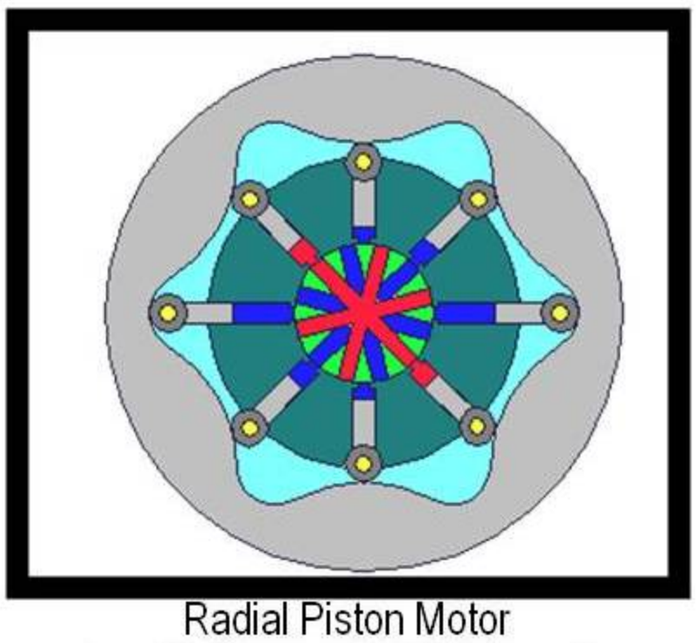
# Free Wheel Valve for Hi-Speed Mobile Application

Keith Mears

April 17, 2008



Radial Piston Motor

Source: http://home.wxs.nl/~brink494/radprnw_e.htm

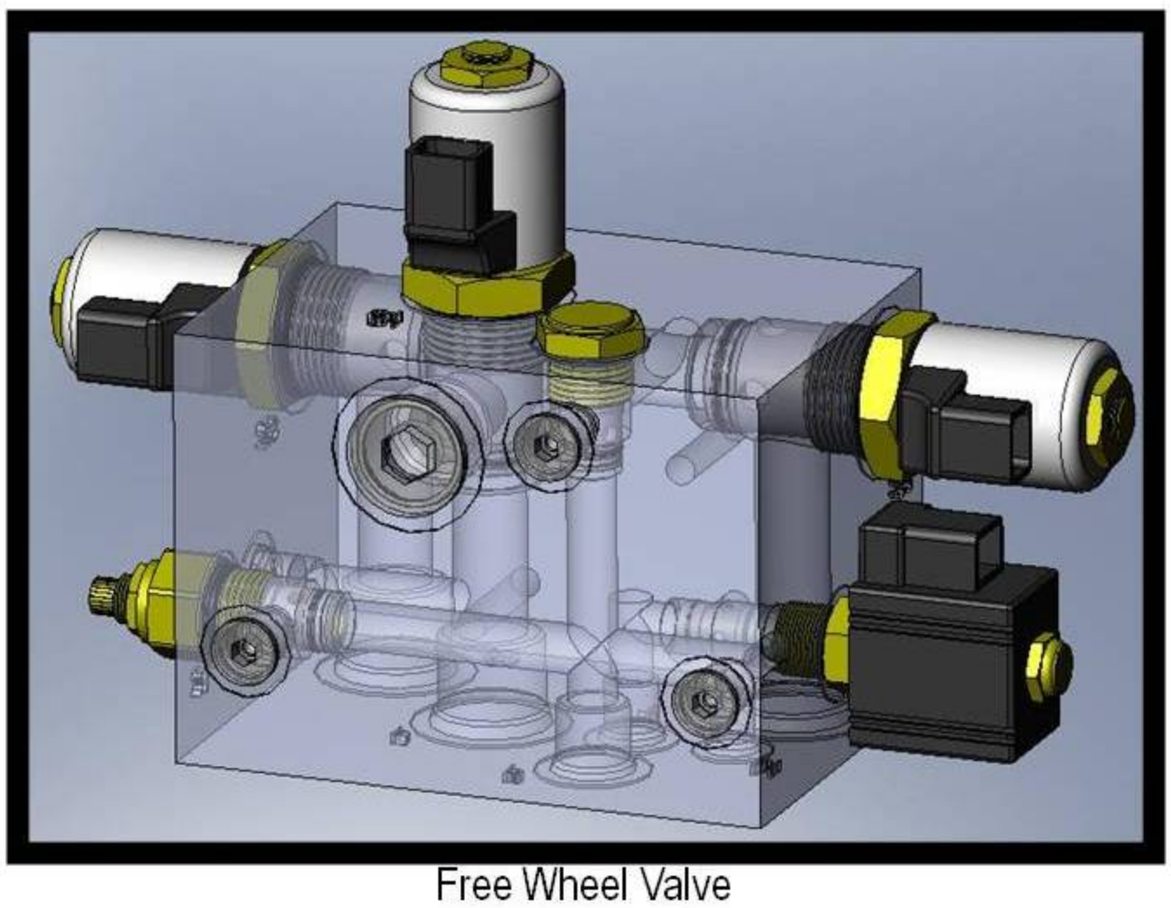
## Problem Statement:

