



Kennesaw State University

April 7th, 2025





- 1. Team Introduction
- 2. KSU FPVC 2024 Comparison
- 3. Construction of Vehicle
- 4. Vehicle Testing
- 5. Final Vehicle

- 6. Regenerative Braking
- 7. Understanding of Design Choices
- 8. Safety and Comfort
- 9. Innovative Concepts
- 10.Lessons Learned





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Team Introductions



David AmayaProject Manager and
System Design



Rosaly Flores-Jimenez Electronic Design and Programming



Yuritzi Cazares Martinez
Pneumatic Design and
Testing



Trinity HuntComputer Automated
Design and Testing



Aidyn Cochran

Mechanical Construction
and Testing



Antonio Patino
Mechanical and Hydraulic
Design, Construction, and
Testing



Fluid Power

Team Introductions





Laura Ruhala Ph.D.
Asst. Dept. Chair
Mechanical
Engineering
Kennesaw State
University



Richard Ruhala Ph.D.

Professor

Mechanical

Engineering

Kennesaw State

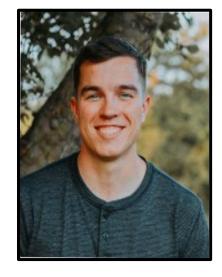
University



Ernie Parker International Fluid Power Society



Chandlar Armstrong
Project Engineering Lead
IFP



Ben Quade Project Engineer IFP





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2024 vs 2025 Comparison



Accumulator re-used

KEY 2025 CHANGES

- Independent direct drive circuit
- Two motors
- First motor for direct drive
- Second motor for accumulator drive and regen
- Accumulator discharge to safety feature
- HMI and PLC control system

