Design Instructions Last update 2011-06-02

This program will calculate approximate size of gears for required power rating. Minimum input data required are: Horse power or KW, input speed, ratio, material selection, quality of gears, and type of mesh.
Program will calculate optimized diameter of the pinion and face width to achieve required power rating in surface fatigue. Based on the diameter calculated the program will optimize DP or Module to achieve power rating in bending fatigue. This program does not use profile shift factors in calculations.

User must make sure to enter the quality of gears and also verify the correct quality numbers are used in analysis program.Tip loading will occur in most of spur gears if gear quality is less than AGMA10 and in some cases even in high quality gears if unit loading per inch of face width is minimal. The program will default to highest point of single tooth contact (HPSTC) option and if the analysis program shows low in bending fatigue capacity, "design" program must be run with highlighting "tip loading" option. Out put data printout will show whether the spur gears are loaded at tip or HPSTC.

If user does not specify pressure angle the program will default to 20 deg. PA. Pressure angles from 14.5 thru 30 degrees can be entered but we recommend using 20 or 25 degrees pressure angles to facilitate using standard tooling. If user selects the helical option and does not specify helix angle, the program will default to 23 degrees. If required life in hours (B1) is not specified, the program will default to 5,000 hours.

User must high light "Module" for metric version and "DP" for English version before entering, executing, and transferring data. We advice users to print the out put data from "Design", if possible, before transferring the data to analysis program and also check all input data in analysis program.

This program calculates optimum diameter for lower pitch line velocity and finer DP or module enough to transmit required power which will result in quieter running gears. The user is advised to review the calculated diameter of pinion, face width, and actual and rounded DP or Module. If face width is large or small for their use, the program must be run again with specified face width before transferring to analysis program. We advise the users to run the program without entering the face width or center distance first and change only if the calculated face width or center distance can not be used due to design restrictions.

If the results of analysis program show the capacity is more or less than required, the design program must be rerun with reduced face width or increased power requirement. If the capacity is too high then reduce face width in the same proportion as the capacity difference. If the capacity is less, then rerun the design program with increased power requirement. For example, if the required power is 100 HP and the calculated power capacity is only 75HP, then increase the power requirement to 125 hp and rerun the design program.

If centerdistance is specified , the user has the option of choosing module, DP, special module or special DP.

If face width or center distance is restricted user can enter ether one but not both. Specifying both restricts the optimization of diameter or face width of pinion to achiieve the power to be transmitted. The program can only optomize the DP or module and the capacity in surface fatigue may be too high or too low.

If non-standard center distance is specified the program will calculate profile shift factors and transfer the profile shift factors along with other data to analysis program. The design program does not use profile shift factors in capacity calculation and hence the calculated capacity may be higher or lower depending upon the sum of profile shift is plus or minus. Program will also calculate the closest standard module or DP. Because of this, the capacity may be little higher or lower depending on the round off.

The data can be exported to the gear life analysis program for detailed analysis by clicking the ”Transfer Data” button. When “Transfer Data” is clicked, an instruction screen will open. Follow instructions to analyze the design data. Click “Calculate” to run the data transferred from “Design” and the results will show up on the screen.

Analysis Instructions Last update 2011-06-02

This program will calculate the power rating of gears per AGMA 2001 and 2101-D04 standards. Data can be transferred from the “Design” program or it can be entered directly on the screen.

To run the rpogram click “Calculate”after entering data. Output data will showup on the screen. Enarge it to review data. Output data contains all AGMA factors and assunmtions in pges 2 nad 3. Click on the “up” arrow on upper RH corner to review AGMA factors. Close the screen to return to “Analysis” input screen. Clicking “Cancel” tab in the input screen will take you back to first page.

Check “DP” or “Module” check box. Input is in English units (Inch, HP, etc.) if “DP” is selected and the input is in metric units (mm, kW, etc.) if “module” is selected.

Required entries are: Mesh type, Pressure angle, Helix angle (if helical), pinion speed, number of teeth in pinion and mating gear, face width, module or DP, quality, material selection, reference power. For standard gears, profile shifts (addendum factors) can be left blank but must be entered for corrected gears. Don’t forget the +/- sign of profile shift.

Reference power is used to determine if spur gear is HPSTC or Tip loaded.
Spur gear capacity in bending fatigue is dependent on whether the gears are tip loaded or loaded at highest point of single tooth contact (HPSTC). Load sharing is dependent on deflection under load and quality of the gear. Enter the power required (HP or KW) in the reference power column and select the required quality of the gears.

If spur gears are used for critical applications the quality of the gears should be higher to make sure load sharing occurs. Helical gears should be preferred choice for critical applications where possible.

If calculated capacity is slightly higher or lower than required, the face width can be increased or decreased to adjust the capacity in the same proportion. If pinion diameter (number of teeth) is changed the capacity in surface fatigue will change by the square of the ratio of change but bending fatigue will vary in the same proportion of change.

