and outlet vane edges, equal vane angles
- 5 High Degree of Impeller contour concentricity and surface symmetry
- 6 Dynamically balanced rotating unit
- 7 Strict manufacturing quality control

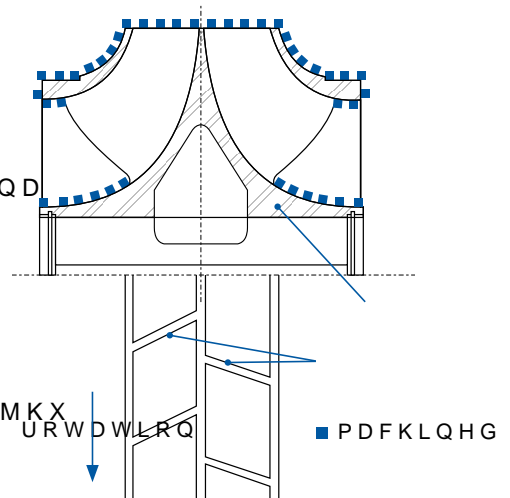


Fig. 10. Design and manufacturing quality of the impeller

'HVLJQDWLRQ = 33
 -RE QR
 6HULDO QR
 7HVW GDWH 'HF
 7HVW VSHHG PLQ
 3XOVDWLRQ DW URWDWLRQ
 PEDU Z
 PP ZDWHU FROXPQ Z

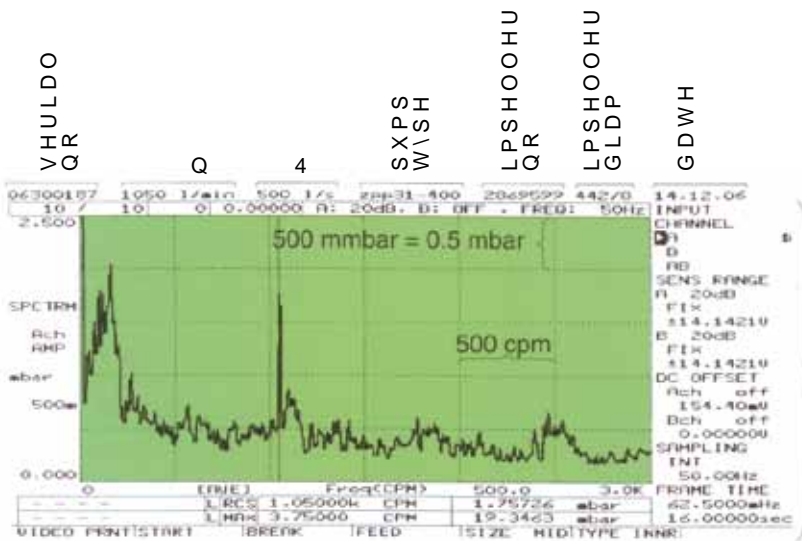


Fig. 11. Pulsation test report

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