

Bi-directional Offset Lifting Bar

Restated Scope and Project Plan



Team 5

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ABSTRACT

Danfoss Turbocor has asked Team 5 to devise an innovative method to lift their new compressor to the testing height using the existing crane hoist and gantry system. The current gantry system is designed to lift the compressor to a height at which was adequate for previous compressor models, but does not lift the new, taller VTT compressor to the appropriate height for testing. The original request was for Team 5 to develop an offset lifting bar to lift their half ton compressor. However, after conceptualization of numerous designs and continuous consultation with Turbocor, Team 5 has instead proposed to increase the vertical lifting height of the compressor by redesigning the current gantry system and developing a separate lifting bar. Turbocor has been supportive of the team's progress and has assured Team 5 of full financial sponsorship. Team 5 believes that its solution to the problem at hand will be fully implemented at Turbocor.

I. INTRODUCTION

Danfoss Turbocor has asked Team 5 to devise an innovative method to lift their new compressor to the testing height using the existing crane hoist and gantry system. The current gantry system is designed to lift the compressor to a height at which was adequate for previous compressor models, but does not lift the new, taller VTT compressor to the appropriate height for testing.

A. *Objective*

The main objective is to increase the lifting height of the compressor. The solution must also have a means to vary the center of gravity to properly lift different versions of the VTT compressor, may they have a change in center of gravity. This new design must completely integrate with the existing equipment in the test room and shall not require a completely new procedure to lift the compressor for simplicity. Finally, this design must minimize all of the safety risks associated with lifting a half ton compressor.

Turbocor has been supportive of the team's progress and has assured Team 5 of full financial sponsorship. Team 5 believes that its solution to the problem at hand will be fully implemented at Turbocor after fabrication and prototyping in spring.

B. *Need Statement*

Danfoss Turbocor requires that each half-ton compressor be tested on the chiller system to ensure quality control. Each time the new compressor is ready for testing, a mechanical engineer must employ the use of a manual chain hoist to lift and install the compressor onto the chiller system. Danfoss Turbocor has sponsored a team of 5 mechanical engineering students to solve this problem. Currently, team 5 is in the process of routinely meeting with Turbocor to discuss project progress. During these meetings, the team presented risk assessments, detailed project specifications, a project plan, and proposed design concepts. After these documents were reviewed, Team 5 proposed an alternative design solution that does not implement the use of an Offset Lifting Bar, but does raise the compressor to a sufficient vertical distance.

II. DESIGN UPDATES

For this project to be considered a success, a few minimum standards must be met: must be able to safely lift a half ton compressor to an increased overall height and adjustment of lifting point for a variation of center of gravity. When designing the following concepts, these requirements were kept in careful consideration. Safety was of the utmost concern, but the performance of each design is absolutely necessary.

A. Modifications

Since the submission of Team 5's final report in the Fall semester, only small changes have been incorporated into the design. In order to improve safety during construction and handling of the system, all edges will now be chamfered to reduce the chance of injury due to sharp edges or burrs. Additionally, some of the critical load bearing fasteners will now thread directly into the machined parts rather than using nuts. This will increase the amount of thread engagement making the parts more secure and further reducing any risk of failure. Lastly, to improve ease of manufacture certain non-critical surfaces have been simplified, and small grooves removed.

i. Sponsor Corrections

Team 5's contact at Turbocor, Kevin Lohman, has reviewed over our entire final fall report and has made corrections on the teams drawings for each part. His advice entails notes on how to improve the engineering drawings and make them easier for the Turbocor machinists to interpret. This minor setback was expected since our project sponsor, Kevin Lohman, had previously stated that he would provide feedback for the team's drawings prior to the Spring semester. There will be no extra delay to overall project progress since Team 5 has already included it in the project plan to rework the drawings before they are to be resubmitted.

III. FINAL DESIGN

Shown below in Fig. 8 is the finalized completed assembly of each component that will be prototyped in spring. The only two components that Team 5 will not be responsible for procuring and manufacturing, is the compressor and the crane hoist (both are in the figure). With just the gantry system alone, team 5 saved about 6 in. of vertical distance. The Lifting bar has also received a height reduction, saving 2 in. The combination of this system saves approximately 8 in., which is sufficient to lift the compressor to the required height.

