

7\$%/(2) &217(176

,QWURGXFWRQ
)XQFWLRQDOJ7RROEDUWLRQ
 3XOO GRZQ 0HQXV
 ,QVHUW
)XQFWLRQDO7RROEDUWLRQ :RUNEHQFK
 %RWRWP 7RROEDU
 7RS 7RROEDUV
 *' 7 5HYLHZ
 *HRPHWULF &KDUDFWHULVWLF 6\PERO
 0RGLI\LQJ 6\PEROV
 2WKHU 6\PEROV

9LHZV
 9LHZ &UHDWLRQ
 2IIVHW 6HFWRQ &XW
 \$OLJQH 6HFWRQ 9LHZ 6HFWRQ &XW
 2ULHQWLRQ
 7UDQVIHU
 8VLQJ \$[LV 6\VWHPV
 3URSHUWLHV
 &KDQJLQJ 6XSSRUW

'DWXPV
 3ODQDU 'DWXPV
 7ROHUDQFLQJ \$GYLVRU
 'DWXP 5HIHUHQFH)UDPHV
 0DQXDOO\
 3RVLWRQLQJ D 'DWXP
 'DWXP 7DUJHWV
 3RLQWV
 7ROHUDQFLQJ \$GYLVRU
 0DQXDOO\
 /LQH V
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 0DQXDOO\
 \$UHDV
 7ROHUDQFLQJ \$GYLVRU
 0DQXDOO\
 'DWXP \$[HV DQG &HQWHU 3ODQH V
 7ROHUDQFLQJ \$GYLVRU
 0DQXDOO\
 <:LFKLWD 6WDWH 8QLYHUVLW\

' L P H Q V L R Q V
& U H D W L Q J ' L P H Q V L R Q V
/ H Q J W K ' L V W D Q F H
\$ Q J O H
5 D G L X V
' L D P H W H U

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2ULHQWDWLRQ &RQWUROV
  3HUSHQGLFXODULW\
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
  $QJXODULW\
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
  3DUDOOHOLVP
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
/RFDWLRQ &RQWUROV
  3RVLWLRQ
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
  &RQFHQWULFLW\
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
  6\PPHWU\
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
5XQRXW &RQWUROV
  &LUFXODU 5XQRXW
    7ROHUDQFLQJ $GYLVRU
    0DQXDOO\
  7RWDO 5XQRXW
    7ROHUDQFLQJ $GYLVRU
  
```

\$QQRWDWLRQV
 &UHDWLQJ 7H[W
 0RGLI\LQJ 7H[W
 7H[W 3URSHUWLHV 7RROEDU
)RQW SURSHUWLHV
 -XVWLILFDWLRQ
 \$QFKRU SRLQW
)UDPH
 ,QVHUW 6\PERO
 3URSHUWLHV
 \$GGLQJ D /HDGHU
 /LQNV
 2ULHQWDWLRQ /LQN
 3RVLWLRQDO /LQN
 \$WWULEXWH /LQN
 4XHU\ 2EMHFW /LQNV
 ,VRODWH 7H[W
)ODJ 1RWHV
 5RXJKQHVV 6\PERO
 :HOG 6\PEROV
 *UDSKLF 3URSHUWLHV 7RROEDU
 &RS\ 2EMHFW)RUPDW
 7ROHUDQFLQJ \$GYLVRU
 7H[W
)ODJ QRWHV
 5RXJKQHVV 6\PERO

*HRPHWU\IRU
 5HVWULFWHG \$UHD
 &RQVWUXFWLRQ &HRDWLRQ
 &RQVWUXFWLRQDQDBPHPHQW
 7KUHDG QMSUHLRQ &UHDWLR
 *HRPHWU\IRU &RQVWUXFWLRQDQDBPHPHQW

1RWH 2EMHFW \$WWULEXWH

5HSRUWV

)XQFWLRQDO 7ROHUDQFLQJ DQG \$QQRWDWLRQ

)XQFWLRQDO DWRGOE QDGHVGDWRBRGHILVQXIVFKUWVDRVSG SURGXFW
LQD 'HQYLURQPHVQVH%WRWRDVLJWZBZGQBMCPDLRQPDW QHHG
EHFUHDWHG ODQHFRUPSDVQLGVDQDLVQWVW LQJRLQJ
HQYLURQPHQW FXXW WQGEWRBSDQMKDQKIQFJWD BGDQQWRWDY
RQH VHW RI WRRDNVHWKIDW FDDQKHLWSL RQ D UHDOLW\

7R HIIHFWLYHO\ LFSLOCH FHKQW FRKHU DFRLOE XUP ZLVWKEWKH
IXQGDPHQW DQVLRIGJLFRFCH L RQLQJ DQ,OV VLR QCHRUD QVFKLQ J Q*W H Q
WKLV FRXUVH WR WJVD FRPH DVV KVM VQEQ SUKRYLXGFGVZRQDO
WKH ZRUNEHQFK OEXV LRV ZWBQ FSVLFOBQD QVROWDWDH D GHV

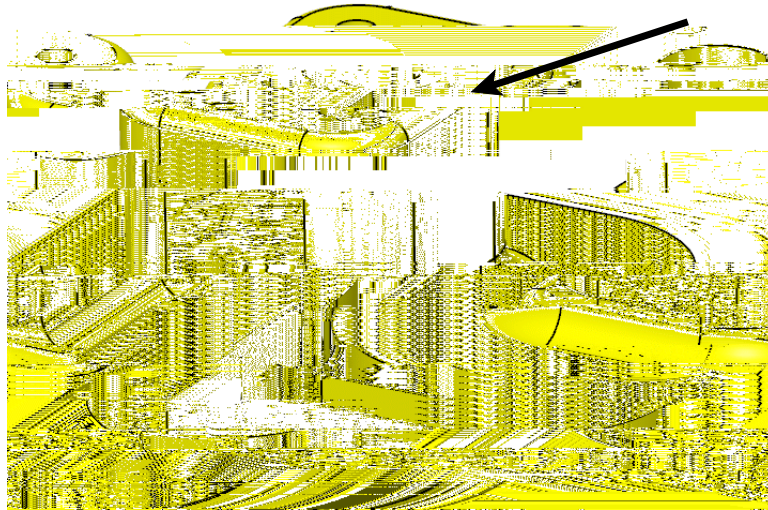
7ROHUDQFLQJ \$GYLVRU

Select the 7ROHUDQFLQJ icon, then select the top of the part.

