The program *Steel Spur Gears* is necessary to solve the asterisked problems - in these the profile shifts are not mid-range and therefore the approximate equations cited above for bending and pitting geometry factors cannot be used.
Problems should be solved manually in a manner similar to the worked examples above, however the following solutions are in the form of output from *Steel Spur Gears*. This output is sufficient to check factors and other parameters in the solution process, though slight discrepancies can be expected due to various approximations used in the manual solution.

PROBLEM 11

```
problem 11a
power, kW    1000.0   PINION, WHEEL - speeds, rpm        150.0         68.2
appl'n factor 1.00   tooth number, profile shift       25  0.36     55  0.05
rel'y factor  1.00   all. contact, bending stresses  1100   290   1000   280 MPa
dist'n factor 1.60   bending geom & max life fctrs  0.469  1.04  0.420  1.04
vel'y factor  1.42   contact, bending life factors  0.778 0.439  0.856 0.508
velocity, m/s 5.05   contact, bending lives, khr    98.04 large  39.32 large
module, mm   25.00   pitting geom factor 0.1140    contact ratio 1.591
width, mm    300.0   open, 6 accuracy level gears

problem 11b
power, kW    1000.0   PINION, WHEEL - speeds, rpm        150.0         68.2
appl'n factor 1.25   tooth number, profile shift       25  0.36     55  0.05
rel'y factor  1.00   all. contact, bending stresses  1100   290   1000   280 MPa
dist'n factor 1.60   bending geom & max life fctrs  0.469  1.04  0.420  1.04
vel'y factor  1.42   contact, bending life factors  0.870 0.549  0.957 0.635
velocity, m/s 5.05   contact, bending lives, khr    13.37 large   5.36 large
module, mm   25.00   pitting geom factor 0.1140    contact ratio 1.591
width, mm    300.0   open, 6 accuracy level gears
```

PROBLEM 12

This is an analysis problem however the module and profile shifts aren’t specified directly and must be deduced from given dimensions.

The addendum diameter is $D_a = m(z +2s +2a)$ in which the module m is from the standard list (p7), s lies within the bounds of Fig G, and a = 1 for the 20deg full depth system. Solving this for the pinion module with a trial profile shift, say the mid-range value of 0.45, gives $m = 83.2/(18 +2*0.45 +2) = 3.98$mm, so the standard 4mm module is indicated. Solve again for $s_1 = (83.2/4-18-2)/2 = 0.40$, and similarly for $s_2 = (233.6/4-56-2)/2 =0.20$.

Further solution proceeds as in the worked examples. If *Steel Spur Gears* is used then solution must be by trial-and-error - trial values of power are input until the resulting life is the desired 10 khr.

```
problem 12    Final iteration with trial power of 9.07 kW
power, kW      9.1   PINION, WHEEL - speeds, rpm        300.0         96.4
appl'n factor 1.00   tooth number, profile shift       18  0.40     56  0.20
rel'y factor  1.00   all. contact, bending stresses  1100   300   1100   300 MPa
dist'n factor 1.21   bending geom & max life fctrs  0.452  1.04  0.421  1.04
vel'y factor  1.20   contact, bending life factors  0.850 0.414  0.850 0.445
velocity, m/s 1.18   contact, bending lives, khr    10.02 large  31.16 large
module, mm    4.00   pitting geom factor 0.1228    contact ratio 1.519
width, mm     50.0   commercial, 6 accuracy level gears
```

PROBLEM 13

This problem illustrates that a solution for the desired life within the usual practical facewidth bounds $9 \le \beta \le 15$ may not be possible. Thus the first solution leads to a wide