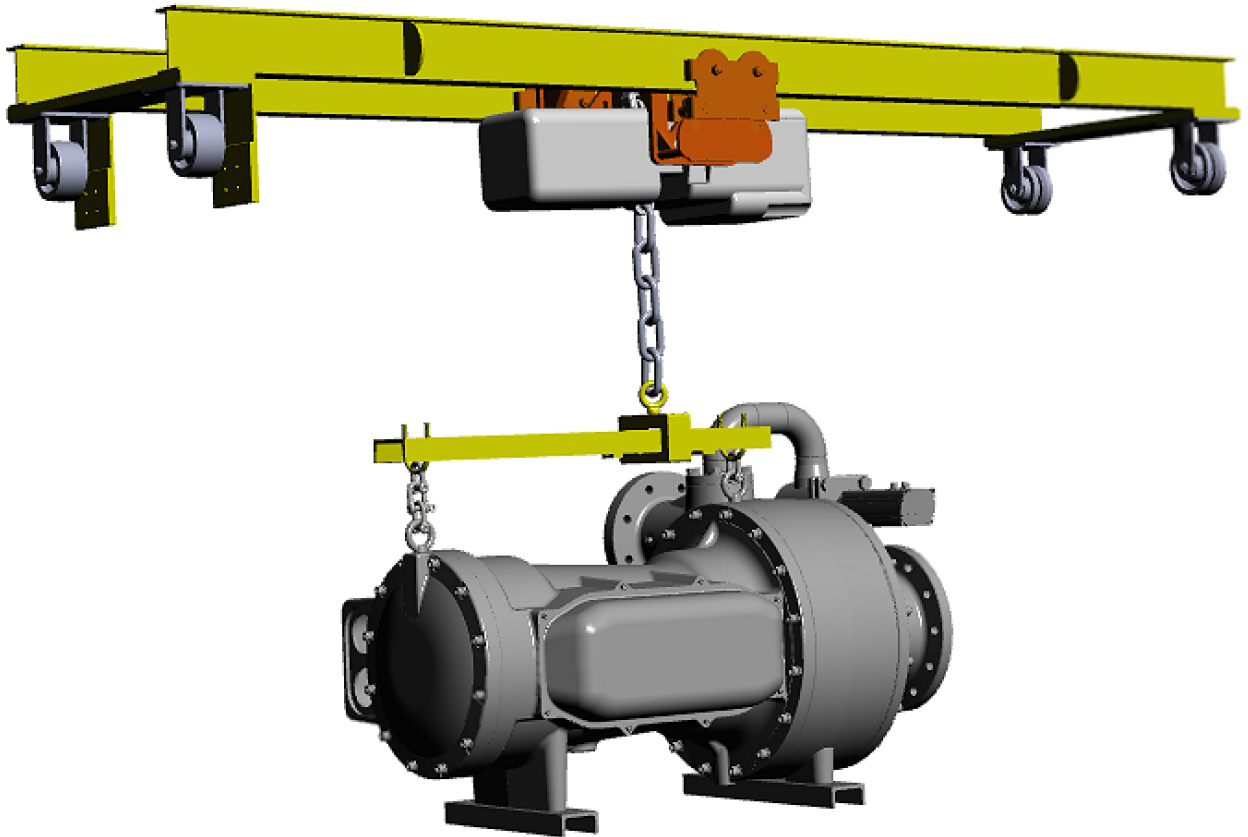


Figure 1 - Complete gantry, trolley, and winch assembly

IV. DEVELOPMENT

Team 5 had submitted all of the purchase orders at the end of fall semester. The corresponding parties at Turbocor made all purchases and the materials have been arriving to their facilities over the course of the break. The Bill of Materials (BOM) for each component can be view below in Table (1,2,3)

As of Wednesday, 1/14/15, Team 5 has sat down with the project sponsors to review the engineering drawings prior to fabrication and to take inventory of all purchases. 95% of the necessary parts and materials have arrived and are in the team's possession. This schedule can be viewed at Fig. 2 in the APPENDIX.