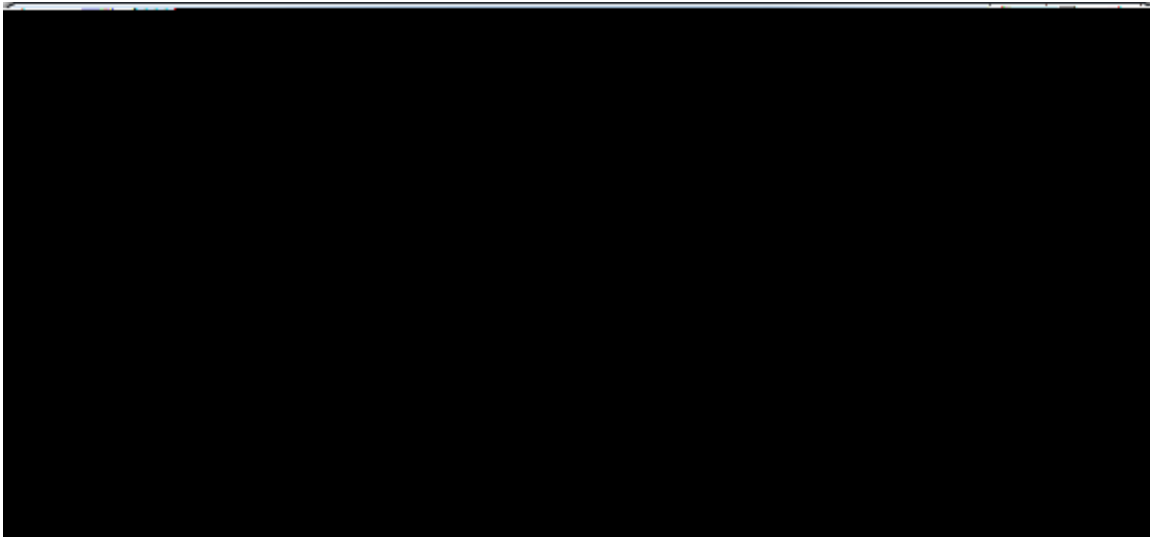


<RX ZLOO

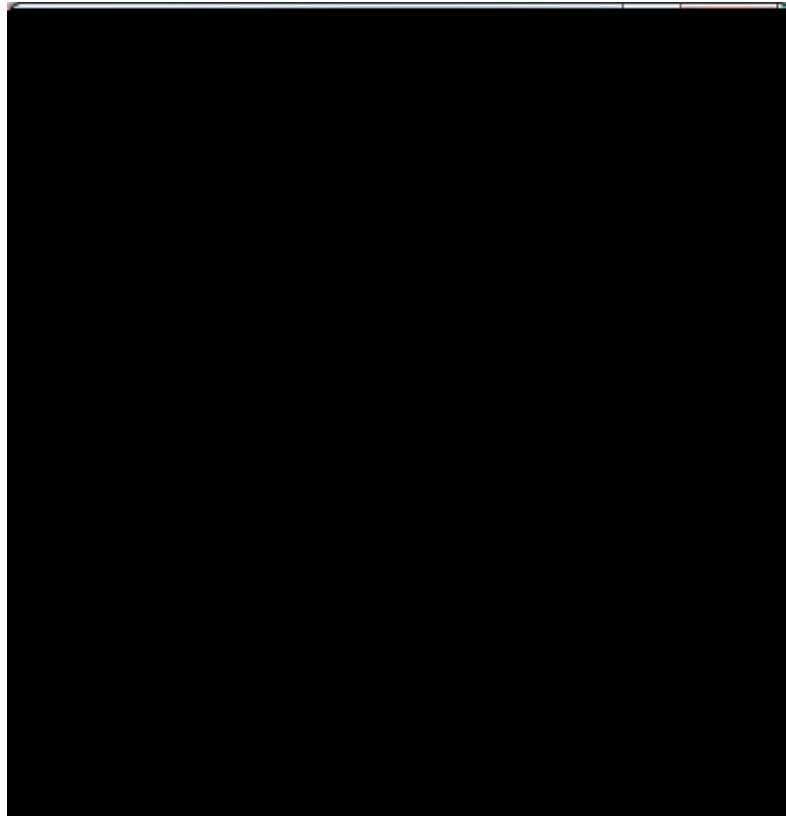
FUHDWH D IODWQHVV WROHUDQFH IRU WKLV IDFH



<RXU ZLQGRZ VKRXQG D\$SHDRQDV DQZOUVS BXW WUKHLRSWLR
DUH QRW YDOLGFRU DQQLQWGH \$XUWOLGHQGLVRSXWLRQGLVLRQ HD
H[HUFLVH



Select the *Unit Basis* tab.



+H U H \ R X F D Q V S H F W R O H U H I Q Q H P R Q W K M P D X U Q B B H D D G B Q J
W R W D O Y D U L D W L R Q R U \ R X F D Q X V H L W

Change the symbol to) O D W with a Value of 0.03. % H I R U H O K / H O R I R M I D Q W
W K H W R O H U D Q F I D U I Q D W K, W J K U D S O H E D I Q H / D W K J L O / O / R R N L Q W
V S H F L I L F D W L R Q, W U V H U D O e t h e r a l T o l e r a n c e / Q D / W H I D e s I D

6WUDLJKWQHVV

6WUDLJKWQHVV WBSOUBDQ FVHR/ VFDQI WFKH HDQ EIV HROWVH R W HWI
IHDWXUHV RI VLJH

,I DSSOLHG WR D RVOXU KRFZH V W W DFWRQ W W KOHL Q XIUHDFHP HQ V W
WR PHHW WKH GHV \$.000 UCHLTXH UHDFH FHM Q VDY IR IWRKH I V X W I Z L V
WROHUDQFH J R Q R S S H F O Q M C Q H G M E V E D W V D W W WROHUDQFH Y

,I DSSOLHG WR D Q Q H L V R I D U F F O R O W G H L F D D W H F R V X W H R O V W K
R I W K H D [L V 7 K / H W D Z L W K P L Q / W W K H L F V L R I O H G J E Q E D H F J R Q Q G V S U H Z
G L D P H W H U K M W R X O H Q D Q R F M Y D O X H


,I DSSOLHG WR D F H Q W H U S O D Q H L W (Y M U F R O W Q U R E O H B H V