•A radial piston hydraulic motor is powered at low rpm and disengaged at high rpm.

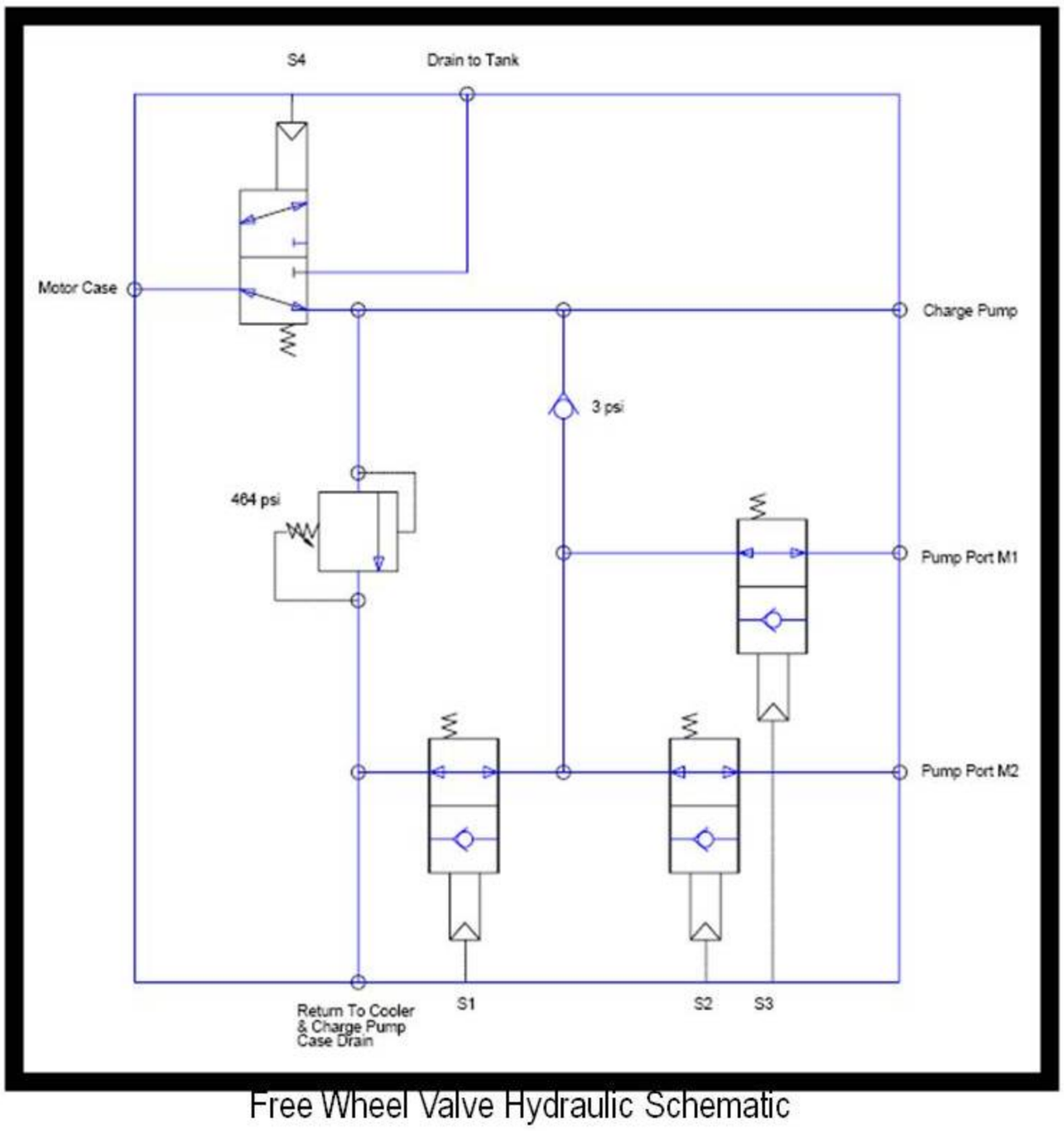
•A Free Wheel Valve is needed to direct hydraulic fluid to hold the motor pistons in a retracted position when the motor is not powered.

