

c

c Piston and Rod

c

c Control the density of the mesh

parameter m 2 n 1 t 1 u 1; c coarse mesh

c parameter m 3 n 2 t 2 u 1; c medium mesh

c parameter m 5 n 4 t 3 u 2; c fine mesh

c Surface definitions

sd 1 cy 0 0 0 1 0 0 20

sd 2 cy 0 0 0 1 0 0 18

sd 3 cy 21 0 0 0 0 1 8

sd 4 cy 2 0 0 0 1 1 9

sd 5 cy 2 0 0 0 -1 1 9

sd 6 cy 21 0 0 0 0 1 2.5

sd 7 cy 0 0 0 1 0 0 16

sd 8 cy 0 0 115 0 1 0 17

sd 9 cy 0 0 5 0 1 0 8

sd 10 cy -5 0 36 0 1 0 20

sd 11 cy 20 0 16 0 1 0 14

sd 12 cy -8 0 90 0 1 0 19

sd 13 cy 21 0 0 0 0 1 3

sd 14 cy 0 0 0 1 0 0 14

sd 15 cy 0 0 0 1 0 0 16

sd 16 cy 21 0 0 0 0 1 2.45

sd 17 cy 0 0 5 0 1 0 5

sd 18 cy 0 0 115 0 1 0 15

sd 19 plan 0 0 122 0 0 1

sd 20 plan 0 0 122 0 0 1

sd 21 plan 5 0 0 1 0 0

sd 22 plan 0 0 122 0 0 1

sd 23 cy 19 0 0 0 0 1 8

sd 24 plan 0 0 0 1 0 0

c Global transformation of rod to fit the piston

lev 1 levct 1 csca .5 ry -90 rx 90 mx 23.5; ;

c PART 1- Top ring

cylinder 1 [1+%u];1 [1+%u*90];1 [1+%u];

lct 1 ry 90;lrep 1;

endpart

c PART 2 - Second ring

```
cylinder 1 [1+%u];1 [1+%u*90];1 [1+%u];
lct 1 ry 90;lrep 1;
endpart
```

c PART 3 - Oil scraping ring made of shell elements

```
cylinder
```

```
-1      [-(1+%u  )];
-1      [-(1+%u  )] [-(1+%u*2 )] [-(1+%u*3 )] [-(1+%u*4 )]
[-(1+%u*5 )] [-(1+%u*6 )] [-(1+%u*7 )] [-(1+%u*8 )] [-(1+%u*9 )]
[-(1+%u*10)] [-(1+%u*11)] [-(1+%u*12)] [-(1+%u*13)] [-(1+%u*14)]
[-(1+%u*15)] [-(1+%u*16)] [-(1+%u*17)] [-(1+%u*18)] [-(1+%u*19)]
[-(1+%u*20)] [-(1+%u*21)] [-(1+%u*22)] [-(1+%u*23)] [-(1+%u*24)]
[-(1+%u*25)] [-(1+%u*26)] [-(1+%u*27)] [-(1+%u*28)] [-(1+%u*29)]
[-(1+%u*30)] [-(1+%u*31)] [-(1+%u*32)] [-(1+%u*33)] [-(1+%u*34)]
[-(1+%u*35)] [-(1+%u*36)] [-(1+%u*37)] [-(1+%u*38)] [-(1+%u*39)]
[-(1+%u*40)] [-(1+%u*41)] [-(1+%u*42)] [-(1+%u*43)] [-(1+%u*44)]
[-(1+%u*45)] [-(1+%u*46)] [-(1+%u*47)] [-(1+%u*48)] [-(1+%u*49)]
[-(1+%u*50)] [-(1+%u*51)] [-(1+%u*52)] [-(1+%u*53)] [-(1+%u*54)]
[-(1+%u*55)] [-(1+%u*56)] [-(1+%u*57)] [-(1+%u*58)] [-(1+%u*59)]
[-(1+%u*60)] [-(1+%u*61)] [-(1+%u*62)] [-(1+%u*63)] [-(1+%u*64)]
[-(1+%u*65)] [-(1+%u*66)] [-(1+%u*67)] [-(1+%u*68)] [-(1+%u*69)]
[-(1+%u*70)] [-(1+%u*71)] [-(1+%u*72)] [-(1+%u*73)] [-(1+%u*74)]
[-(1+%u*75)] [-(1+%u*76)] [-(1+%u*77)] [-(1+%u*78)] [-(1+%u*79)]
[-(1+%u*80)] [-(1+%u*81)] [-(1+%u*82)] [-(1+%u*83)] [-(1+%u*84)]
[-(1+%u*85)] [-(1+%u*86)] [-(1+%u*87)] [-(1+%u*88)] [-(1+%u*89)]
[-(1+%u*90)];
```

```
1      [1 +%u  ];
```

```
18.1 20.4
```

```
1  4  8 12 16 20 24 28 32 36 40 44 48 52 56
60 64 68 72 76 80 84 88 92 96 100 104 108 112 116
120 124 128 132 136 140 144 148 152 156 160 164 168 172 176
180 184 188 192 196 200 204 208 212 216 220 224 228 232 236
240 244 248 252 256 260 264 268 272 276 280 284 288 292 296
300 304 308 312 316 320 324 328 332 336 340 344 348 352 356
359
```

```
32.1 32.9
```

```
lct 1 ry 90;lrep 1;
```

```
endpart
```