S O D Q H P X V W H [L H W D Q E M K R Q H W K S H D F R O H G S E O D V Z R W S D B U D V
E \ W K H W R O H U D Q F H Y D O X H

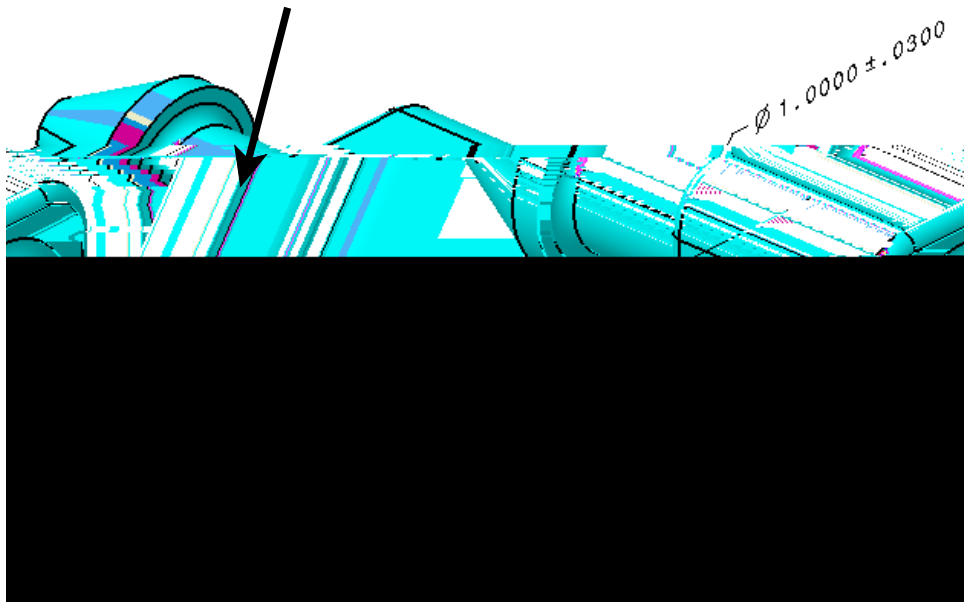
Open the 6WUDLJKWQHVV document V7ZR YLHZV DQG WZR GLPHQVLRQV D

7ROHUDQFLQJ \$GYLVRU

\$V VWDWHG EHIRU \$ G Y L K H R U R O M X D I C F V J G W K P H W R Q E D O Y D O R O H
FUHDWHG

Select the 7ROHUDQFLQJ icon, then select the cylindrical surface indicated

below.  <RX ZLOO FUHDWRIO HDUVDQ E E L J R W W Q M Q V R W X W I D H F B W X
VLJH VR WKH WBSOUBDQ FVHRZ W G E W B H Q Y X H O D H F H Q Q R W R W R L V
FHQWHUOLQH

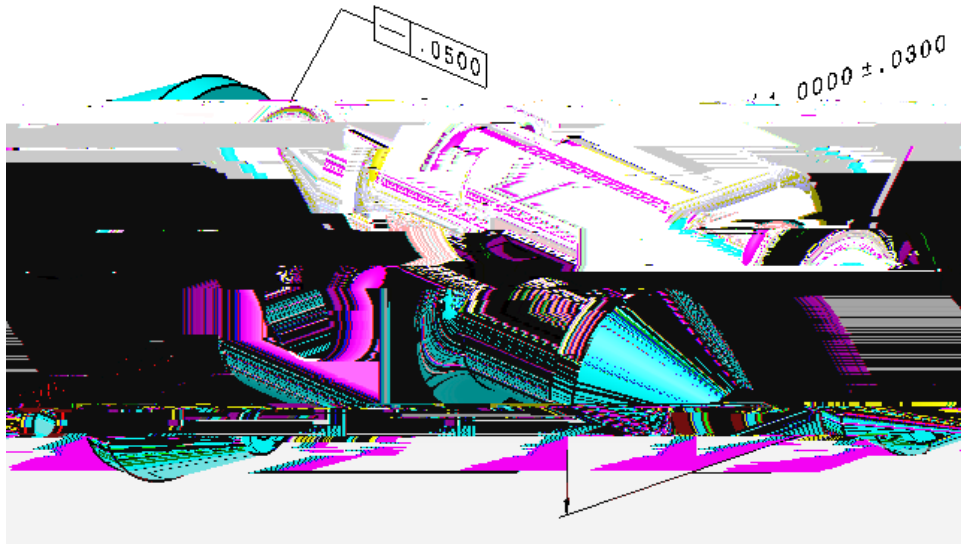


7 K Semantic Tolerancing Advisor Z L Q G R Z H [S D Q G R Q D Q G K D W H Z R S W L Q R W Y D
W K H F X U U H Q W H V H O H Q F W L O R Q H K B G D Z D \

6 H O H F W W K L H K W Q H V V 6 S F R Q I L F Q W H R C a l S p e c i f i c a t i o n
Z L Q G R Z D S S H D U V

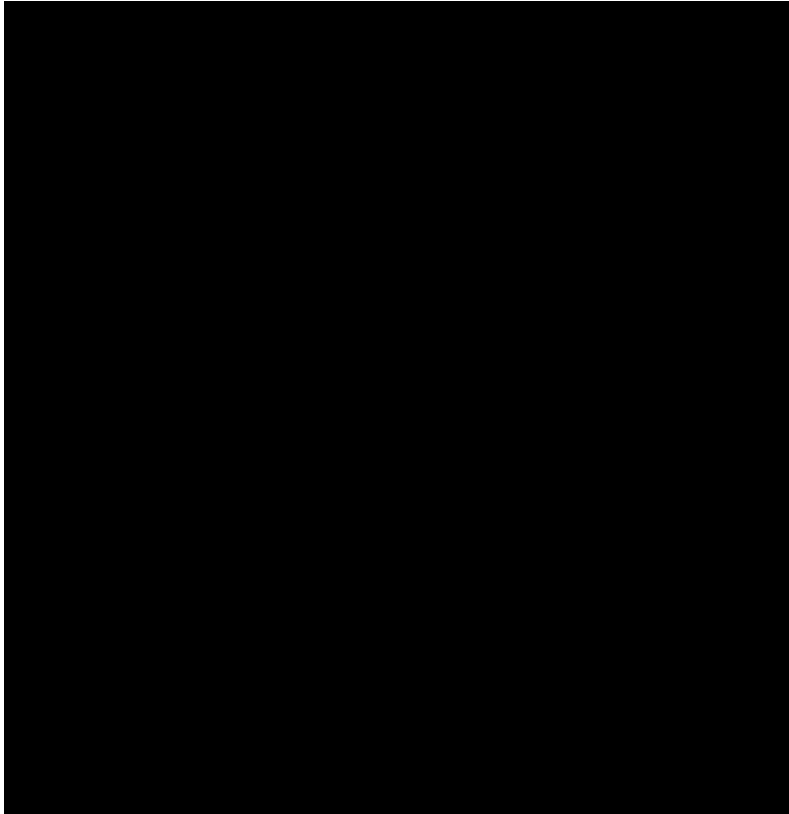
& K D Q J N u m e r i c a l Y D O X H W R O K D Q G H M O R H O F W D Q F H D S S H D U V D Q
7 R O H U D Q F L Q J \$ G Y L V R U U H P D L Q V D F W L Y H

Select *Close*, then position the tolerance as shown below.



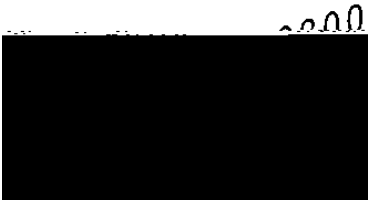
Select the tolerance, then press and hold the first mouse button on the yellow diamond.