## Design Objectives:

1. Design freewheel valve that can be made by TUTHILL Drive Systems at Brookston manufacturing facility.
2. Reduce the cost of the Free Wheel Valve.
3. Simplify the Free Wheel Valve design.



Free Wheel Valve




Free Wheel Valve Hydraulic Schematic

## Design Tasks:

•Determine current system specifications.

•Develop hydraulic schematic.

•Select electronically controlled solenoid valves to shift valve.

•Create a 3D computer model of possible valve design.

•Create an engineering drawing to manufacture valve manifold.

•Test and validate proposed design.

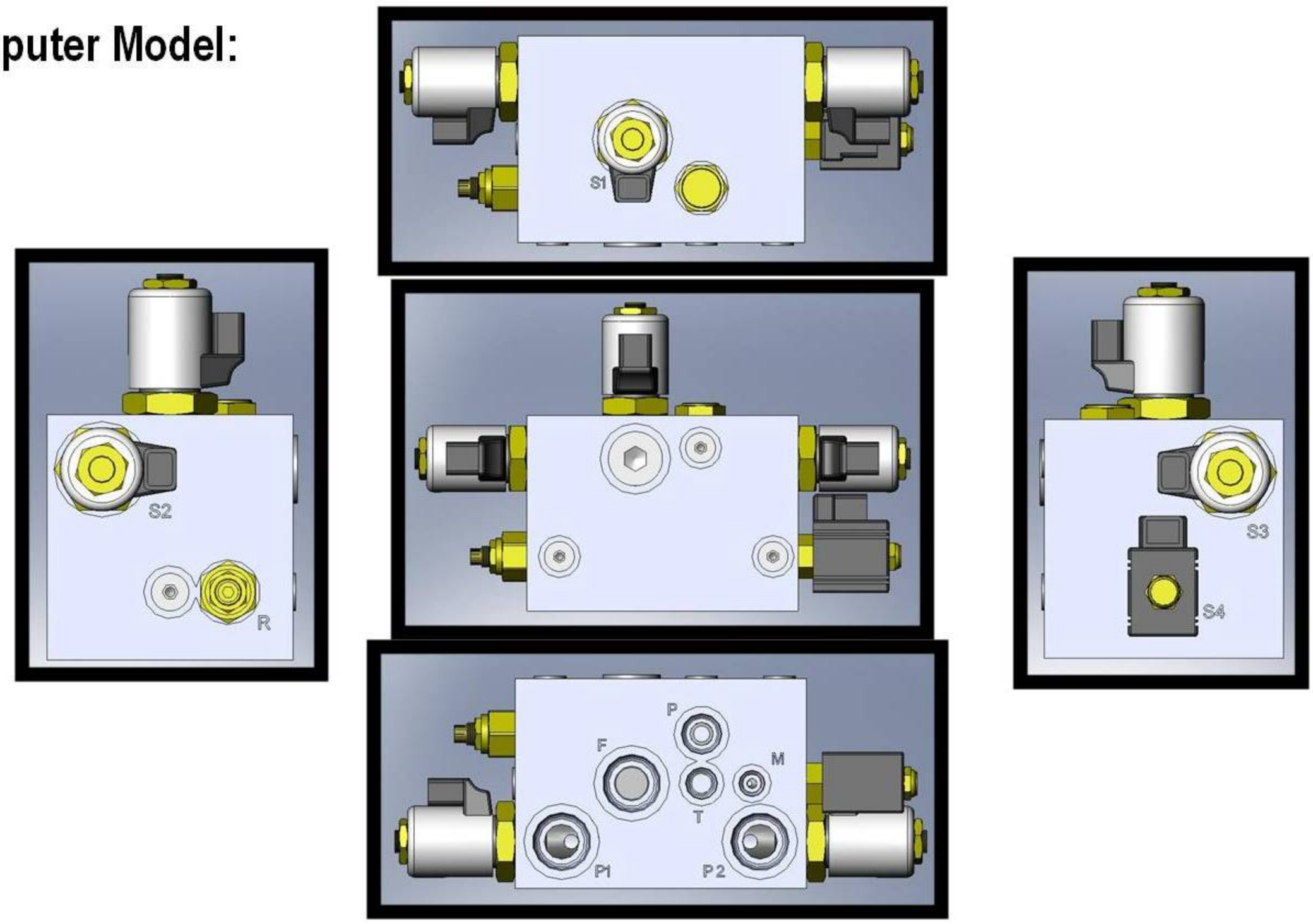
•Complete a bill of materials.