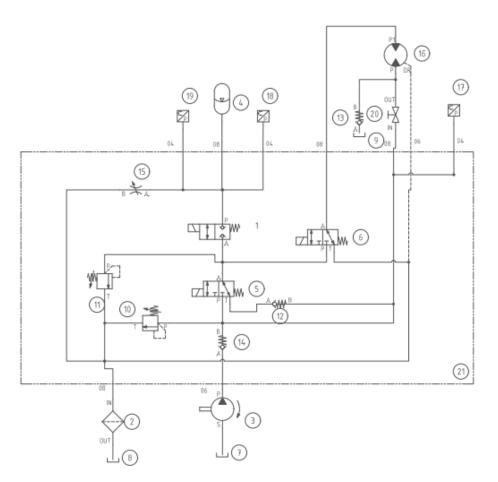


Frame re-used

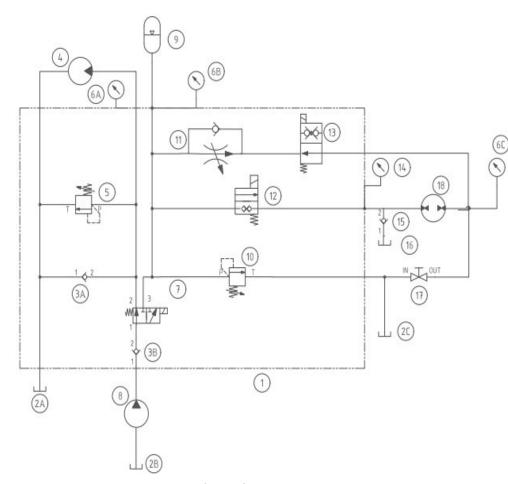


Final Hydraulic Circuit





2024 Hydraulic Circuit

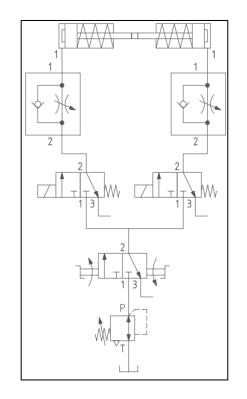


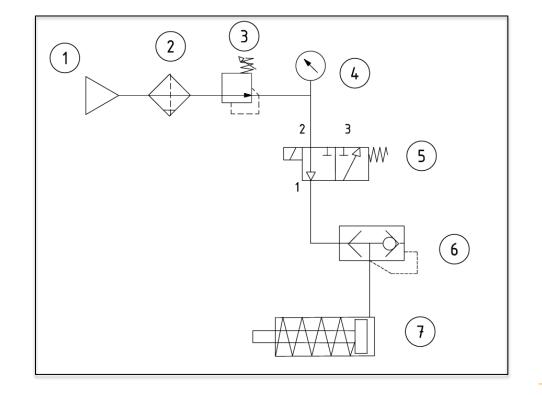
2025 Hydraulic Circuit

Pneumatic Design

Fluid Power
VEHICLE
Challenge

- 2024 Pneumatic Gear Shifting
- 2025 Pneumatic Clutch







2024 Pneumatic Schematic

2025 Pneumatic Schematic

Electronic Design

- 2024 Arduino
- 2025 HMI + PLC

















Fluid Power



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Timeline of Construction





Construction began by dismantling the 2024 trike.

January 2025



The team began fitting 3D parts to begin to design the layout of the components.

March 2025



The team began to manufacture parts such as the reservoir

March 2025

Fluid Power



Construction concluded and testing began.



The team began to build upon manifold design to solidify component placement

December 2025



The team reached out to Hydraulic Supply Co. to begin making the lines for the vehicle.



Full assembly began, as well as fine tuning of intermediate shaft





March 2025





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Vehicle Testing and Design Changes



- Gear ratios were tested using initial sizes and a 10-tooth sprocket on the accumulator motor, which exceeded the pneumatic clutch's torque limit; replaced with a 13-tooth sprocket and optimized accordingly
- Crankset upgraded to increase pump RPM.
- PLC issues prevented solenoid activation; initial testing used last year's Arduino board
- Reservoir redesign prompted by initial leakage
- Pneumatic solenoid reversed; 1/8" NPT plug replaced with a muffler







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Final Vehicle



 Constructed and thoroughly tested to ensure reliability, safety, and operations.







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Hydraulic Circuit Modes



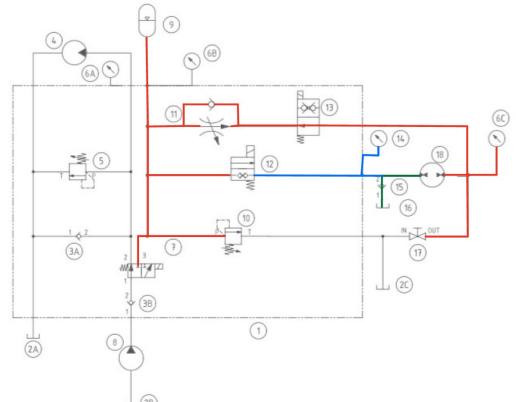
Direct Drive

Accumulator Charge

Accumulator Drive

Regeneration Mode

Accumulator Discharge





Pneumatic Friction Clutch

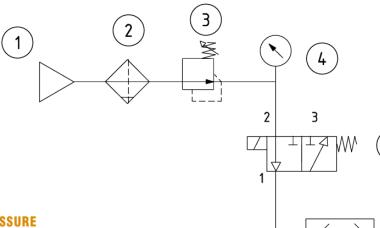


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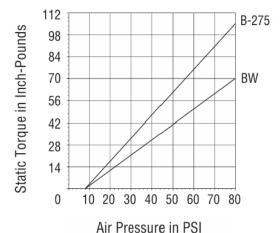
(7)

 Used to engage and disengage the second motor from the drive train

 The clutch minimum pressure needed to engage is about 8 psi with a maximum pressure of 80 psi



▶ TORQUE Vs. AIR PRESSURE



NOTE: Dynamic torque is approximately 85% of static torque.

