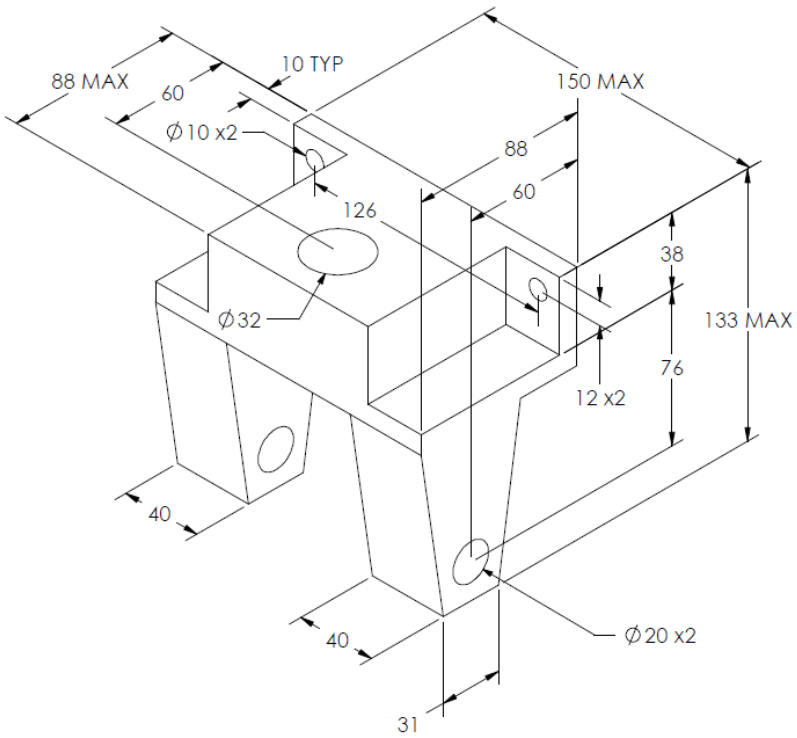
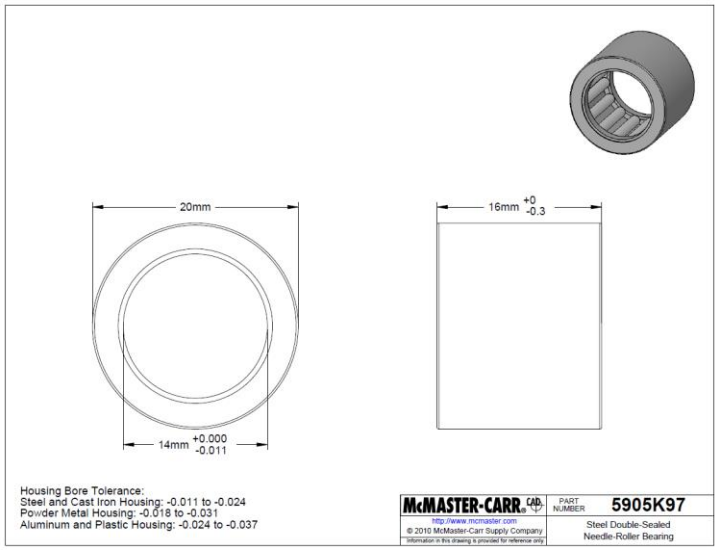
SCIENCE & TECHNOLOGY SAMPLE ASSIGNMENT