Change the Numerical value to 0.05. 7KH GLDPHWHW WLFERODXSRPD UV LQ
IHDWXUH FRQWUR\$ NQBZM WIKDFH ISWLRQBIUFDQIEGJRIQFD \$OV
PDWHULDORFRQGLUMLQRZLBYDLODEOH



Select the  0D[LPXP 0DWHULD  GLTKLRQDOORZV IRU H[WUD W
ZKLOH VWLOOXHQE WLURLQ R IWKVHPEO\

Select **OK**, then select **Close**. 7KH VWUDLJKWSSHVDUW REHQHDDQFKH W KH GLPH
WROHUDQFH DQGLKON W RSEBWLW:KRFQDYKH G KPHQRORIQDQFH Z
PRYH ZLWK LW 7CHUDQUBILDQWPHMYLWZV DLQWKKHGLDPHQVLR



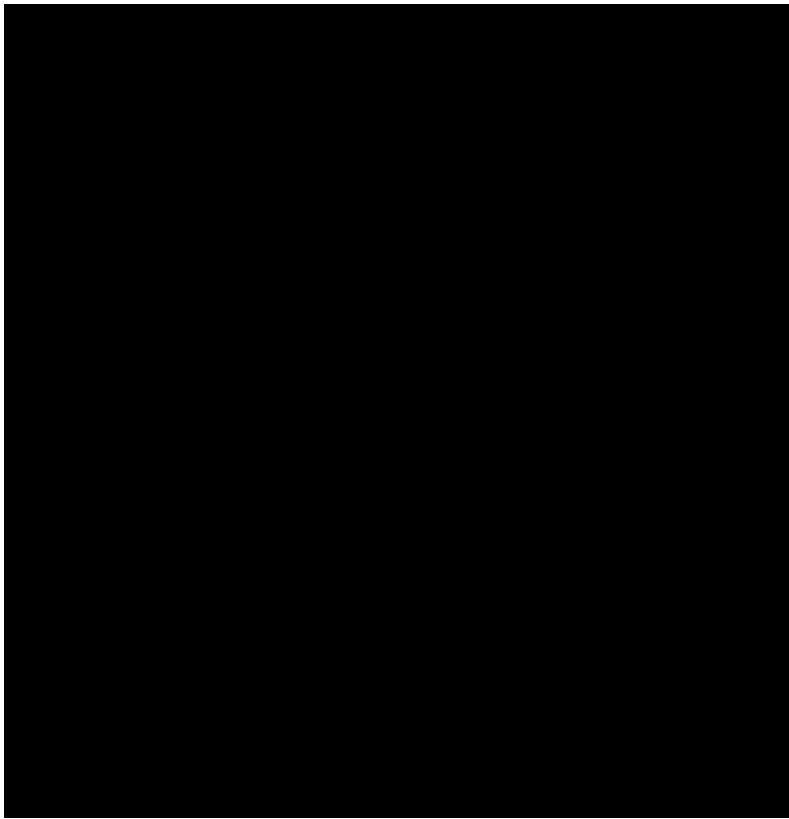
Select in the

Open the 6 WUDLJKWQHVV document. W < % X VZLVOO GHILQH VRPH VWUDL WROHUDQFHV VZKWC XELVQHE DWKLPWROHUDQFHV

Select the 7 R O H U D Q F L Q icon () L V R S e h n t i c T o l e r a n c i n g A d v i s o r Z L Q G R Z D S S H D U V

Select the top face of the part, then choose the 6 WUDLJKWQHVV 6 c 6 n t i l f d w l r q 7 K G e o m e t r i c a l S p e c i f i c a t i o n Z L Q G R Z D S S H D U V R \$ D Y L L F Z D D V D U K H D W H G V W K H U H Z H U H Q R Q H E H I R U H K D Q G

Change the Numerical value to 0.05 and select the Unit Basis tab. 7 K H R S W L R Q V K H U H D Y H U \ V L P L O D V Q H W R V R K S M I L B Q V H [F R C S H W O M I Q D W K V C H I L L Q I L W L R Q O



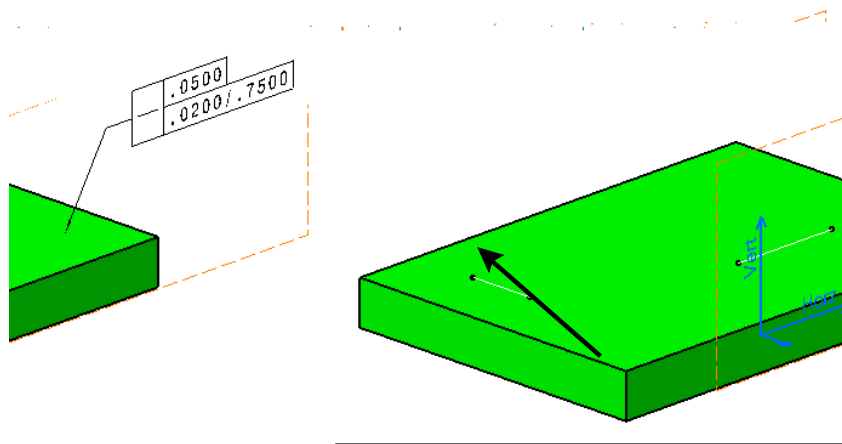
Unit Basis W D E V S H F L I L H V D Q B H I L R Q H I D H V Q P D W R S O H D D H Q D V R Q R I W Z L W K D W R W D O Q E U L X W L R C E \ R D W H W A R D X , Z L W C L W S F F L I \ D U H I I V W D W L Q J W K D W K I R U P D [L P X P H Y Q J W E M W R Q F D Q R Q O \

Select the *Applied on Unit Basis* and *Refinement Tolerance* options, change the *Numerical value* of the refinement to 0.02 and *Length 1* to 0.75, then select *OK*.
 PHVVDJH DSSH DUWLVQRWQHILORZHWUKHJLW\$ZV\$VZKQG/RZPHPHV
 EHIRUH

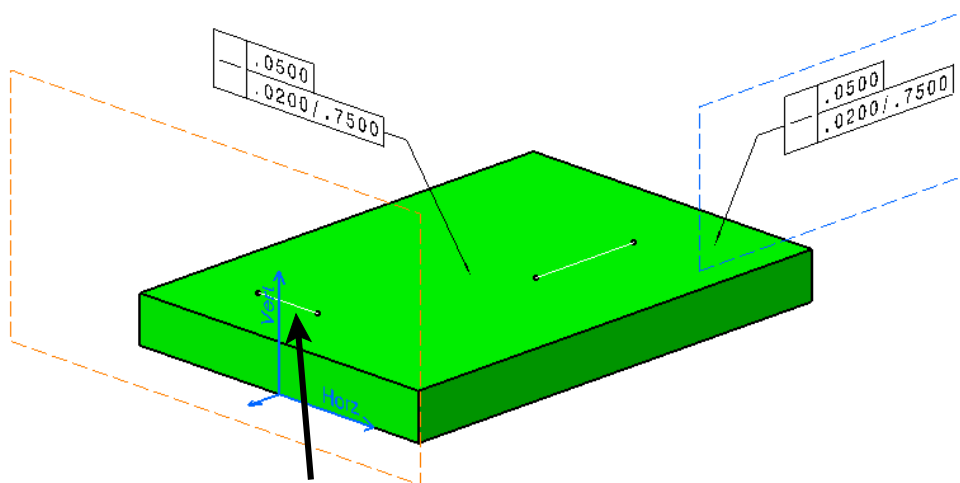
No definition element has been selected.
 Hence, the created geometrical tolerance applies to all the lines defined by all the possible intersection planes. This is not explicitly allowed by GD&T standards. Make sure it is really the specification you want to define.

Select *Close*, then double-click on the tolerance just created. :KHQ XVLQJ D SODQH
 WROHUDQFRIUGWVHFWLBDLUKWQHVV PXVW EH VSHFLILHG

Under the *General* tab, select in the *Definition Element* field and choose the line indicated below, then select *OK* and position the tolerance as shown here.



Create a view normal to the existing view, then create another straightness tolerance as shown below using the other line as the direction.



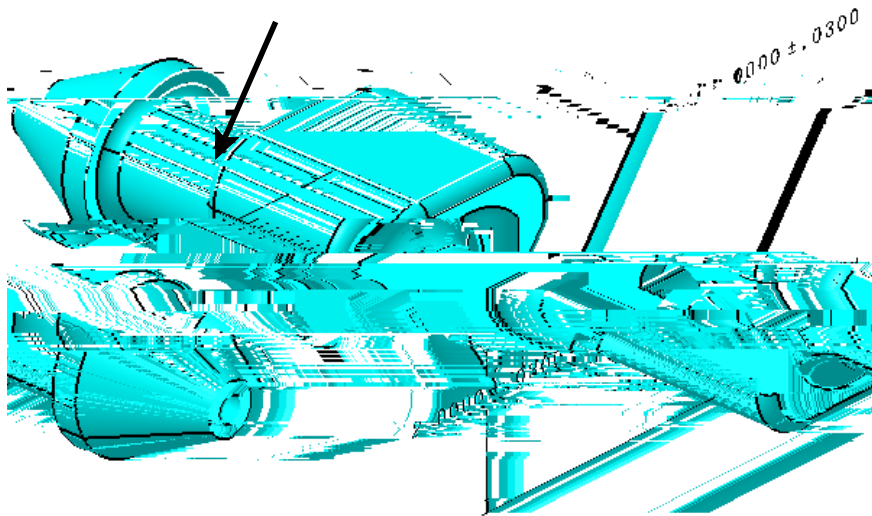
Save and close the document.