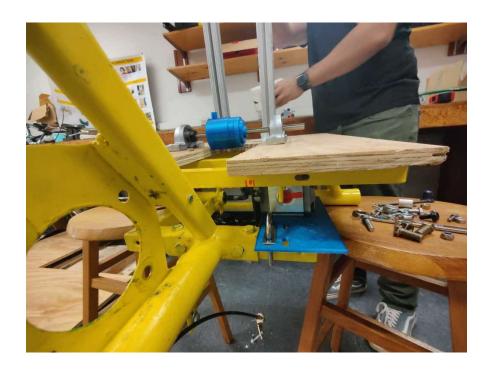


Intermediate Shaft

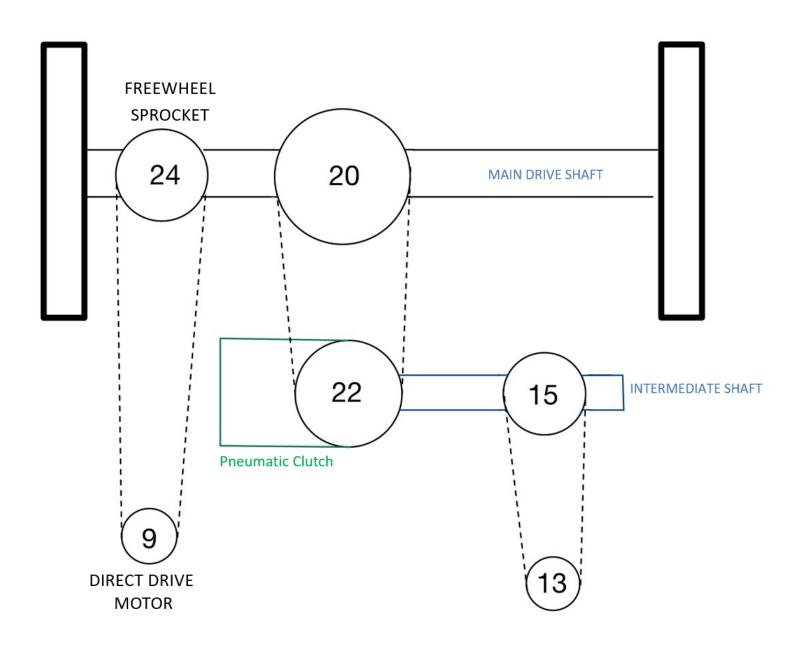


- One of the most vital components for the trike
- Allows for the secondary motor to engage with the driveshaft

















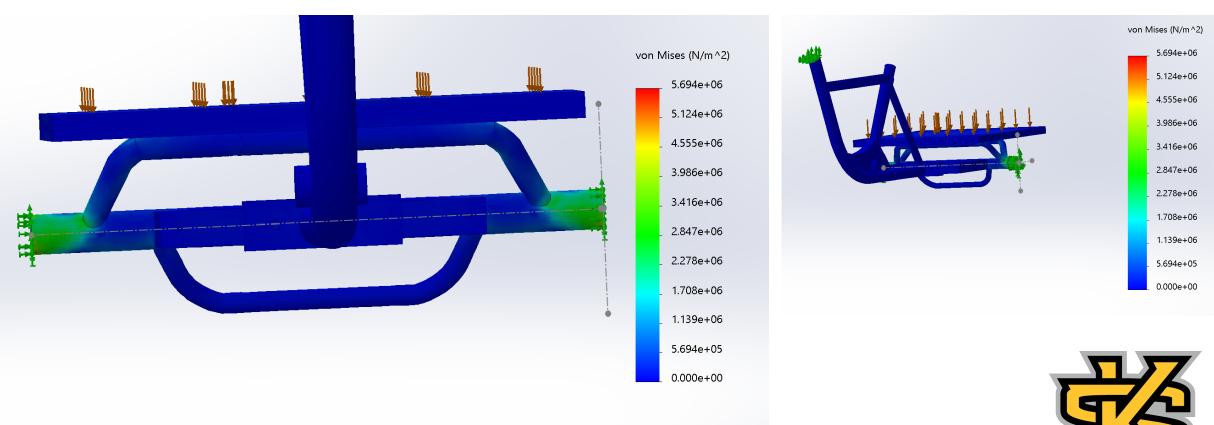
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FEA—Frame



