Table 89 Optimum design of the **unstiffened imperfect equivalent ellipsoidal shell with the thick apex (Shell Segment 1) of uniform thickness 0.47183 inch.** The optimum design and margins were obtained in the presence of axisymmetric buckling modal imperfections with amplitude, **Wimp = plus and minus 0.1 inch.** Optimization was with the use of plus and minus axisymmetric modes 1 and 2 and one execution of SUPEROPT. **During optimization the lower bound of the uniform thickness of Shell Segment 1 was 0.4 inch.** Critical margins are in bold face. This table represents an abridged and edited version of the GENOPT output file, "eqellipse.OPM", in which "eqellipse" is the user-selected name of the specific case. **Note that there is no longer a local thickened band, THKSKN(3), a characteristic present in the case of the optimum design for the unstiffened imperfect shell listed in Table 33, which was found to be under-designed. This shell is not under-designed.**

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  STRUCTURAL ANALYSIS WITH UNPERTURBED DECISION VARIABLES
 VAR.  CURRENT          DEFINITION
  NO.   VALUE
   1  4.7183E-01  skin thickness at xinput: THKSKN(1 )
   2  4.7183E-01  skin thickness at xinput: THKSKN(2 )
   3  3.5443E-01  skin thickness at xinput: THKSKN(3 ) ←no thick band
   4  3.4638E-01  skin thickness at xinput: THKSKN(4 )
   5  3.3343E-01  skin thickness at xinput: THKSKN(5 )
   6  2.9722E-01  skin thickness at xinput: THKSKN(6 )
   7  2.6247E-01  skin thickness at xinput: THKSKN(7 )
   8  2.5712E-01  skin thickness at xinput: THKSKN(8 )
   9  2.3469E-01  skin thickness at xinput: THKSKN(9 )
  10  2.1146E-01  skin thickness at xinput: THKSKN(10)
  11  2.1325E-01  skin thickness at xinput: THKSKN(11)
  12  1.4812E-01  skin thickness at xinput: THKSKN(12)
  13  2.3452E-01  skin thickness at xinput: THKSKN(13)

  14  1.0000E-06  height of isogrid members at xinput: HIGHST(1 )
  15  1.0000E-06  height of isogrid members at xinput: HIGHST(2 )
  16  1.0000E-06  height of isogrid members at xinput: HIGHST(3 )
  17  1.0000E-06  height of isogrid members at xinput: HIGHST(4 )
  18  1.0000E-06  height of isogrid members at xinput: HIGHST(5 )
  19  1.0000E-06  height of isogrid members at xinput: HIGHST(6 )
  20  1.0000E-06  height of isogrid members at xinput: HIGHST(7 )
  21  1.0000E-06  height of isogrid members at xinput: HIGHST(8 )
  22  1.0000E-06  height of isogrid members at xinput: HIGHST(9 )
  23  1.0000E-06  height of isogrid members at xinput: HIGHST(10)
  24  1.0000E-06  height of isogrid members at xinput: HIGHST(11)
  25  1.0000E-06  height of isogrid members at xinput: HIGHST(12)
  26  1.0000E-06  height of isogrid members at xinput: HIGHST(13)

  27  3.0000E+00  spacing of the isogrid members: SPACNG
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 28  1.0000E-05  thickness of an isogrid stiffening member: THSTIF

******************* DESIGN OBJECTIVE ******************
   CURRENT VALUE OF THE OBJECTIVE FUNCTION:
VAR.   CURRENT
NO.     VALUE            DEFINITION
 1    1.105E+02  weight of the equivalent ellipsoidal head: WEIGHT

***** RESULTS FOR LOAD SET NO.  1  (+mode 1 and +mode 2) ******
MARGIN CURRENT
NO.     VALUE            DEFINITION
 1    1.200E-02 (CLAPS1( 1)/CLAPS1A(1 )) / CLAPS1F(1 )-1; F.S.= 1.00
 2    7.155E-02 (GENBK1( 1)/GENBK1A(1 )) / GENBK1F(1 )-1; F.S.= 1.00
 3    5.177E+01 (SKNBK1(1,1)/SKNBK1A(1,1))/SKNBK1F(1,1)-1; F.S.=1.00
 4    1.196E+01 (SKNBK1(1,2)/SKNBK1A(1,2))/SKNBK1F(1,2)-1; F.S.=1.00
 5    2.369E+04 (STFBK1(1,1)/STFBK1A(1,1))/STFBK1F(1,1)-1; F.S.=1.00
 6    1.232E+04 (STFBK1(1,2)/STFBK1A(1,2))/STFBK1F(1,2)-1; F.S.=1.00
 7    4.728E-01 (SKNST1A(1,1)/SKNST1(1,1))/SKNST1F(1,1)-1; F.S.=1.00
 8   -4.803E-02 (SKNST1A(1,2)/SKNST1(1,2))/SKNST1F(1,2)-1; F.S.=1.00
 9    1.231E+00 (STFST1A(1,1)/STFST1(1,1))/STFST1F(1,1)-1; F.S.=1.00
10    1.602E-01 (STFST1A(1,2)/STFST1(1,2))/STFST1F(1,2)-1; F.S.=1.00

