

Bi-directional Offset Lifting Bar Danfoss Turbocor

Instructor - Dr. Gupta Advisor - Dr. Hollis

Team 5

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Outline

ENGINEERING TOMORROW



- Background
- Project Description
- Fall Recap
- Procurement & Fabrication
- OSHA Standards
- Summary





Background

- Danfoss Turbocor is the world leader in oil-free centrifugal compressors used for cooling applications
- All compressors must be tested prior to distribution
- Since Chiller 3 was built Turbocor has developed a new line of VTT Compressors which have a greater height than can be installed with the current gantry and hoist system
- Turbocor asked Team 5 to develop a lifting bar that can be used with the current facility crane hoist and gantry



Project Description

- A better lifting system must be designed and implemented in order to conveniently install the compressor for testing
- Lifting bar to include:
 - Auto-leveling
 - Adjustable lifting positions
 - 1 Ton load capacity
 - Less than 500lb operating weight
 - OSHA Compliant



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Fall Recap: Current Hoist and Gantry

- Crane hoist hangs below gantry
- Wasted space
- Can't be used for VTT Compressor





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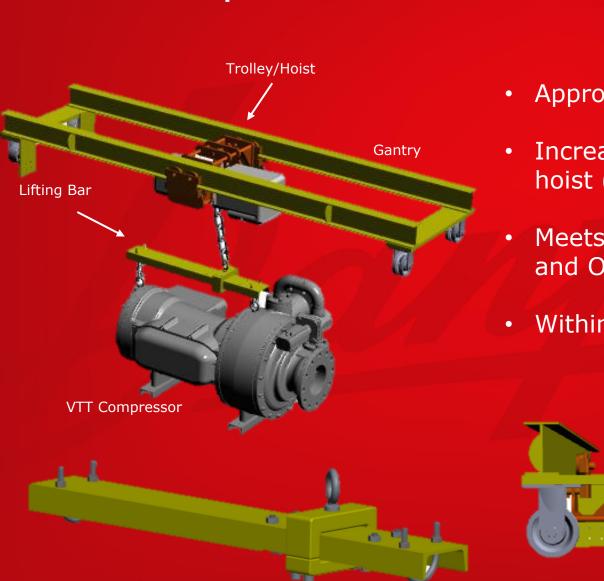


Fall Recap: Current VTT Lifting Bar

- Non-adjustable lifting hook positions
- Non-adjustable lifting point for variable center of gravity
- Suboptimal vertical height between lifting points



Fall Recap: Final Design

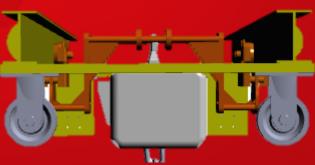


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Approved by Turbocor

- Increase vertical height of hoist (Approx. 177mm)
- Meets design requirements and OSHA standards
- Within budget constraints



Procurement



- Originally budgeted \$1,000 by Turbocor
- Budget extended to \$1,500 after justification
- Procurement Complete
- Parts inventoried

Component	Part #	Vendor	Cost	Qty.	Total				
Adjustable Lifting Bar									
Eyebolt for lifting - M12 x 1.75, 30 mm eye	3040T15	McMaster-Carr	\$6.63	1	\$6.63				
Steel Shackle - 3/8" x 1 7/16"	3560T47	McMaster-Carr	11.14	2	\$22.28				
U-Bolt - 3/8" x 16, for 2" pipe	3043T41	McMaster-Carr	6.33	2	\$12.66				
4" x 8" x 2" Steel Block (4"x4"X12")block	N/A	Speedy Metals	103	1	\$103.00				
63 mm of chain		McMaster-Carr	10.64	1	\$10.64				
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 Sheet, 2" x 12" x 1/8"	8662K13	McMaster-Carr	4.2	1	\$4.20				
U-channel C4x5.4 (roughly 31 inches)	N/A	Speedy Metals		1	\$25.55				
Total Cost					\$608.61				
Trolley System									
1/2" x 24 " x 24 " Steel Plate	P112	Metals Depot	110.24	1	\$110.24				
3/4" x 6' A36 Round Bar	R134	Metals Depot	14.82	1	\$14.82				
Grade 9, 3/4" x 5" bolt	90201A660	McMaster-Carr	11.25	1	\$11.25				
Hoist Trolley	3267T62	McMaster-Carr	160.17	2	\$320.34				
Total Cost					\$456.65				
Gantry									
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" Caster 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 Sheet, 3" x 12" x 3/8"	8662K35	McMaster-Carr	13.83	1	\$13.83				
Total Cost					\$402.09				
		Total Cost			\$1,467.35				