•Prove cost reduction of valve design.

## Design Specifications:

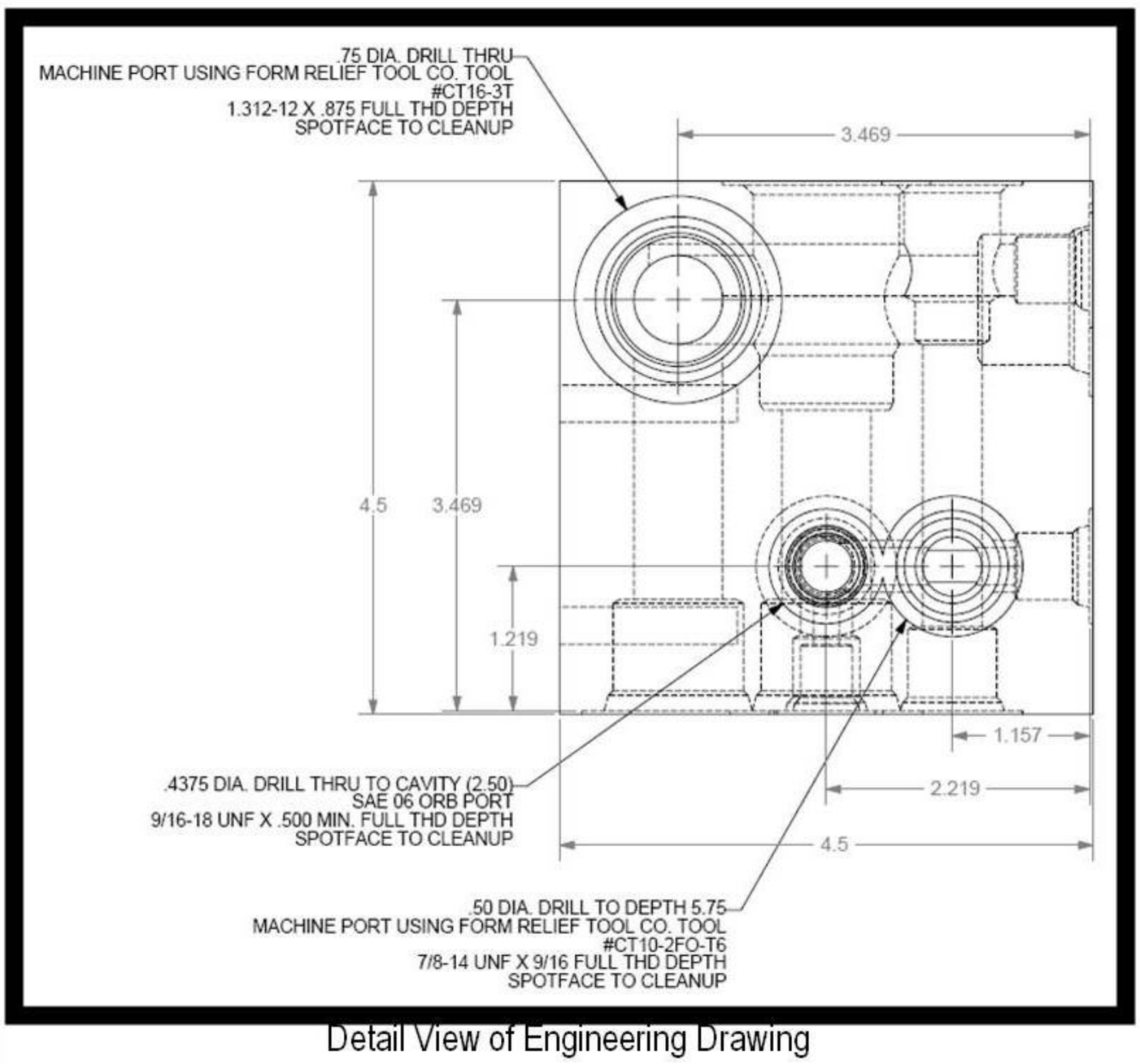
| Pump | Flow Rate (gpm) | Max. Pressure (psi) |
|---|---|---|
| Auxilary | 13 | 3000 |
| System Charge | 17 | 3000 |
| System | 80 | 6000 |

