MEGR-2156 Assignment Two:

VP-44 Cummins ISB 24-valve fuel pump wrench ideas

By: Gregory Markowski

MEGR 2156

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Purpose

The purpose of this wrench is to make it easier to assemble and remove the fuel pump from a VP-44 Cummins ISB 24-valve diesel engine. This would improve the efficiency and frustration of working on these engines.

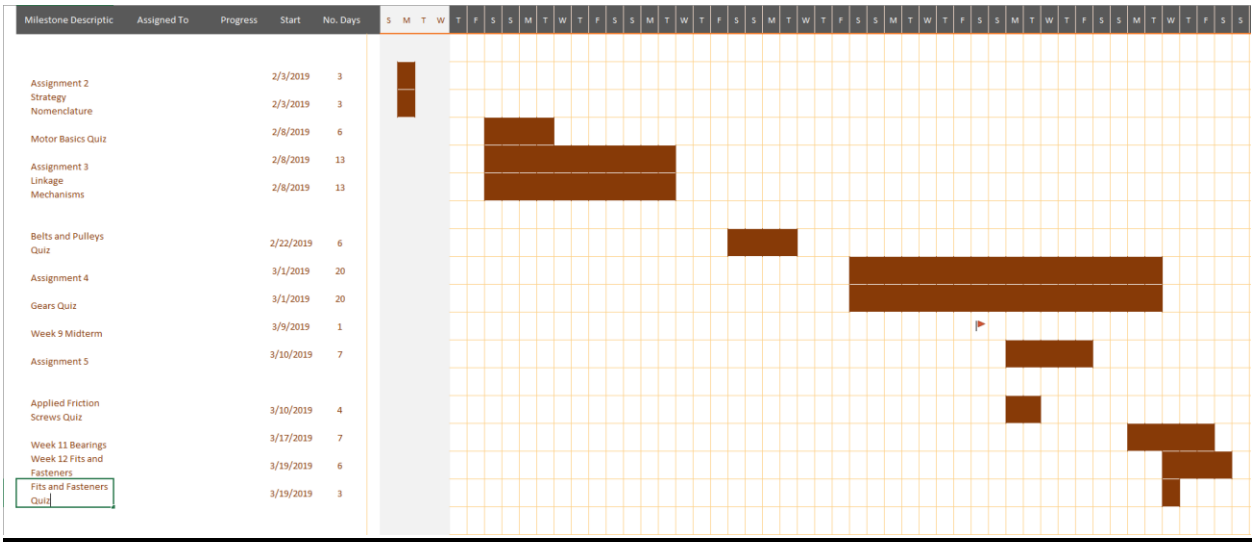
Assumptions

It can be assumed the device will be used at a constant rate of 1 rad/s.