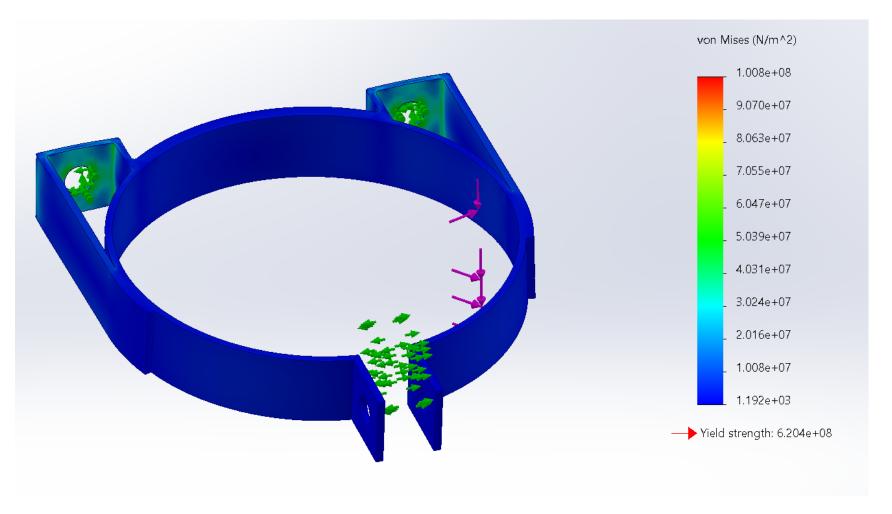


FEA Simulations revealed Von Mises Stresses were within acceptable range



FEA – Accumulator Mount

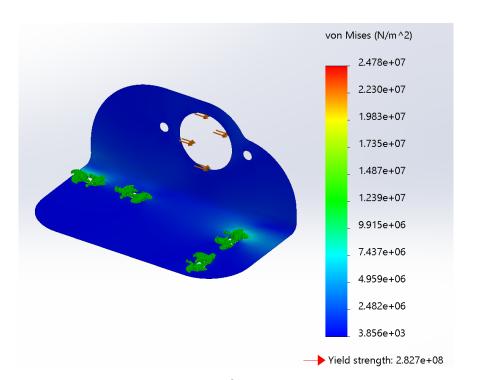


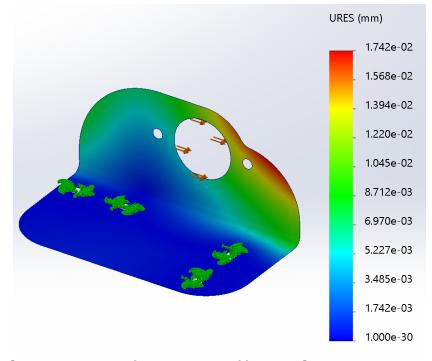




FEA—Accumulator Motor Mount







- Accumulator motor mount design features slots to allow for easy chain tensioning
- Von Mises Stresses are within acceptable range
- Resultant deformation is negligible



FEA—Pump/ Motor Mounts



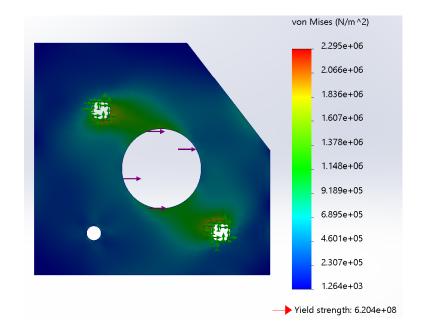
Motor mount for pump

 Adapter for the new pump to fit correctly where last year's larger pump was placed

1.372e+07 1.234e+07 1.097e+07 9.602e+06 8.230e+06 6.859e+06 5.487e+06 4.115e+06 2.744e+06 1.372e+06 6.269e+02

Mount for Direct Drive Motor

 Both mount designs allow for the components to fit where the previous team's larger parts were placed

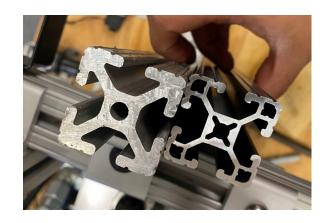




Manifold and Accumulator Mounting





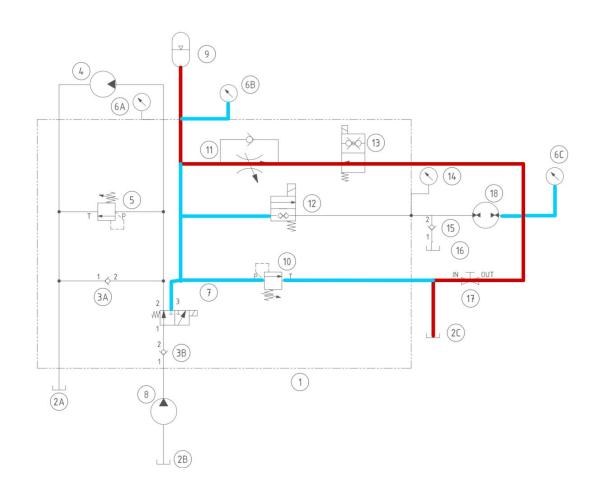


Weight-saving design choice



Hydraulic Circuit Modes Accumulator Discharge





This design choice was made to safely remove pressure from the accumulator without entering Accumulator Drive Mode.