0DQXDOO\

1RZ \RX ZLOO PDQXDPOUHRPHWULWKE WROHUDQFHV

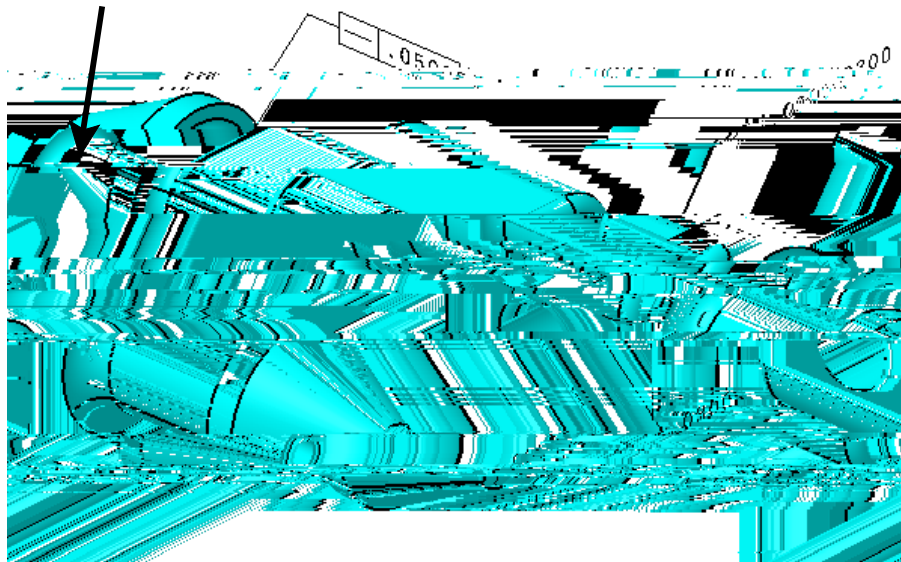
Open the original 6WUDLJKWUWHV again, then select the *HRPHWULFDO 7R0HUHQF 1RWKLQJ ZLOO KDSBHQXQWLQDFWHG

Select the cylindrical surface shown below. 7Geometrical ToleranceZLQGRZ DSSHUV



Change the specification to 6WUDLJKWUWHV 0.05 for the Tolerance and click OK. 7KLV WROHUDQF FWHKHFQZHWKHUHQF RQJ \$GYLVRU

Select the *HRPHWULFDO 7R0HUHQF conical surface shown below. 7Geometrical ToleranceZLQGRZ DSSHUV

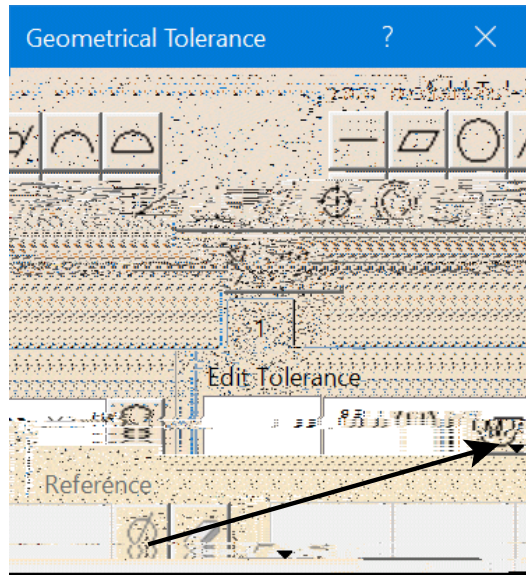


Change the symbol to \ominus with a value of 0.03 and select OK. The tolerance appears.

Select the *HRPHWULFDO icon, then select the 1.0000 dimension. Geometrical Tolerance ZLQGRZ DSSHDUV

Change the symbol to \ominus with a value of 0.05 and select OK. The tolerance appears.

Select before the value in the Edit Tolerance field, then select the symbol drop down as shown below. \$ PHQX ZLWK YDULRXV V\PEROV DSSHDUV



Select the \ominus symbol. 7KH GLDPHWUWHUWVHGOEHVRUH WKH

Change the value to 0.05, then select the symbol drop down again and choose the \ominus symbol. 0D[LPXP 0DWHULD Symbol (M) LWZRQ V\PEROVHIGV D\WHU WKH YD

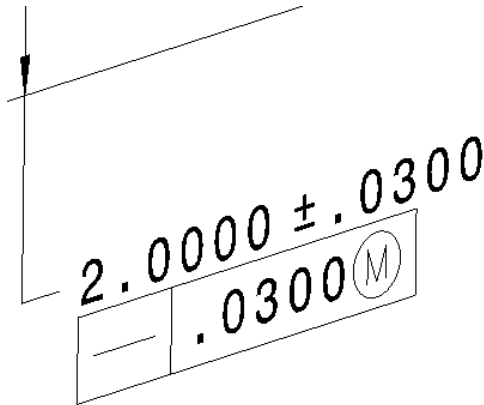
Select OK. 7KH WROHUDQFKHDVSDHJFOEFDWLSMQLSRFDQWL RQ W 7KH *HRPHWDQFDIORSPVLRUUGHQWOQDVOFVZUDQJWQHVV WR EHG HILQHG LSWDDQQRXVWH SRVLWLRQHG

Select the *HRPHWULFDO icon, then select the 2.0000 dimension. Geometrical Tolerance ZLQGRZ DSSHDUV

Change the symbol to 6 W U D L J K W H A with a value of 0.03. —

Add the 0 D [L P X P 0 D W H U L D Q symbol after the value in the *Tolerance* field and select *OK*. (M) 7 K H W R O H U D Q F H D S S H D U V


Change the leader of the 2.000 dimension to 7 Z R 3 D then position the tolerance beneath it as shown here. ↙




7 K H U H D U H D F R X Q Q W H R I K W I K H Q J W H D V D K R Q H U D Q F H Z D V X Q D E
G H I L Q H G D Q G V W H Q W J H K W Q E D Q H R Q W R Q H R U D Q F H X G L U U H F W L R

Close the document.