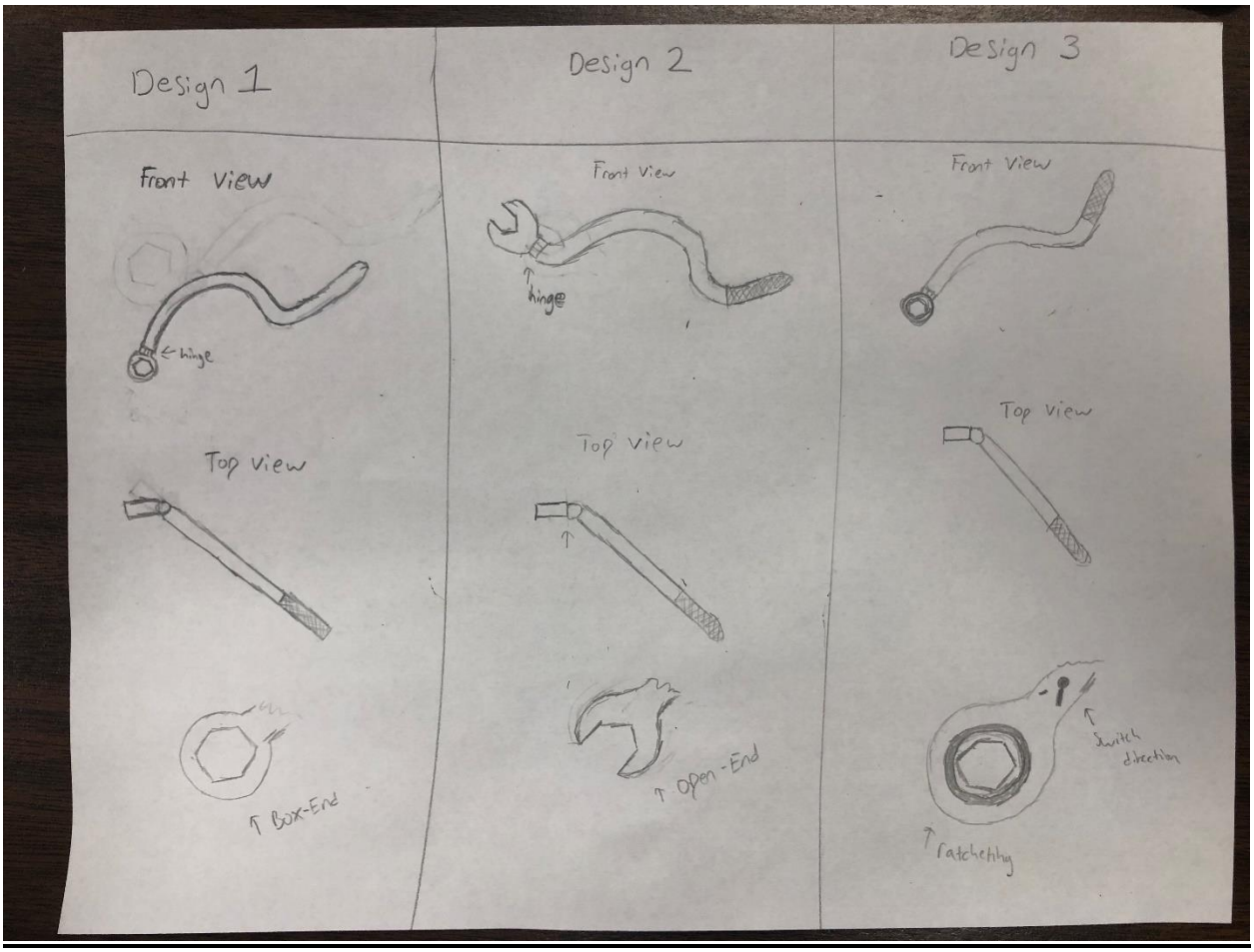
Specifications and Requirements

- It must accept 15mm bolts
- It must be no longer than 10 inches
- It must be able to overcome a torque of 35 ft-lbs
- It must be able to fit around a 4 inch diameter fuel pump and a 2 inch diameter header
- It must have a grip
- It should be easy to get on the head of the bolt

Gantt chart



Sketches


Design 1
Front view
hinge
Top view
Box-End
Design 2
Front view
hinge
Top view
Open-End
Design 3
Front view
Top view
Switch direction
Ratcheting

(all designs are designed for mechanics assuming they are 18+ and work for cummins)

FRDPARCC of Design 1

Functional Requirements	**Design Parameters**	**Analysis**	**References**	**Risk**	**Countermeasures**
Strength	Made of tool steel	High hardness high-strength but high cost compared to other steels	Metals depot.com	It is brittle if dropped on a hard surface.	Using a lower carbon steel that maintains a decent strength.
Ease of use	Box-end and hinge	The box-end holds onto the head of the bolt, while the hinge allows for precision in a tight space	http://navyaviation.tpub.com/14310/css/Box-Wrenches-31.htm	The hinge is the weakest part of the wrench possibly compromising strength	Use a pre-bent angle instead of a hinge. However this may make the tool less versatile and adaptable to other bolt locations.
Ease of Manufacture	Three parts: box end, hinge pin, handle	Manufacturing should be simple and low cost	Materials in Manufacturing Book	Minimal risk	Measures should be taken to produce the tool as efficiently as possible.

FRDPARCC of Design 2

Functional Requirements	**Design Parameters**	**Analysis**	**References**	**Risk**	**Countermeasures**
Strength	Made of mild steel	Lower cost but less strength and hardness compared to tool steel	Metalsdepot.com	May bend under high stress	Using a higher carbon steel
Ease of Use	Open-end and hinge	The open-end wrench style can grip onto the bolt faster than the box end style.		The open end may slip off the bolt	Using a box end style
Ease of Manufacture	Three parts	Similar to box end, cost effective	Materials in Manufacturing Book	Minimal risk	A production manager can oversee production to ensure efficiency.

FRDPARCC of Design 3

Functional Requirements	**Design Parameters**	**Analysis**	**References**	**Risk**	**Countermeasures**
Strength	Made of stainless steel	Highest cost and medium strength between the two other metals. Does not rust	Metals depot.com	Highest cost	Use a mild steel with a coating rather than stainless
Ease of use	Box end style and ratchet	The box end keeps the wrench on the bolt while the ratchet allows the wrench to stay on for more than one rotation	https://www.garagejournal.com/forum/showthread.php?t=134337	The ratchet costs much more	Use a box end style with no ratchet mechanism
Ease of Manufacture	Many parts	The ratchet mechanism has many parts and would take much more time compared to other methods	Materials in Manufacturing Book	More time is more cost	Use a simpler design

Power

At a minimum the bolts are torque speced to 35 ft-lbs= 47.453 n-m.

P=Tomega

At an average rotational speed of 1 radian per second would mean all three wrenches use at a minimum of 47.453 W power

Lessons Learned

Overall I learned to start projects earlier as I am currently typing this at 2 in the morning.

Activities Date and Time

Time Spent (min)	Activity
120	Brainstorming
45	Gantt Chart
30	Sketching
60	Research
20	Reflection
25	Advisee response

Advisee

Everything looks good however I would make sure your pictures scan in clearly they are little hard to understand.