c Begin the global transformation of the rod

c to the piston coordinate system

```
pslv 1
```

c PART 4 - Wrist pin bearing and clamp on the rod

```

block 1 [1+%n] [1+3*%n] [1+5*%n];
      1 [1+%n] [1+2*%n] [1+4*%n] [1+5*%n] [1+6*%n];
      1 [1+%n] [1+5*%n] [1+6*%n] [1+8*%n];
7.466 7.466 .286 0 -12 -8 -4 4 8 12 13 12 -2 -3 -5
dei 1 2;;1 2 0 3 5;
de 2 0 2 4 0 3
de 3 0 3 4 0 5
pb 3 0 3 3 0 5 x 0
pb 2 0 1 2 0 1 z 12
pb 2 0 4 2 0 4 z -2
mb 2 0 5 2 0 5 x -2
sfi -1 4;;-1 -4;sd 9
sfi -2 4;;-2 -3;sd 17
res 2 1 1 4 6 2 i 1
lct 1 rt 0 0 0 rt -1 0 0 rt 0 -1 0 ;lrep 0 1;
endpart

```

c PART 5 - Main bearing and clamp on rod

```

block 1 [1+%n] [1+3*%n] [1+5*%n];
      1 [1+%n] [1+2*%n] [1+4*%n] [1+5*%n] [1+6*%n];
      1 [1+%n] [1+2*%n] [1+5*%n] [1+6*%n] [1+8*%n];
17 15 10 0 -12 -8 -4 4 8 12 100 103.5 107 119.5 122 135
dei 1 2;;1 2 0 4 6;
de 2 0 2 4 0 4
dei 2 4;1 2 0 5 6;5 6;
pb 1 0 2 1 0 2 xz 15 100
pb 1 0 4 1 0 4 z 122
mb 1 1 1 2 6 2 xz 2 2
pb 2 0 5 2 0 5 x 17
pb 3 0 4 3 0 5 xz 7 126
mb 2 0 6 2 0 6 x -2
mb 2 1 4 2 6 4 xz -1 2
mb 2 1 2 2 6 2 xz -1 -2
sfi -1 4;;-1 -5;sd 8
sfi -2 4;;-2 -4;sd 18
sf 1 0 4 1 0 4 sd 19
sf 2 0 5 2 0 5 sd 20
sfi -3; ; -1;sd 12
res 2 2 5 4 5 6 i 1
res 2 1 2 2 6 4 k 1
lct 1 rt 0 0 0 rt -1 0 0 rt 0 -1 0 ;lrep 0 1;
endpart

```

c PART 6 - Rod

```

block 1 [1+2*%n] [1+4*%n] [1+5*%n] [1+6*%n] [1+7*%n] [1+8*%n];
  1 [1+*%n] [1+3*%n] [1+4*%n];
  1 [1+3*%n] [1+5*%n] [1+16*%n] [1+17*%n];
  0 10 15 17 19 23 25 -8 -4 4 8 122 100 90 18 13
de 1 0 1 4 0 2
de 3 0 3 7 0 5
de 5 2 1 6 3 3
dei 1 2;1 2;2 4;
dei 1 2;3 4;2 4;
mb 4 0 2 7 0 3 3 7
pb 2 0 5 2 0 5 xz .286 12.999
pb 2 1 2 2 4 2 xz 8.14446 100
pb 3 0 5 3 0 5 xz 7.466 12
res 4 4 1 7 4 3 i 1
res 4 1 1 7 1 3 i 1
res 1 1 5 3 4 5 i 1
res 2 1 2 4 4 2 i 1
res 7 1 1 7 4 3 j 1
sfi -5 -6;-2 -3;1 3;sd 13
sf 4 0 1 4 0 2 sd 8
sf 1 0 2 4 0 2 sd 8
sf 3 0 4 3 0 4 sd 11
sf 0 0 5 0 0 5 sd 9
sf 2 0 2 2 0 3 sd 12
sf 0 0 1 0 0 1 sd 22
sfi 5 -7;-1 -4;1 3;sd 23
sfi -2; ; -4;sd 21
sfi 1 2;1 4;-4;sd 10
sfi -1; ; ;sd 24
lct 1 rt 0 0 0 rt -1 0 0 rt 0 -1 0 ;lrep 0 1;
endpart