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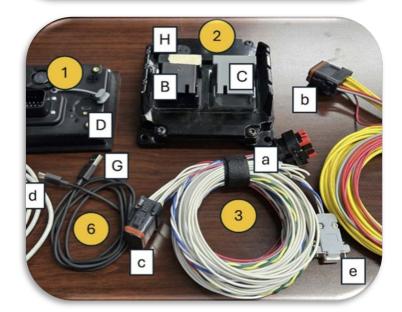
2025 Electronics



Overview of Design

- S50 Display
- MC2 PLC
- One 24 V DC battery
- Proper Electrical insulation/connections







Electronics Mounting

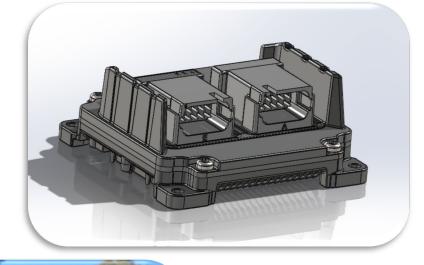
Fluid Power

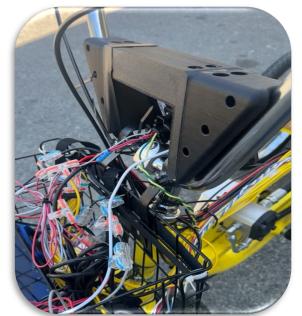
Safety and Comfort

- Fail Safe to direct drive
- Ergonomic
- Ease of mode activation
- Precise pressure reading









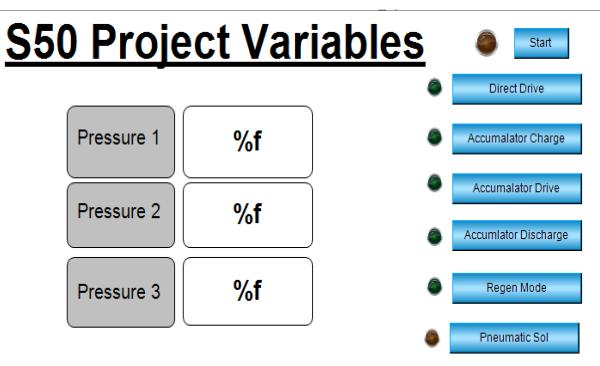




CODESYS Code



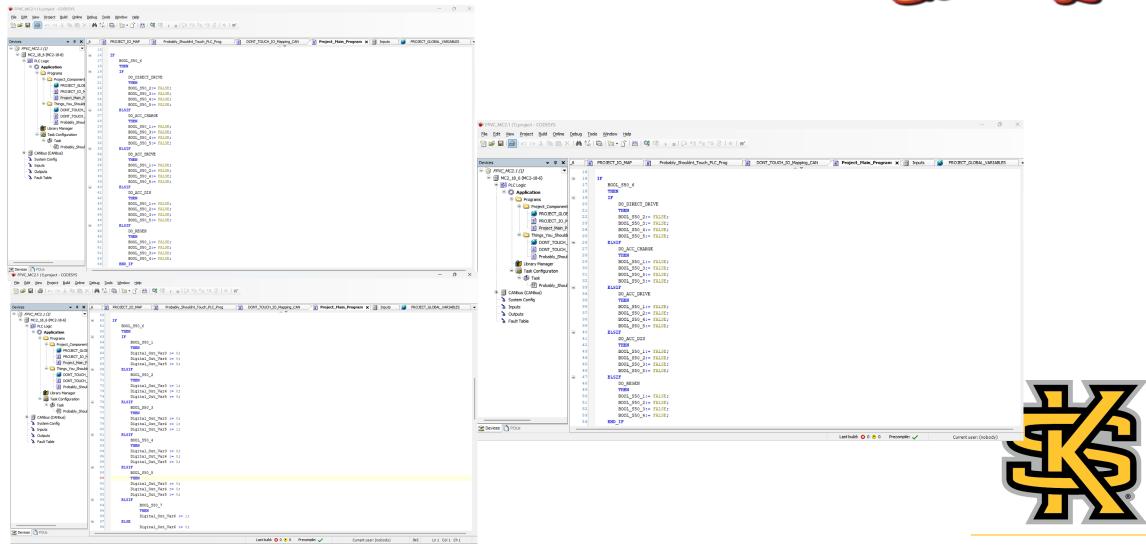
- Mode selection
- Voltage pressure conversion
- Solenoid activation
- Default mode is Direct
 Drive