Beginning Friday, 1/16/15, the team will begin fabrication of blanks at the College of Engineering machine shop which will be handed over the machinists at Turbocor the following week for finishing.

Table 1– BOM for lifting bar

Parts Cost for Lifting Bar					
Part	Part #	Vendor	Cost	Quantity	Total
Eyebolt for lifting - M12 x 1.75, 30 mm eye	3040T15	McMaster	\$6.63	1	\$6.63
Steel Shackle - 3/8" x 1 7/16"	8494T14	McMaster	\$7.68	2	\$15.36
U-Bolt - 3/8" x 16, for 2" pipe	3043T41	McMaster	\$6.33	2	\$12.66
4" x 8" x 2" Steel Block (4"x4"x12")block	N/A	Speedy Metals	\$103.00	1	\$103.00
63 mm of chain					\$0.00
Block Ball Screw	BSBR1505-250	Misumi	\$245.92	1	\$245.92
Support Bearing - Fixed Side	BSWE12	Misumi	\$87.14	1	\$87.14
Support Bearing - Support Side	BTN12	Misumi	\$90.59	1	\$90.59
Delrin for Adjusting Hook Block	8739K13	McMaster	\$4.20	1	\$4.20
U-channel C4x5.4 (36 inches)	N/A	Speedy Metals	\$25.55	1	25.55
Total Cost					\$591.05

Table 2– BOM for Trolley

Parts Cost for Trolley					
Part	Part #	Vendor	Cost (\$)	Quantity	Total (\$)
1/2" x 24 " x 24 " Steel Plate	P112	Metals Depot	110.24	1	\$110.24
3/4" x 72" steel rod	R134	Metals Depot	14.28	1	\$14.28
Grade 9, 3/4" x 5" bolt	90201A660	McMaster-Carr	11.25	1	\$11.25
Trolley	3267T62	McMaster-Carr	160.17	2	\$320.34
Total Cost					\$456.11

Table 3– BOM for Gantry

Parts Cost for Gantry					
Part	Part #	Vendor	Cost	Quantity	Total
I Beam 4" x 3" x 20'		Trident	\$240.00	1	\$240.00
4" Track Wheels	8745T89	McMaster_Carr	\$31.99	2	\$63.98
4" Cast Wheels	2453T1	McMaster_Carr	\$26.63	2	\$53.26
1/4" x 12" x 24" Steel Plate guide and bumpers	P114	Metals Depot	\$31.02	1	\$31.02
Delrin	8739K13	McMaster	\$4.20	1	\$4.20
Total Cost					\$392.46

V. RESOURCE ALLOCATION

Devin Stubbs is responsible for submitting machinist approved drawings to team 5's sponsor, Turbocor. He will oversee the machining of each component per drawing. Devin will also take part in the assembly of the gantry and trolley. Devin will help maintain project milestones to make sure goals are met in a timely manner.

Luke Leelum will also aid Devin in submitting machinist approved drawings to Turbocor. Similar to Devin, he will also oversee the machining of each component per drawing. Luke will take part in the assembly of the lifting bar. Luke will maintain communication with Turbocor to ensure all parties are on the same page.

Yoel Bugin will assist in assembly of every component as well as manage the gantry and lifting bar optimization sector. In this sector, Yoel will make sure that the fabricated components of the lifting bar and gantry system are in accordance to the design. He will inspect the assemblies to make sure there are no problems. Yoel will be in charge of water jetting the particular parts that require this process.

Coert Maraist will come up with a design in order to test the gantry, trolley, and lifting bar. He will be responsible for ordering the necessary components and the assembly of the testing rig. Coert will oversee the testing phase and make sure everything is tested properly. Coert will help get the Gantry system approved for use in Turbocor's chiller

3.

VI. NEW CONCERNS

As fabrication progresses, the team must remain mindful of the testing phases that are to come. There is minor concern regarding the method that will need to be developed in order to test the gantry and hoist system. Due to there being no pre-existing way of performing these tests at Turbocors' facilities, and their desire to not involve a 3rd party, Team 5 will need to engineer a method to accurately and safely test the project in a timely manner or otherwise face delays.