## 3D Computer Model:




## Making the Manifold:

- 3D Model was used to create a detailed engineering drawing.
- Three finishing tools were purchased to machine valve ports.




Detail View of Engineering Drawing

Finishing Tools Used to Machine Ports


Machining a Manifold

PURDUE UNIVERSITY

*Free Wheel Valve for Hi-Speed Mobile Application.*

*Keith Mears. ABE. April 17, 2008*

Tuthill

# Test & Validation:

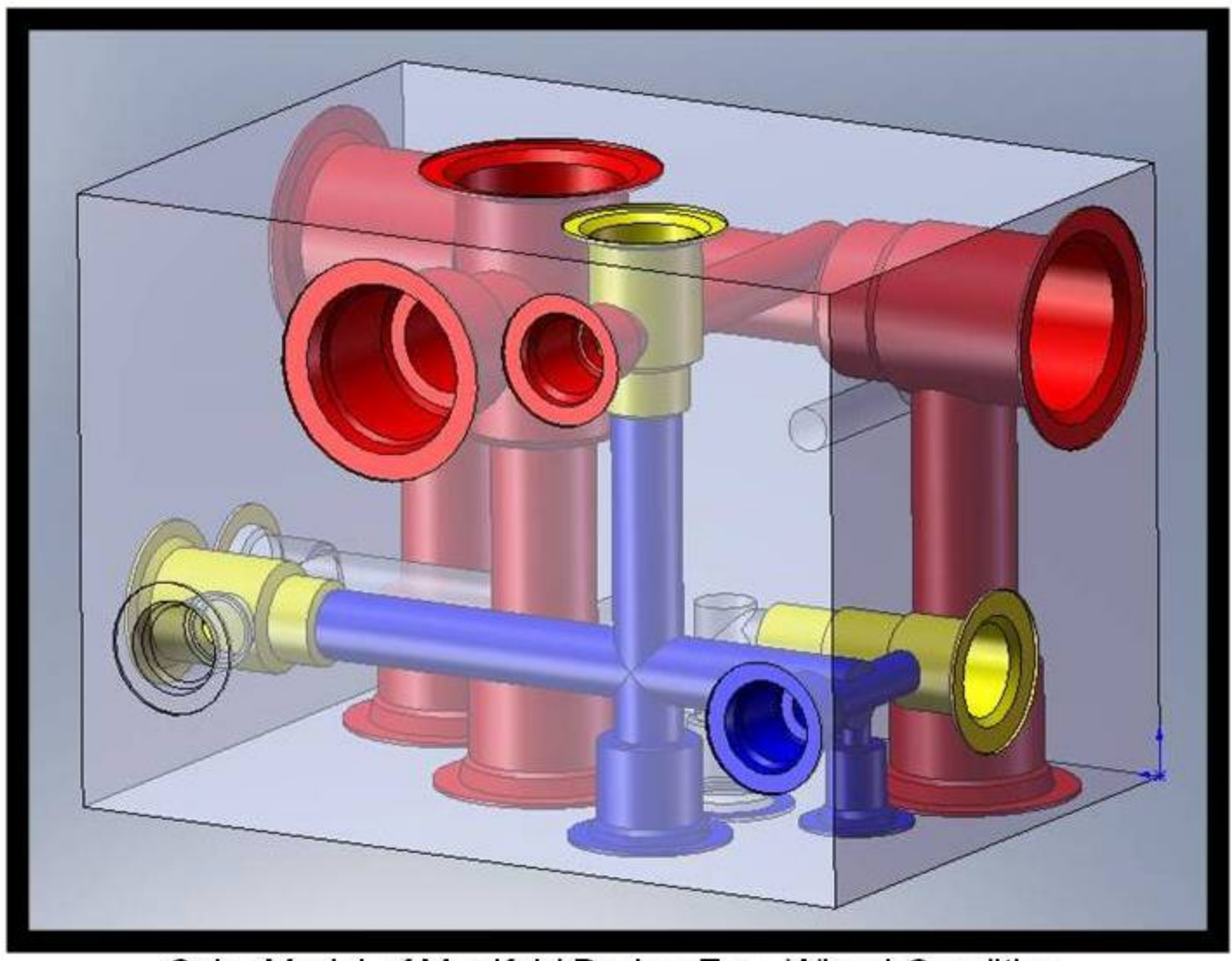
- Test procedure was created based on application requirements.
- Schematic theory discussed and approved for all four modes of operation.
- Manifold tests were conducted using color models.