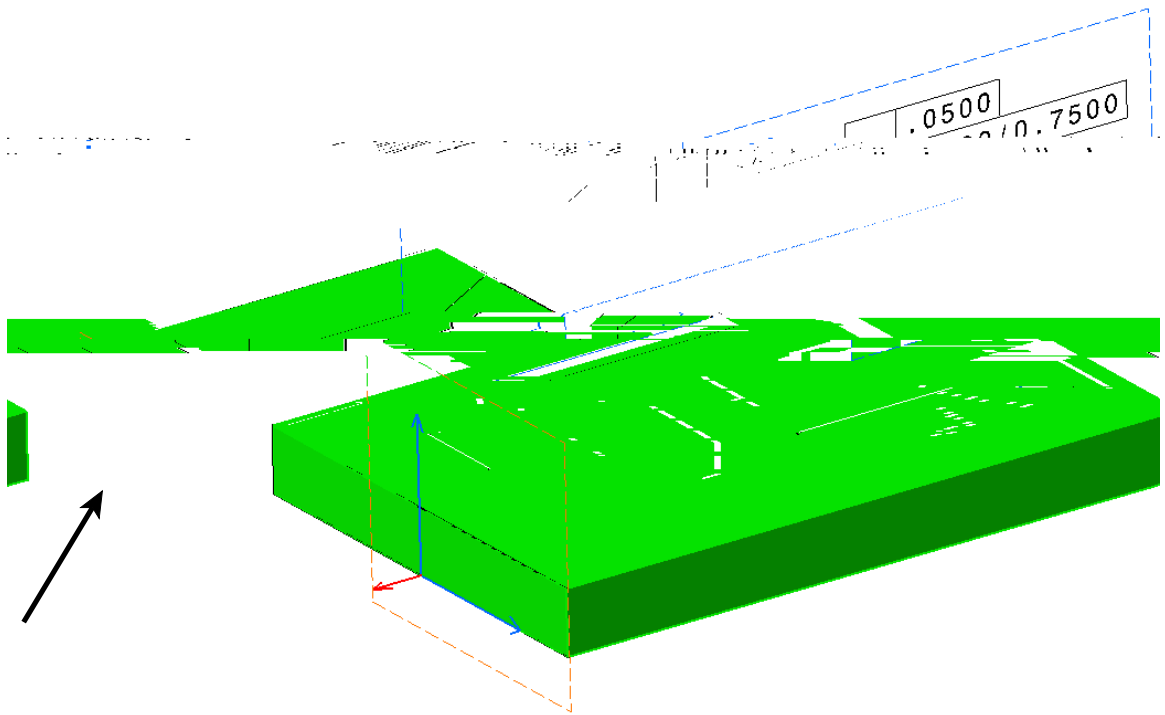
Open the 6WUDLJKWQHVV document. W<% Ø VZLVOO PDQXDOO\ FUHDW
WROHUDQFHV WKDW ZHUH FUHDWHG HDUOLHU

Select the *HRPHWULFDO icon, then select the top face of the part.  7KH
Geometrical Tolerance ZLQGRZ DSSHUV

Change the symbol to 6WUDLJKWQHVV with a value of 0.05 and select OK.  7KH
WROHUDQFH DSSHUV

7R GHILQH WKH FRVWV WKHUH WR\O HDU G DFKLWHHQ W &\$LH\$ Z\VOUH QR V
DXWRPDWLFDOO\ KDNH WKH G HZRYLH ZDOHQ\ PDQ

Select the 9LHZ icon, then create a front view on the face that is
shown below.  7KH YLHZ LV FUHDWHG



&LUFXODULW\

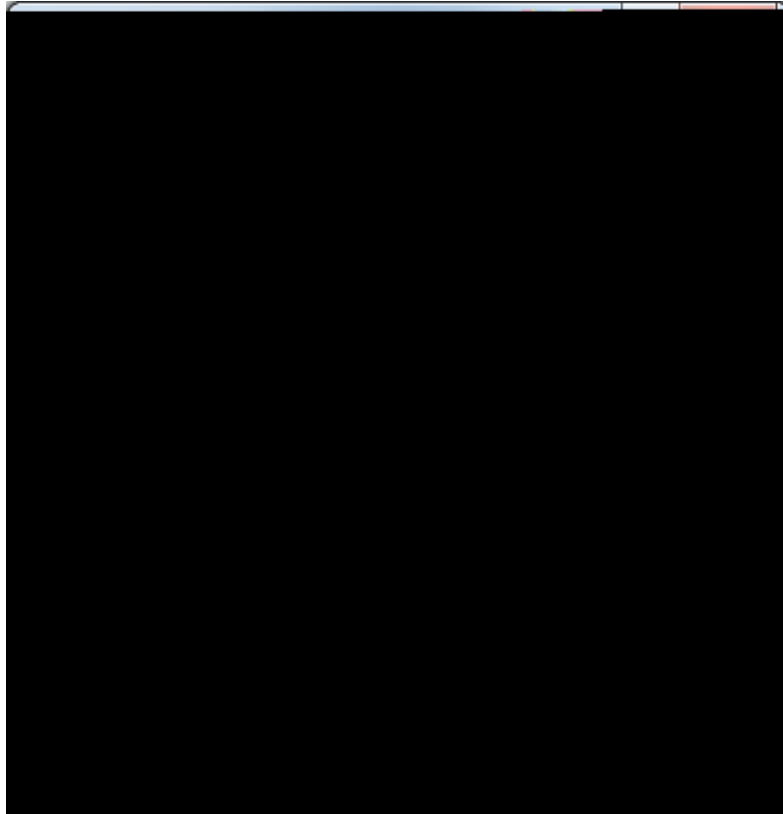
&LUFXODULW\ WOR RIZ DJRFXQVG FDR Q XWURDFUH VPRX VPM HEVH W@ HR G H
UHTXLUHPHQWV

,I DSSOLHG WR D Q XDUV SFSRBY WNOQW DFKH WKDW DUH LQWH
SODQH QRUPDO W@ UW @ FHD PLXW R I RYCKHW D ZLFM KJLRQ M K/S HF LIL
FRQFHQWULF FSD EODWH @ HEDW @ HU WROX H

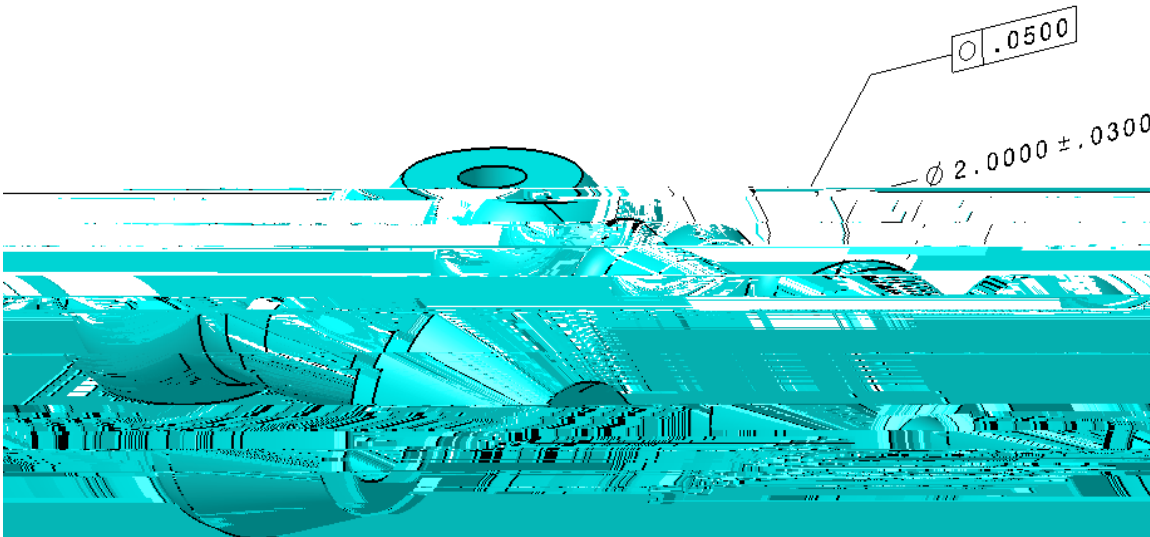
,I DSSOLHG W@ S R/LSQW VDF IHWKH D W@ W H G @ W @ Q \ SODQH S
WKURXJK WKH FHSKWHUH SPRLQW HR LQW@ Z QW@K L @ QW@K VSW RLIL
FRQFHQWULF FSD EODWH @ HEDW @ HU WROX H

Open the &LUFXODULW\

Select the & LUFXODULW\ 65 FLI7CE0W\lca SpecificationZ L Q G R Z
DSSHUV

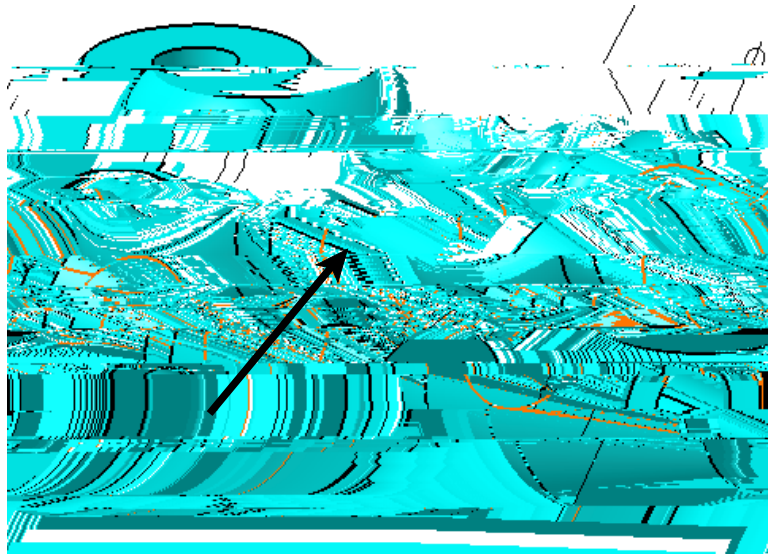



Change the *Numerical* value to 0.05 and select *OK*, then select *Close*. 7 KH WROHUDQFH