Reliability and/ or safety factors other than the default value of 1.0 can be selected depending on requirements.

Special factors such as tooth thinning or cutter tip radii can be entered if known. Be careful! Use default values when possible (leave fields blank). Small errors in input here can result in bad (or no) results. Default tooth thinning is per AGMA standard backlash.

If a material other than those listed in the material table is needed, it can be added to the material table. To add a material, go to the Gear Engineering screen (first screen) and select options. Select add/edit material and fill in the fields on the screen.

Press Calculate. The program will calculate the power capability of the gear set for 5,000, 10,000, 25,000, 50,000, and 100,000 B1 hours. Torque, tangential force and static capacity of the pinion and gear will also be included in printout. Static capacity is based on yield strength and if exceeded permanent deformation or even tooth breakage may occur.
Verify that the input data printed on top half of the sheet is correct! If they are not, results are invalid.

Note: use 70% of the bending fatigue HP or KW capacity listed in the printout for idler gears and other gears where the teeth are completely reverse loaded on every cycle.

If the ratio is greater than one and the total number of teeth is not less than 60 it is desirable to apply positive profile-shift to the pinion. At standard center distance this involves giving equal and opposite (negative) profile-shift to the gear to balance the respective beam strength of the two gears. This also improves the general curvature of the pinion profile. Optimized profile shift can be obtained from ‘Dimension” program. Use recommended profile shift to balance beam strength for most applications if strength of materials of pinion and gear are identical.

For speed increasing drives it is desirable to avoid too much approach contact and gears should be designed to operate at extended center distance. Larger profile-shift should be applied to the driver in the proportion of diameter of driver and driven gears.

Capacities calculated for high quality gears (AGMA12-AGMA14) assume design and manufacturing techniques that ensure low transmission error and accurate alignment under operating conditions and that the gears are adequately lubricated.

Allowable stress numbers for gear materials given in the material table are established by specific quality control requirements for each material type and grade. Minimum quality for material is Grade1 per AGMA and the materials must be given precise heat treatment to use the stress levels listed in the material table. For critical applications AGMA Grade 2 material must be considered.

If you get strange (or no) results or error messages, check the input data! Numbers in input fields left over from the previous run can cause strange results. Incorrect input results in invalid output! Always verify the input by checking it on the output sheet.

Dimension Instructions Last update 2011-06-02

Caution! Data left in a field from a previous run can cause strange results.
Review the input data to make sure only the required data and options are entered. For example, if no crown is required be sure to check "None" in crown column. If you do not, the program will calculate default crown or special crown, if used in previous run.

This program will calculate the information needed to manufacture and inspect gears. The values calculated consist of: dimension over pins, span measurement (base tangent), center distance (if not known), and tolerances for specified quality for external and internal pinion, gear or rack. The program will also calculate gear blank tolerance required to achieve quality level if diameters of shaft and or bore are entered.

There are four options:
New pinion and gear
Mate new pinion to existing gear
Mate new gear to existing pinion
Both pinion and gear exist.

Center distance may be set to standard, non standard or calculate. If non-standard is selected, center distance must be entered.The program will prompt if any required data is missing. Read the displayed messages as they appear before proceeding. It is possible to enter data that specifies impossible geometry.

When the existing pinion or existing gear option is checked, the input screen will open input fields for entering the existing pinion/gear dimensions data, If the center distance is given, the correct profile shift for the gear/pinion will be calculated. If both pinion and gear data are known and entered, the center-distance will be calculated. If the center distance is not given, it will be calculated if sufficient information is given.

If AGMA Q or AGMA A standard is used, the user has three options for backlash - standard, reduced or special. If DIN or ISO is used then the backlash will have five variations plus special backlash. In DIN or ISO version, the backlash is dependent on quality and the user must make sure the quality specified is also correct. AGMA backlash amount does not depend on quality of the gear. If special backlash is selected, minimum and maximum values must be entered.

Note: Special crown amount is in mm per mm or inch per inch of face width. For example, if crown required is 0.127mm for 127mm face width gear the special crown amount entered should be 0.001mm/mm of face width. Default crown amount is 0.00024” per inch of face width (0.006 mm/25.4 mm).

This program can calculate dimension over pins for a rack. The DOP printed is from pitch line of rack to top of pin. If addendum value of rack is deducted from the DOP printed then the dimension is from top of rack to top of pin.
A rack has no profile shift. Our program treats racks as 999 teeth gears for calculating roll angles, and form diameter for pinion, contact ratio, and tolerances for rack. DOP for rack is calculated treating it as rack.

Output will have one page of data for the pinion and one for the gear. Top half of the sheet will show input data which should be verified to make sure they are correct.

End