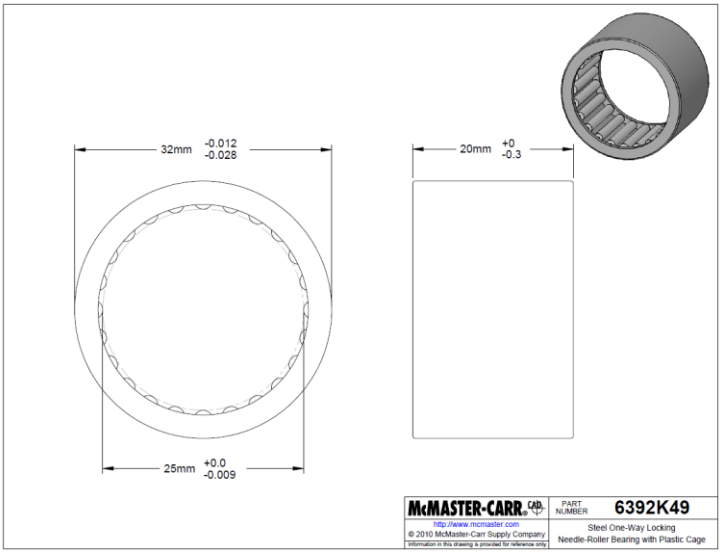
EST112: Computer Aided Design II
Major Group Project

OVERVIEW:
As a new engineer just recently hired by Space Exploration Vehicle Corporation, you have been assigned to work on the latest generation of Mars robotic explorers (Nomad V) that your company has become famous for. One of the most challenging aspects for the design of any mechanical system that is destined to be launched on a rocket is that system's mass. Your engineering manager has given you the task of designing a critical component within the Nomad V to a given specification layout while minimizing its mass. This component called the "Bevel Gear Support". The rough layout design for the Bevel Gear Support is as follows:



It is critical that all mounting holes and bearing holes remain in the same relative positions. The overall dimensions of the bezel cannot exceed 150mm x 133mm x 88mm. The 20mm and 32mm diameter holes are designed to accept standard bearings as shown:





You are free to change any and all other geometry. You are also free to explore different materials as well. All methods of manufacture are available to you (machining, molding, casting…).

Engineering analysis has shown that acceptable strength can be achieved with minimum wall thicknesses of 10mm.

EXISTING MATERIAL SPECIFICATION:

Material:	Stainless Steel Alloy 201, ASTM B-725
Material Hardness (Rockwell B):	95
Tensile Strength:	75,000 lbs/s^2
Material Finish:	None
Working Temperature Range:	-54C to 50C
Density:	7800kg/m^3
Environmental:	Outdoor Mars Use. No shelter from the elements

Spec Sheet: http://www.northamericanstainless.com/wp-content/uploads/2010/10/Grade-201-201LN.pdf

TEAM ACTIVITY (do this first):

Review the current situation with your team (4 students Maximum). Brainstorm ways in which science and technology could possible help you solve this problem. Where are you going to look for answers? How are you going to know when/if you have a viable solution? Are there any other ways of solving this problem without using existing technology? Be prepared to answer these questions during your presentation (below). **[CRITERIA 1 AND 2]**

PROJECT DELIVERABLES:

A. ***Class Presentation***: Your engineering team will need to develop and present the following deliverables in a single 10 minute class presentation. You are free to choose the presentation format of your choice. Power Point, Poster Board, or whatever you and your team are comfortable with. Make sure the class can easily see what you are presenting. Models are fantastic! Your presentations should be as follows:

- **Describe the Assignment:** Keep this concise. Bullet format is fine.
- **What engineering laws or theories did your team use to refine this design?**: What engineering theories have you and your team found that helped you optimize the design.
- **New Product Specification**: This should be similar to the existing specification. You are free to make changes here for your new design. How is the new specification going to help reduce the Bezel mass while maintaining strength? Why do we use tensile strength for describing a material's characteristics? Why do we use mass instead of weight?
- **Initial Product Concepts**: Prepare several design ideas (one from every person in your group). This will be put into a presentation form of your choice and presented to the rest of the engineering staff (your class) for comment and review. Make sure that each concept is shown using orthographic projection. Please determine the estimated mass your design. How did you calculate the mass? **[CRITERIA 4 AND 5 (case study)]**
- **Personal Experience:** Detail other instances that you have encountered with other products that you have personally used where the design was subsequently changed by the manufacturer to achieve a clear improvement in performance or cost. Refer to at least one news article that refers to a similar design failure and how it was fixed. **[CRITERION 3]**
- **Sources of Information:** Where did you get the information in the development of your solution? Several sources will be needed for a viable solution.

