$(\frac{d}{R})$
$d >$
$1mm$
$R <$
$50mm$
$R_{cylinder} =$
$30mm$
$R_{out} =$
$25mm$
$h =$
$30mm$
??
:
$_1/female_mold.jpgLongitudinalsectionofthefemalemold$
$R_{in} =$
$R_{cylinder} =$
$30mm$
$5mm$
$5mm$
5
$_1/sleeve_translation.jpglongitudinalsectionofthesleeve$
??
:
$R_{int} <$
R_{out}
$R_{int} =$
$18.5mm, 20mm, 23mm$
1
$_1/male_mold.jpglongitudinalsectionofthemalemold$
$R_{in} =$
$R_{cylinder} =$
$30mm$
$5mm$
$50mm$
??
:
$_1/rolling_machine.pngPastamaker$

®

®
$\frac{d}{R}$
A
B

R_{int}
th
?

$$2\pi R_{out} \approx 157mm$$

ρ
μ
7
??
1/$schematic_experimental_setup.pngSchematicsofthespringexperiment$
??
$310^5 Pa$
1/$cuve.pdfSchematicsofthepressurizeabletank$
$F_{measured} =$
$K\Delta x$
$\approx$
20%
®
?
$P_c \propto$
$(\frac{d}{R})^2$
6.410^{-3}
6.7610^{-2}
?
©
??
μ
1/$OB1.pngOB1pressurecontroller$
©
μ
$f =$
50
©
??
1/$schematic_experimental_setup_light_lenses.pngRepresentationofthelightandcameradispositon$

8
??
??
?3
−3
−3
−6

12
??
α?
1/$dynamic_pressure_cycle.pngQualitativerepresentationofpressurecyclesappliedforthedynamicexperiments$
????
??
?
$\frac{d}{R}$
$^{-1}$
$\frac{d}{R} =$
$\frac{d}{R} =$
$\frac{d}{R} =$

θ_0 [14]
a_k
$k =$
$0, ..., M$
M
$R_{exp}(\theta)_i -$
$\tilde{R}_(\theta)_i$
"'$Levenberg-$
$Marquardt$"'
"'$least-$
$squares$"'
$_1/outer_contour.pngFittedoutercontouringreen, andcenteroftheparametriccurveinblue$
??
??
$_1/concavity_extraction.pngExtractionoftheconcavityexperimentalpoints$
$M(R_h, \theta_h)$
$\tan(\theta+\alpha) = 0$
(1)
α
T
$Q\vec{M}$
??
$$\tan(\alpha) = |\frac{\tilde{R}(\theta)}{\tilde{R}'(\theta)}|$$
(2)
$_1/tan_alpha.pngDefinitionofthehorizontaltangent$
$_horizontal, givesaconditionanequationontheta :$
$\tan(\theta+$
$\alpha) =$
0
$\Rightarrow$
$\frac{\tan(\theta)+\tan(\alpha)}{1-\tan(\theta)\tan(\alpha)} =$
0
$\Rightarrow$
$\tan(\theta)+$
$\tan(\alpha) =$
0
$\Rightarrow$
$\tan(\theta)+$
$|\frac{\tilde{R}(\theta)}{\tilde{R}'(\theta)}| =$
0
$\Rightarrow$
$\tan(\theta)+$
$$|\frac{\sum_{k=0}^{M} a_k \sin(\theta)^k)}{\cos(\theta)\sum_{k=1}^{M} k a_k \sin(\theta)^{(k-1)})}| =$$
$0The point_h, \theta_h)$
$\tilde{R}(\theta) =$
$\sum_{k=0}^{M} a_k \sin(\theta)^k$
$\theta \in$
$[-\pi -$
$\theta_h, \theta_h]$
$M(R_h, \theta_h)$
$^6 +$
$bx^4 +$
$cx^2 +$
d
$withthefollowingcontinuityconditionsonandd =$
$-cx_c^2 -$
$bx_c^4 -$
$ax_c^6 +$
y_c
$andc =$
$-2bx_c^2 -$
$3ax_c^4$
a, b, c, d
x_c, y_c
$M(R_h, \theta_h)$
"'$Levenberg-$
$Marquardt$"'
??
[15]
θ_h
$\frac{\pi}{2}$
$_1/outer_contour_complete.pngFittedoutercontourinblue, fittedconcavityinred, andexperimentalconcavitypointsinyellow$