11    1.863E+00 (WAPEX1A(1 )/WAPEX1(1 )) / WAPEX1F(1 )-1; F.S.= 1.00
12    1.367E-02 (CLAPS2( 1)/CLAPS2A(1 )) / CLAPS2F(1 )-1; F.S.= 1.00
13   -4.165E-02 (GENBK2( 1)/GENBK2A(1 )) / GENBK2F(1 )-1; F.S.= 1.00
14    3.937E+01 (SKNBK2(1,1)/SKNBK2A(1,1))/SKNBK2F(1,1)-1; F.S.=1.00
15    1.178E+01 (SKNBK2(1,2)/SKNBK2A(1,2))/SKNBK2F(1,2)-1; F.S.=1.00
16    2.578E+04 (STFBK2(1,1)/STFBK2A(1,1))/STFBK2F(1,1)-1; F.S.=1.00
17    1.060E+04 (STFBK2(1,2)/STFBK2A(1,2))/STFBK2F(1,2)-1; F.S.=1.00
18    1.483E-01 (SKNST2A(1,1)/SKNST2(1,1))/SKNST2F(1,1)-1; F.S.=1.00
19   -4.159E-02 (SKNST2A(1,2)/SKNST2(1,2))/SKNST2F(1,2)-1; F.S.=1.00
20    1.356E+00 (STFST2A(1,1)/STFST2(1,1))/STFST2F(1,1)-1; F.S.=1.00
21   -2.192E-03 (STFST2A(1,2)/STFST2(1,2))/STFST2F(1,2)-1; F.S.=1.00
22    1.321E+00 (WAPEX2A(1 )/WAPEX2(1 )) / WAPEX2F(1 )-1; F.S.= 1.00


***** RESULTS FOR LOAD SET NO.  2  (-mode 1 and -mode 2) ******
MARGINS CORRESPONDING TO CURRENT DESIGN (F.S.= FACTOR OF SAFETY)
MARGIN CURRENT
NO.     VALUE            DEFINITION
 1   -1.727E-02 (CLAPS1(2 )/CLAPS1A(2 )) / CLAPS1F(2 )-1; F.S.= 1.00
 2   -8.594E-03 (GENBK1(2 )/GENBK1A(2 )) / GENBK1F(2 )-1; F.S.= 1.00
 3    4.772E+01 (SKNBK1(2,1)/SKNBK1A(2,1))/SKNBK1F(2,1)-1; F.S.=1.00
 4    1.182E+01 (SKNBK1(2,2)/SKNBK1A(2,2))/SKNBK1F(2,2)-1; F.S.=1.00
 5    1.806E+04 (STFBK1(2,1)/STFBK1A(2,1))/STFBK1F(2,1)-1; F.S.=1.00
 6    1.112E+04 (STFBK1(2,2)/STFBK1A(2,2))/STFBK1F(2,2)-1; F.S.=1.00
 7    6.212E-01 (SKNST1A(2,1)/SKNST1(2,1))/SKNST1F(2,1)-1; F.S.=1.00
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8	**-3.045E-02**	**(SKNST1A(2,2)/SKNST1(2,2))/SKNST1F(2,2)-1; F.S.=1.00**
9	7.006E-01	(STFST1A(2,1)/STFST1(2,1))/STFST1F(2,1)-1; F.S.=1.00
10	**4.729E-02**	**(STFST1A(2,2)/STFST1(2,2))/STFST1F(2,2)-1; F.S.=1.00**
11	1.017E+00	(WAPEX1A(2)/WAPEX1(2)) / WAPEX1F(2)-1; F.S.= 1.00
12	**-3.065E-02**	**(CLAPS2(2)/CLAPS2A(2)) / CLAPS2F(2)-1; F.S.= 1.00**
13	**1.441E-01**	**(GENBK2(2)/GENBK2A(2)) / GENBK2F(2)-1; F.S.= 1.00**
14	5.792E+01	(SKNBK2(2,1)/SKNBK2A(2,1))/SKNBK2F(2,1)-1; F.S.=1.00
15	1.200E+01	(SKNBK2(2,2)/SKNBK2A(2,2))/SKNBK2F(2,2)-1; F.S.=1.00
16	1.378E+04	(STFBK2(2,1)/STFBK2A(2,1))/STFBK2F(2,1)-1; F.S.=1.00
17	1.212E+04	(STFBK2(2,2)/STFBK2A(2,2))/STFBK2F(2,2)-1; F.S.=1.00
18	3.137E-01	(SKNST2A(2,1)/SKNST2(2,1))/SKNST2F(2,1)-1; F.S.=1.00
19	**-2.544E-02**	**(SKNST2A(2,2)/SKNST2(2,2))/SKNST2F(2,2)-1; F.S.=1.00**
20	2.971E-01	(STFST2A(2,1)/STFST2(2,1))/STFST2F(2,1)-1; F.S.=1.00
21	**1.409E-01**	**(STFST2A(2,2)/STFST2(2,2))/STFST2F(2,2)-1; F.S.=1.00**
22	1.414E+00	(WAPEX2A(2)/WAPEX2(2)) / WAPEX2F(2)-1; F.S.= 1.00

NOTE: The design margins listed above are divided into two groups of 11 margins each: Margins 1 – 11 and Margins 12 – 22. The first group of 11 margins are obtained with use of the axisymmetric mode 1 imperfection, and the second group of 11 margins are obtained with use of the axisymmetric mode 2 imperfection.