VII. APPENDIX

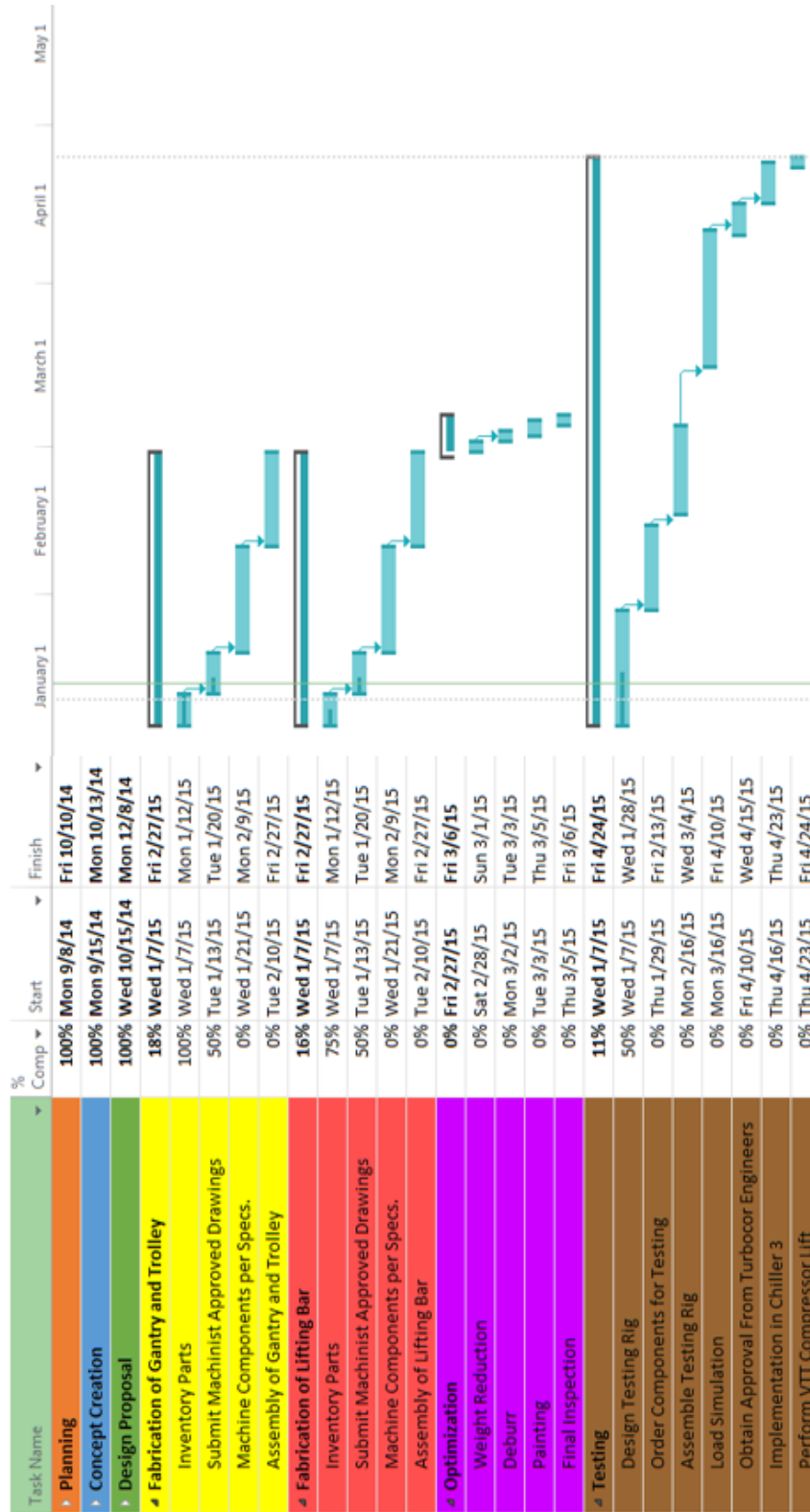


Figure 2 - Gantt chart