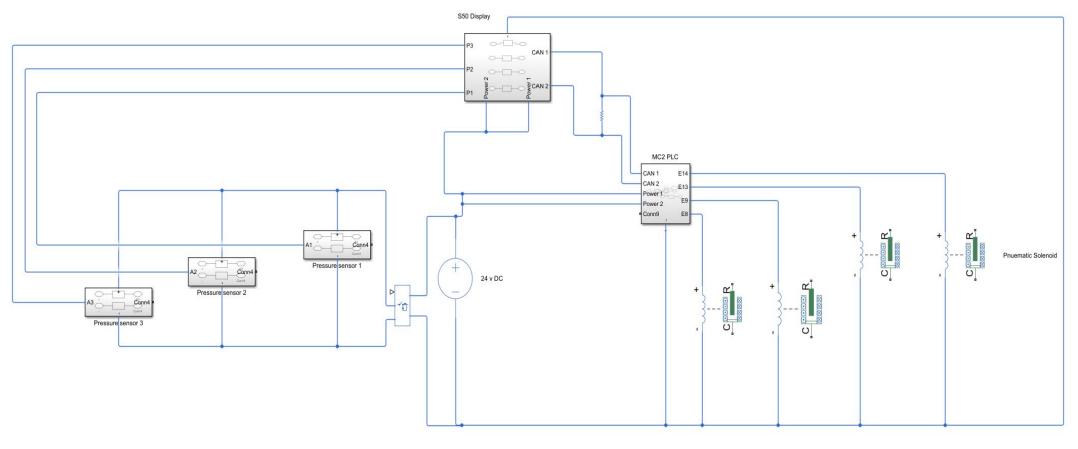
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Final Electrical Circuit









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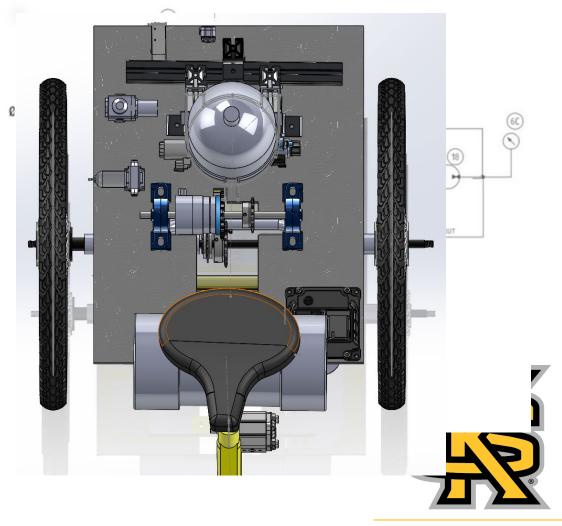
- 6. Regenerative Braking
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Innovative Concepts

- Pneumatic friction clutch
- Intermediate Shaft
- Fail safe direct drive
- Improved weight distribution

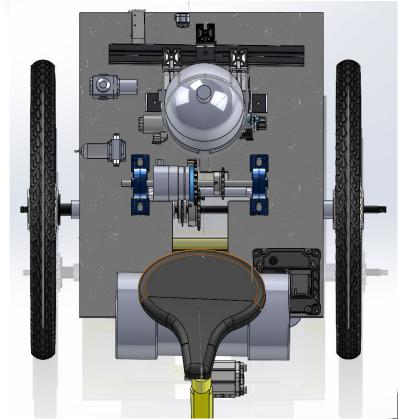




CAD Model

- CAD was used to establish component localization
- Simulation through SolidWorks
- Clearances were estimated even before components arrived







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Lessons Learned



- Calculations don't consider limitations of other components
- No substitute for testing
- Lead times for components vary and must be considered carefully
- Create designs that can be assembled and disassembled easily
- Thankful for our testing time!
- Skilled office managers (like Holly) are a big asset!