DSSHUV 3RVLWLRQ LW DV VKRZQ EHORZ



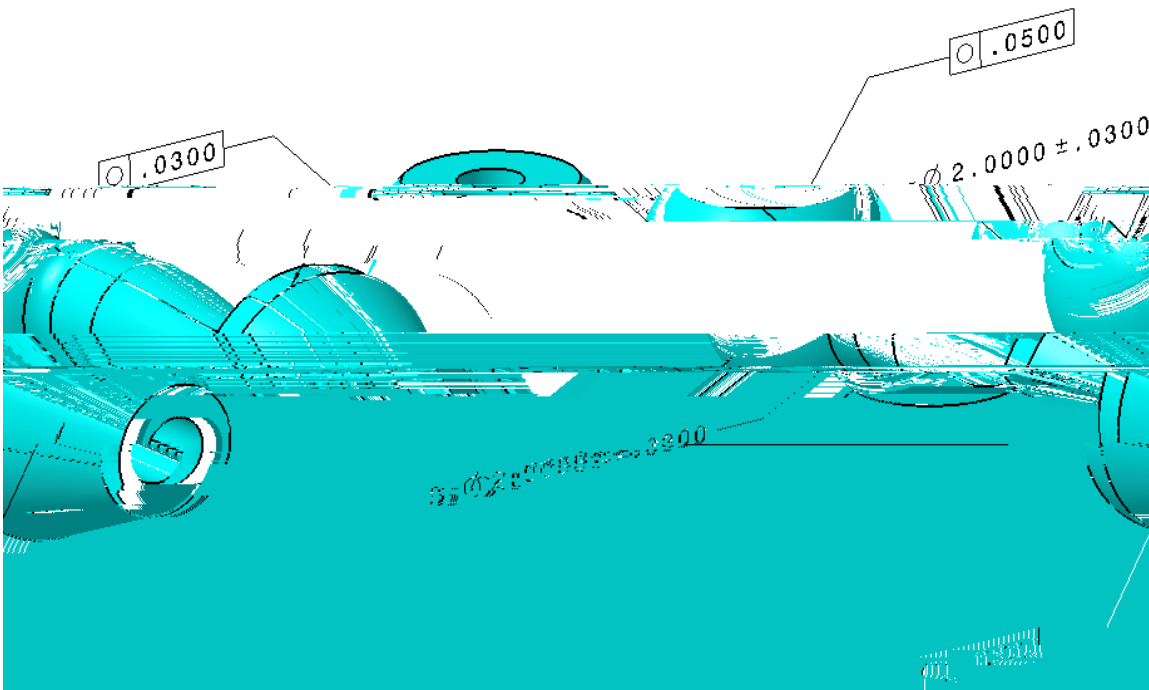
& OLFNLQJ DQG G0D RJZ GL BRQRW & HDW0 W/KW ZILQO RH Q/DK10 10 L W
LQ D FLUF X0B X QO WLKPL 0 X UI D/RHWK HR0LQW D DLS 0 W Q H V V

Select the surface shown below. 7KH FLUFXODVLQRWRŠVŠRDRUGRHKLV LV D
OLPLWDWLRQ RI WKH 7RKHUFDQF FONDSDWLEVRFOHHUDDHG ZLWK
*HRPHWULF 7ROH ZDQ ĐHE HFRQVLEW HWDQWL



Select the spherical surface instead, then select the Geometrical Specification tool.  7RKHUFDQF FONDSDWLEVRFOHHUDDHG ZLWK
RQ WKH VSKHUH

Change the Numerical value to 0.03 and select OK, then select Close. 3RVLWLRQ WKH
WROHUDQFHV DV VKRZQ



Save and close the document.

0 D Q X D O O \

1 R Z \ R X Z L O O F U H P D H W H U W F K D O V D R B H U H D R Q F H V P D Q X D O O \

Open the & L U F X O symbol, then select the * H R P H W U L F D O icon (U D Q F H (Q V X U H \ R X R S H Q X P K I Q W U Q J L V Q D O K B R R Q K L Q R X Z L D O H K G D S S H Q D Q H O H P H Q W L V V H O H F W H G

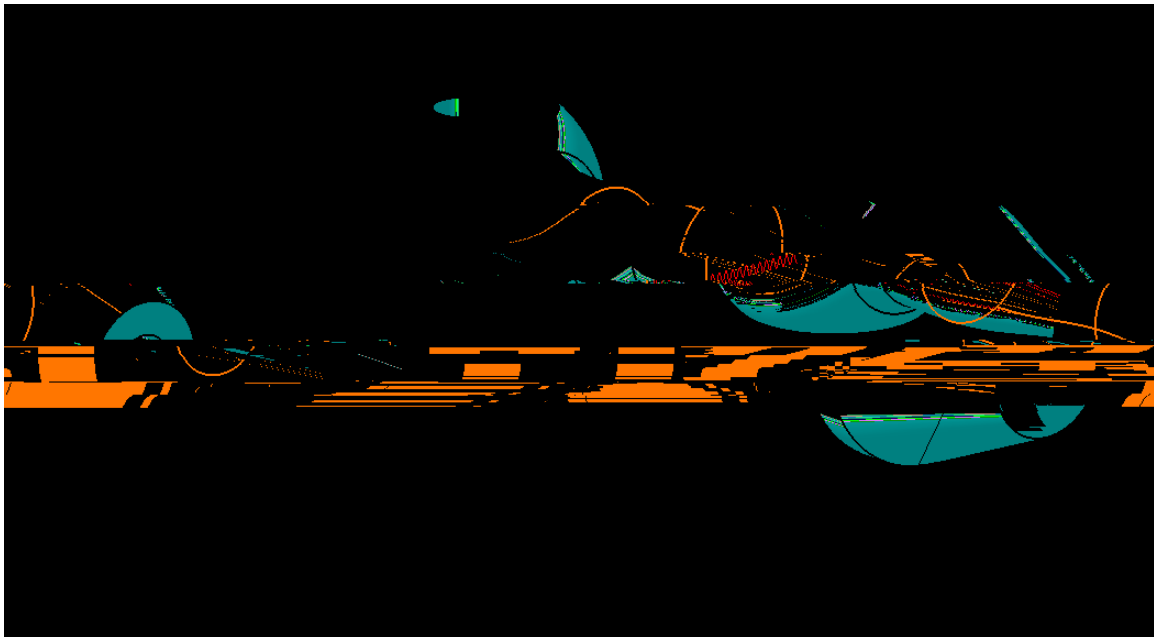
Select the cylindrical surface, then change the symbol to & L U F X O symbol

Enter 0.05 in the Tolerance field and select OK. 7 K H W R O H U D Q W H L D S S H D U W L F D W K H R Q H F U H D R V C H U D Q W K Q W K S G Y L V R U