```

c End the global transformation of the rod
c to the piston coordinate system
pplv

c PART 7 - Piston

```

block
1 [1+*%m] [1+2*%m] [1+5*%m] [1+6*%m] [1+6*%m+%n]
  [1+6*%m+2*%n] [1+6*%m+3*%n] [1+6*%m+4*%n]
  [1+6*%m+5*%n] [1+6*%m+6*%n] [1+7.5*%m+6*%n];
1 [1+*%t] [1+2*%t] [1+3*%t+%m] [1+3*%t+4*%m]
  [1+4*%t+5*%m] [1+5*%t+5*%m] [1+6*%t+5*%m];
1 [1+*%t] [1+2*%t] [1+3*%t+%m] [1+3*%t+4*%m]

```

```

[1+4*%t+5*%m] [1+5*%t+5*%m] [1+6*%t+5*%m];
2 11 15 27 31 32 33 34 35 36 37 43
-20 -20 -20 -6.5 6.5 20 20 20
-20 -20 -20 -6.5 6.5 20 20 20
de 1 2 0 2 7 0
de 5 2 0 6 3 0
de 5 6 0 6 7 0
de 5 3 3 10 6 6
de 3 4 0 4 5 0
de 1 2 2 5 7 7
dei ;1 3 0 6 8;1 3 0 6 8;
dei 5 7 0 8 9 0 10 11;;1 2 0 7 8;
dei 1 2;;1 4 0 5 8;
dei 5 7 0 8 9 0 10 11;1 2 0 7 8;;
pb 3 4 0 3 4 0 x 13
pb 3 5 0 3 5 0 x 13
pb 4 4 0 4 4 0 x 29
pb 4 5 0 4 5 0 x 29
pb 3 4 0 4 4 0 2 -8
pb 3 5 0 4 5 0 2 8
mb 12 3 3 12 6 6 1 2
sfi ;-3 -6;-3 -6;sd 14
sfi -12;-2 0 -7;2 7;sd 15
sfi -12;2 7;-2 0 -7;sd 15
sfi -3 -4;-4 -5;;sd 3
sfi 1 12;-1 -8;-1 -8;sd 1
sfi 1 11;-2 -7;-2 -7;sd 2
sfi 1 -2;7 8;-5 6;sd 4
sfi 1 -2;-5 6;7 8;sd 4
sfi 1 -2;7 8;3 -4;sd 5
sfi 1 -2;3 -4;7 8;sd 5
sfi 1 -2;1 2;-5 6;sd 5
sfi 1 -2;-5 6;1 2;sd 5
sfi 1 -2;1 2;3 -4;sd 4
sfi 1 -2;3 -4;1 2;sd 4
relaxi 1 5;-1 -2 -7 -8;-1 -2 -7 -8;10 0.001 1
endpart

```

c PART 8 - Wrist pin bearing in piston

block

```

1 [1+2*%m] [1+5*%m] [1+7*%m];
1 [1+2*%m] [1+5*%m] [1+7*%m];
1 [1+%t] [1+2*%t] 0 [1+4*%t] [1+5*%t] [1+6*%t];
13 13 29 29

```

```
-8 -8 8 8  
-20 -20 -14 0 14 20 20  
de 2 2 0 3 3 0  
dei 1 2 0 3 4;1 2 0 3 4;;  
sfi -2 -3;-2 -3;;sd 6  
sfi -1 -4 ; -1 -4 ; ; sd 3  
sfi ;;-1 -7;sd 1  
sfi ;;-2 -6;sd 2  
endpart
```

```
c PART 9 - Wrist pin  
block 1 [1+3*%m];1 [1+3*%m];1 [1+7*%m];  
20 22 -1 1 -19 19  
sfi -1 -2;-1 -2;;sd 16  
endpart
```

```
merge
```