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- Ernie Parker, International Fluid Power Society/ NFPA
- Chandlar Armstrong, IFP
- Ben Quade, IFP
- Craig Boezwinkle, Hydac
- Alex Greven, Hydraulic Supply Company (HSC)
- Ethan Williams, KSU Machine Shop Technician
- Mary Pluta, NFPA
- Holly Davis, KSU Mechanical Engineering Office Manager







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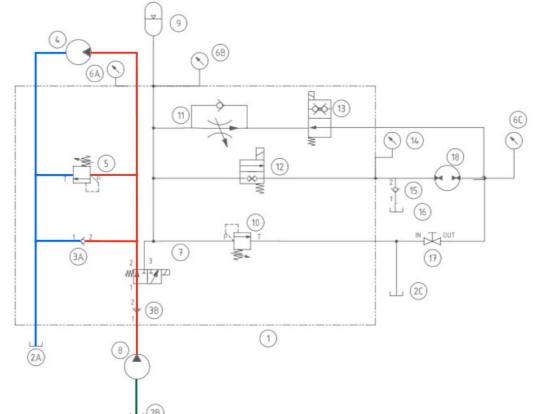




Direct Drive

Accumulator Charge
Accumulator Drive
Regeneration Mode
Accumulator Discharge

Key Benefits: No Solenoid Activation Minimal Pressure Loss

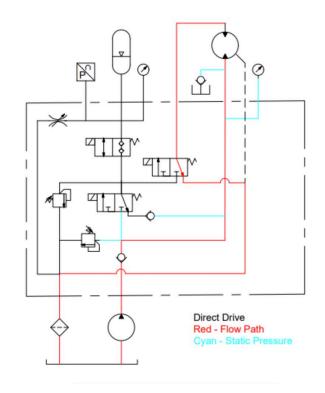




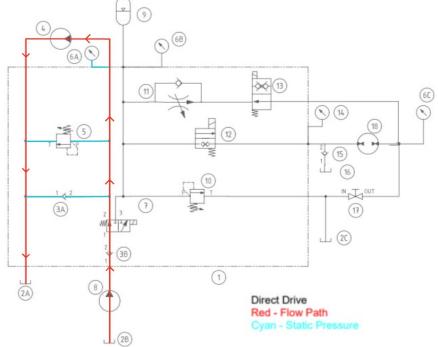
Hydraulic Circuit Direct Drive



2024 Circuit



2025 Circuit







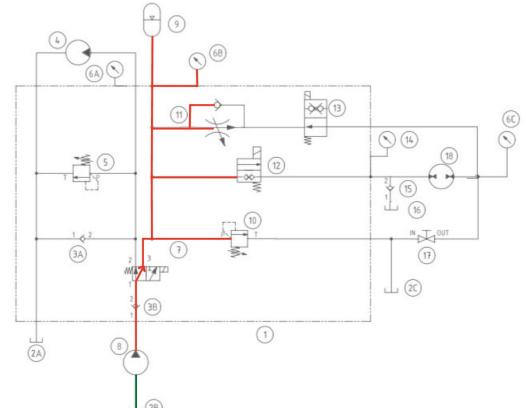
Direct Drive

Accumulator Charge

Accumulator Drive

Regeneration Mode

Accumulator Discharge