Select the * H R P H W U L F D O icon again, then select the conical surface. Geometrical Tolerance Z L Q G R Z D S S H D U V

Change the symbol to & L U F X O symbol with a value of 0.03 and select OK. 7 K H W R O H U D Q F H D S S H D U V

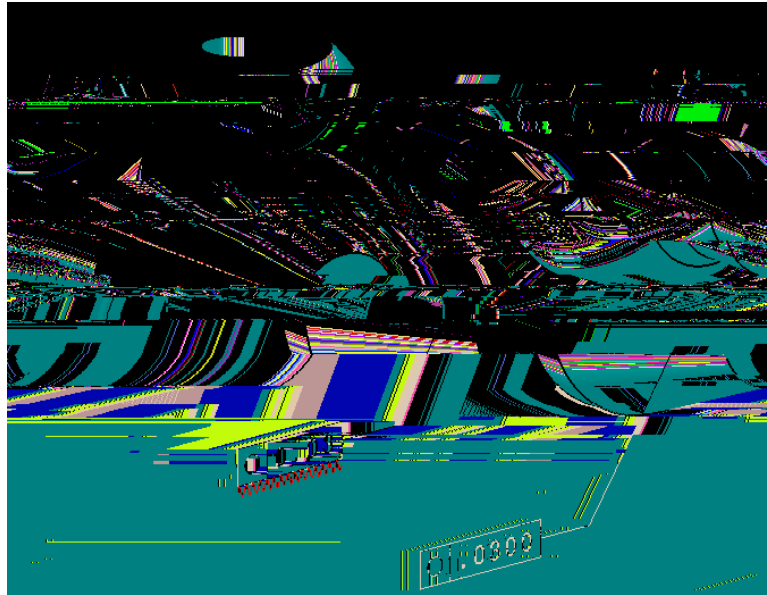
Select the * H R P H W U L F D O icon, then select the surface shown below. Geometrical Tolerance Z L Q G R Z D S S H D U V



Change the symbol to  with a value of 0.03 and select *OK*.

7 KH

WROHUDQFHHLGQRQVLIWPCQMDLVWHEWZDMVFWHDM, W DSSHUV
 WKH UHG VTXLJWV\ DQGHZIEUQIEUWIRPHWULFDO WROHUDQFH
 VSHFLILFDWLRQ WUHH



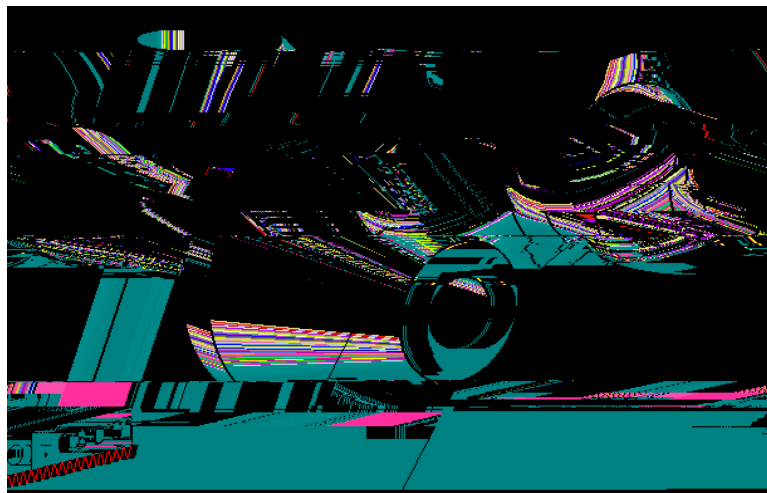
7 KH YDOXH G IRG QRWD D G LMX V MR WLG/ KDRYH VHPFDDQW HFLW< R X F D
 IRUFH LW WR UH D G L Q R U W K I F W Q D F E W F R O V H \ R X Z D Q W


Double-select on the new geometrical tolerance. 7 KH Geometrical Tolerance Z L Q G R Z
 DSSHUV

Geometrical Tolerance Z L Q G R Z

Change the value to .0300 and select *OK*.

1 RZ WKH YDOXH UH D G V SURSHUO\



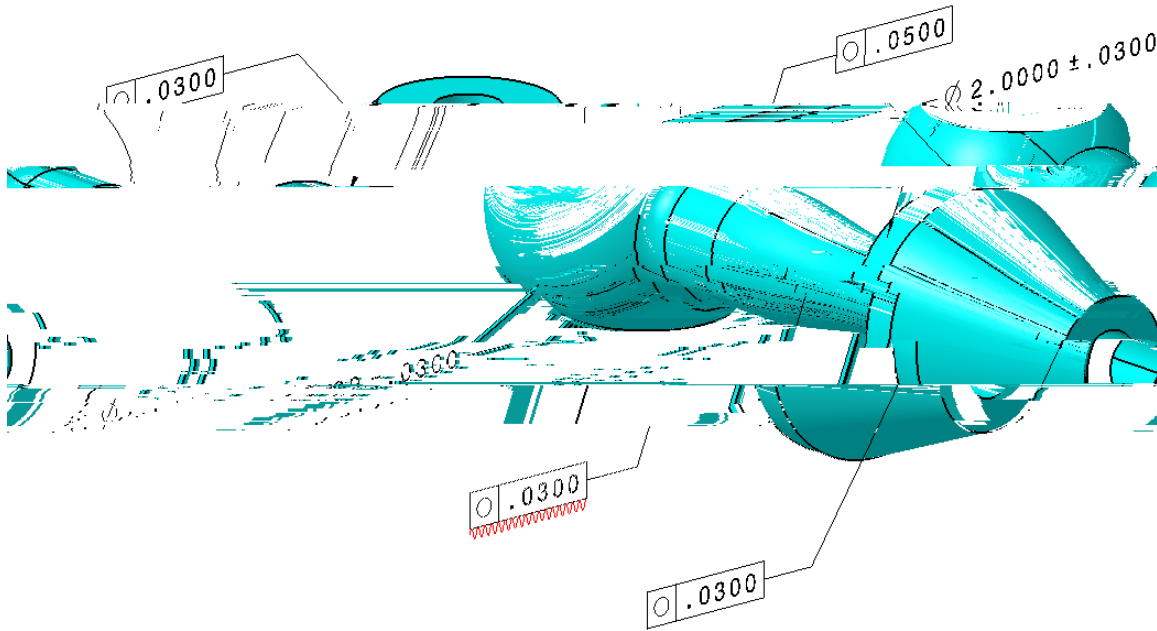
Select the  icon, then select the spherical surface. Geometrical Tolerance Z L Q G R Z DSSHUV

7 KH

Change the symbol to LUF X with a value of 0.03 and select *OK*.



3 RVLWLRQ W
WROHUDQFHV DV VKRZQ EHORZ



Close the document.