Fabrication

- FEA and drawings were presented and approved by Turbocor
- Minor fabrication changes
- Team 5 will be water jetting simple components
- Complex machining will be completed by Turbocor certified machinist
- Team 5 will complete assembly with help of welder

OSHA Requirements

engineering Tomorrow

- Team 5 has been asked to follow OSHA standards for lifting equipment:
- OSHA Standards (1910.179- Overhead and gantry cranes):
 - Trolley Bumpers & Stops
 - Safety Yellow Paint
 - Tested to 125% of Max Weight Load Limit
 - 3" (76mm) overhead clearance, 2" (51mm) of lateral clearance
 - No direct shear on bumper bolts



Schedule

<u>Spring 2015</u>

- Biweekly meetings with Turbocor; weekly team meetings
- All parts have been delivered and inventoried
- Fabrication set to begin
- Assembly of all components & mitigation of unforeseen issues
- Prototype testing with dummy-weight
- Full onsite implementation at Turbocor

Gantt Chart



Task Name	% Comp 🔻	Start 👻	Finish 👻	January 1 February 1 March 1 April 1 May 1
Planning		Mon 9/8/14	Fri 10/10/14	
Concept Creation	100%	Mon 9/15/14	Mon 10/13/14	
Design Proposal	100%	Wed 10/15/14	Mon 12/8/14	
Fabrication of Gantry and Trolley	18%	Wed 1/7/15	Fri 2/27/15	
Inventory Parts	100%	Wed 1/7/15	Mon 1/12/15	
Submit Machinist Approved Drawings	50%	Tue 1/13/15	Tue 1/20/15	in the second
Machine Components per Specs.	0%	Wed 1/21/15	Mon 2/9/15	
Assembly of Gantry and Trolley	0%	Tue 2/10/15	Fri 2/27/15	řenem (
Fabrication of Lifting Bar	16%	Wed 1/7/15	Fri 2/27/15	
Inventory Parts	75%	Wed 1/7/15	Mon 1/12/15	
Submit Machinist Approved Drawings	50%	Tue 1/13/15	Tue 1/20/15	i i i i i i i i i i i i i i i i i i i
Machine Components per Specs.	0%	Wed 1/21/15	Mon 2/9/15	
Assembly of Lifting Bar	0%	Tue 2/10/15	Fri 2/27/15	
 Optimization 	0%	Fri 2/27/15	Fri 3/6/15	
Weight Reduction	0%	Sat 2/28/15	Sun 3/1/15	u _
Deburr	0%	Mon 3/2/15	Tue 3/3/15	i
Painting	0%	Tue 3/3/15	Thu 3/5/15	
Final Inspection	0%	Thu 3/5/15	Fri 3/6/15	
4 Testing	11%	Wed 1/7/15	Fri 4/24/15	
Design Testing Rig	50%	Wed 1/7/15	Wed 1/28/15	
Order Components for Testing	0%	Thu 1/29/15	Fri 2/13/15	
Assemble Testing Rig	0%	Mon 2/16/15	Wed 3/4/15	
Load Simulation	0%	Mon 3/16/15	Fri 4/10/15	
Obtain Approval From Turbocor Engineers	0%	Fri 4/10/15	Wed 4/15/15	
Implementation in Chiller 3	0%	Thu 4/16/15	Thu 4/23/15	
Perform VTT Compressor Lift	0%	Thu 4/23/15	Fri 4/24/15	



Summary

- Original project description asked for offset lifting bar
- True goal was to increase lifting height of the compressor
- Developed Redesigned gantry system and lifting bar
- Engineering drawings have been submitted and approved by Turbocor
- Raw materials have been delivered and inventoried
- Manufacturing scheduled to begin
- Team 5 is developing methods to safely and effectively perform prototype testing



Questions?

More information available online at:

http://eng.fsu.edu/me/senior_design/2015/team05