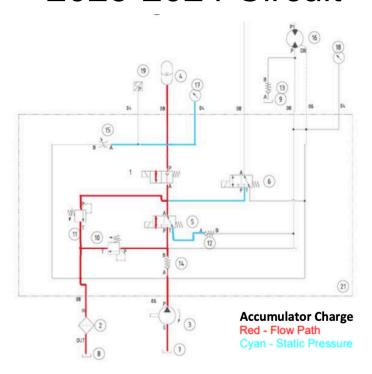




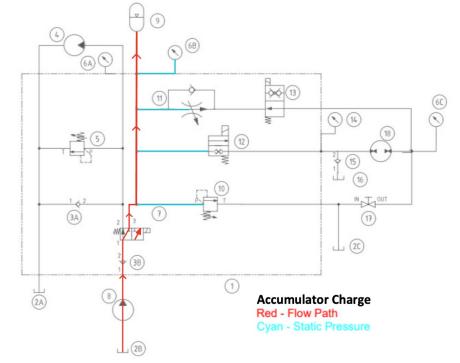
Hydraulic Circuit Accumulator Charge



2023-2024 Circuit



2024-2025 Circuit







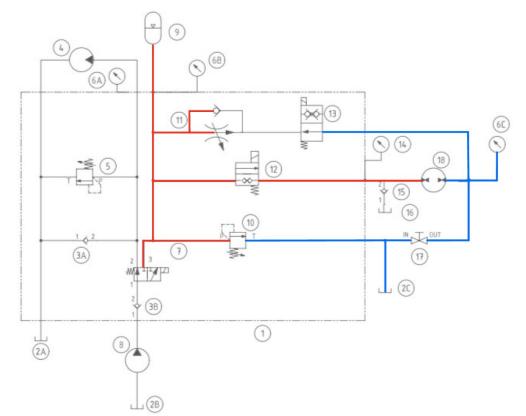
Direct Drive

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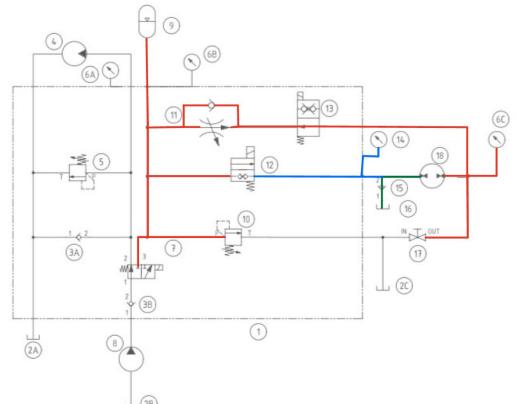
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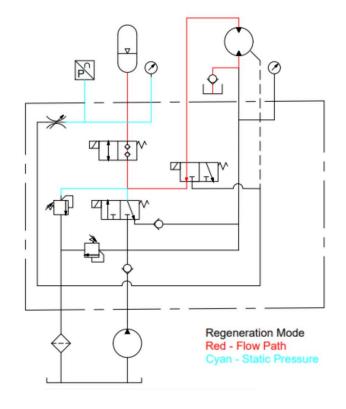
Accumulator Discharge





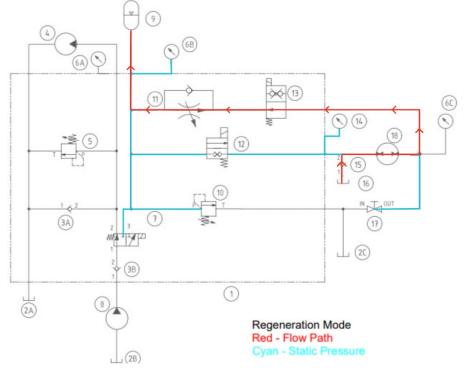
Hydraulic CircuitRegeneration Mode

2023-2024 Circuit





2024-2025 Circuit



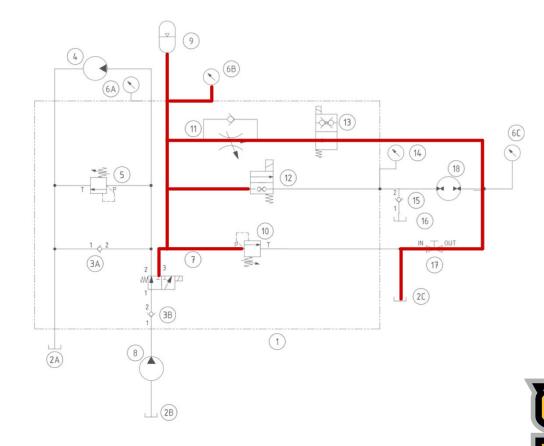




Direct Drive
Accumulator Charge
Accumulator Drive
Regeneration Mode
Accumulator Discharge

Key Benefits: Additional Safety

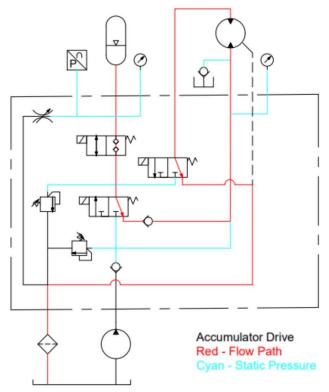
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Hydraulic Circuit Accumulator Drive

Fluid Power VEHICLE Challenge

2023-2024 Circuit



2024-2025 Circuit