B. ***Design Portfolio (CAD Model):*** Clearly show the detailed design of the Bezel using orthographic projection and good dimensioning practice. Insert the bearings into your design using an assembly print. Clearly state the Bezel's Mass in kg in the detail drawing notes. This portfolio will be passed in for grading by the instructor. **[CRITERIA 4 AND 5]**

Grading System:

Your Grade for your Group Project will be derived from 4 scores: **[Taken directly from the Technology Intensive Course Designation Rubric]**

1. Demonstrate basic knowledge of technology and the application to optimizing the design = 15%
2. Determine the mass of your new design = 15%
3. Clearly show using CAD drawings how the product has been optimized = 60%
4. What sources did you use to use to develop your solution = 10%

Appendix I: Presentation Guidelines:

PRE-PRESENTATION

- Identify the group's purpose.
- Determine what will be needed to achieve that purpose.
- Determine how to customize material for that audience and for time limit.
- Determine what visual aids may enhance the presentation.
- Consider whether handouts and/or leave-behinds will be used.
- Decide on areas of responsibility for the research and development of the material to be presented.
- Determine who will be responsible for each visual.
- Divide speaking roles equitably among group members.

PRESENTATION MECHANICS

- Select a group member to serve as moderator as well as a technical contributor.
- Having one moderator can enhance organization, flow and continuity during the group presentation.
- Gather as much information as possible about the presentation's setting beforehand (size, AV availability, chalkboard space, chair/speaker arrangement flexibility, access to electric outlets, need for microphones and their placement, projection screen availability, room-darkening capability).
- Determine the most effective order for the participants' presentations.
- Arrange for smooth transitions between speakers both orally and physically.
- Plan AV arrangements beforehand for smooth incorporation of visuals, (e.g. is an extra pair of hands needed to display a chart? Can another group member distribute handouts?)
- Rehearse as a group as many times as possible.
- Smooth, coherent and credible presentations can only be achieved with diligent rehearsal.

DELIVERY

- The moderator should provide a brief overview of the presentation; identify group members and the areas they will cover.
- The moderator informs the audience as to when questions should be asked.
- The moderator introduces the first presenter and his/her topic.
- The presenter maintains eye contact with the audience, not other group members.
- Each presenter should show how his/her material relates to the discussion as a whole or how it interrelates with other speakers. Referring specifically to other speakers' contributions builds group cohesion and facilitates audience understanding.
- Each group member should listen intently and offer non-verbal encouragement to the person speaking.
- The presenter's conclusion flows into an introduction of the next speaker.
- Each speaker thanks the previous speaker, greets the audience, ends his/her presentation with another introduction, the overall conclusion for the entire group, or a return to the moderator.
- The moderator may conclude for the group as a whole if not already done. The moderator conducts the question and answer session.
- After the question and answer session, the moderator delivers a final statement to provide closure. Closure may take the form of thanks or may provide information for follow-up, an avenue for future contact or feedback, or an inducement to adopt or accept the group's proposal

Appendix II: Rubrics

1. **Demonstrate basic knowledge of technology and the application to optimizing the design**

	4 is strong, 1 is weak			
	4	**3**	**2**	**1**
Establish current theories, data and other information to Optimize the Bezel Design	Are the theories selected applicable to the problem?			

2. **Determine the mass of your new design**

	4 is strong, 1 is weak			
	4	**3**	**2**	**1**
Identify specific theory(s) that you are using to determine mass	Have you and your team established a clear and accurate method to determine mass of your new design?			

3. **Clearly show using CAD drawings how the product is improved**

	4 is strong, 1 is weak			
	4	**3**	**2**	**1**
Define the design optimization based on sound engineering knowledge and theories. Communicate this using CAD.	How effective is your CAD model. Does it clearly show how mass has been reduced while maintaining strength?			

4. **What sources did you use to use to develop your solution**

	4 is strong, 1 is weak			
	4	**3**	**2**	**1**
What reliable sources of information were used to establish your solution?	Credible sources have been clearly established as a basis for the design solution.			