**Condition 1:** Free Wheeling
**Parameters:** *-Solenoid Valves*
S1: Off
S2: Off
S3: Off
S4: Off
*-Hydraulic Ports*
P: 13 gpm
P1: connected to P2 with loop
P2: connected to P1 with loop
**Results:** F: 13 gpm
T: 0 psi 0 gpm
M: 20 psi 0 gpm

Excerpt from Test Procedure

**Model Legend:**

- **Blue** – free wheel pressure set by check valve
- **Red** – return pressure
- **Yellow** – working valves

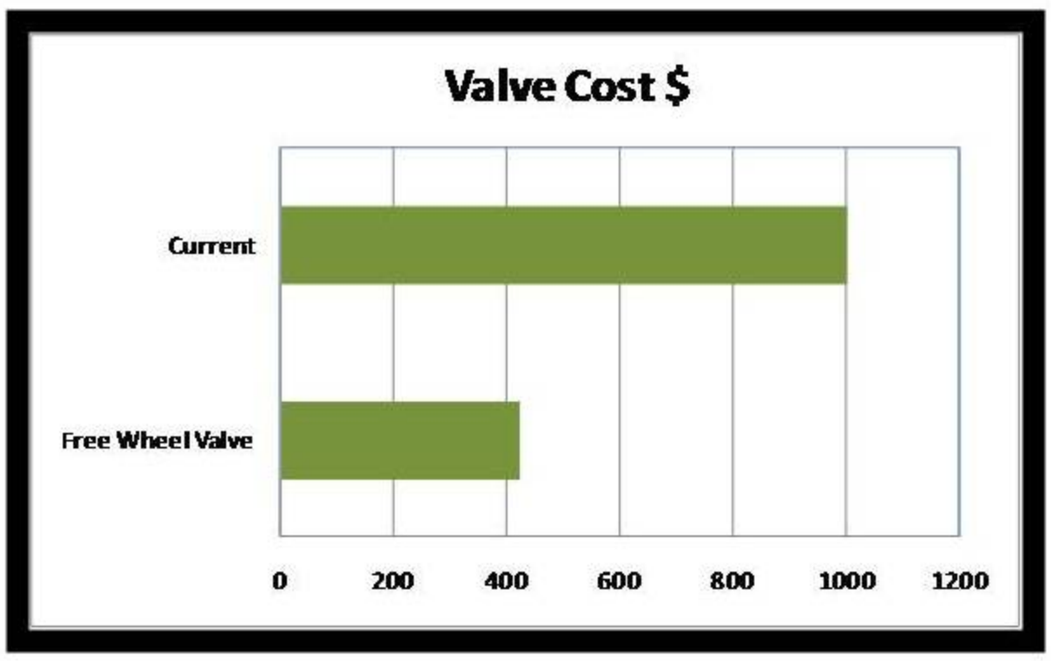


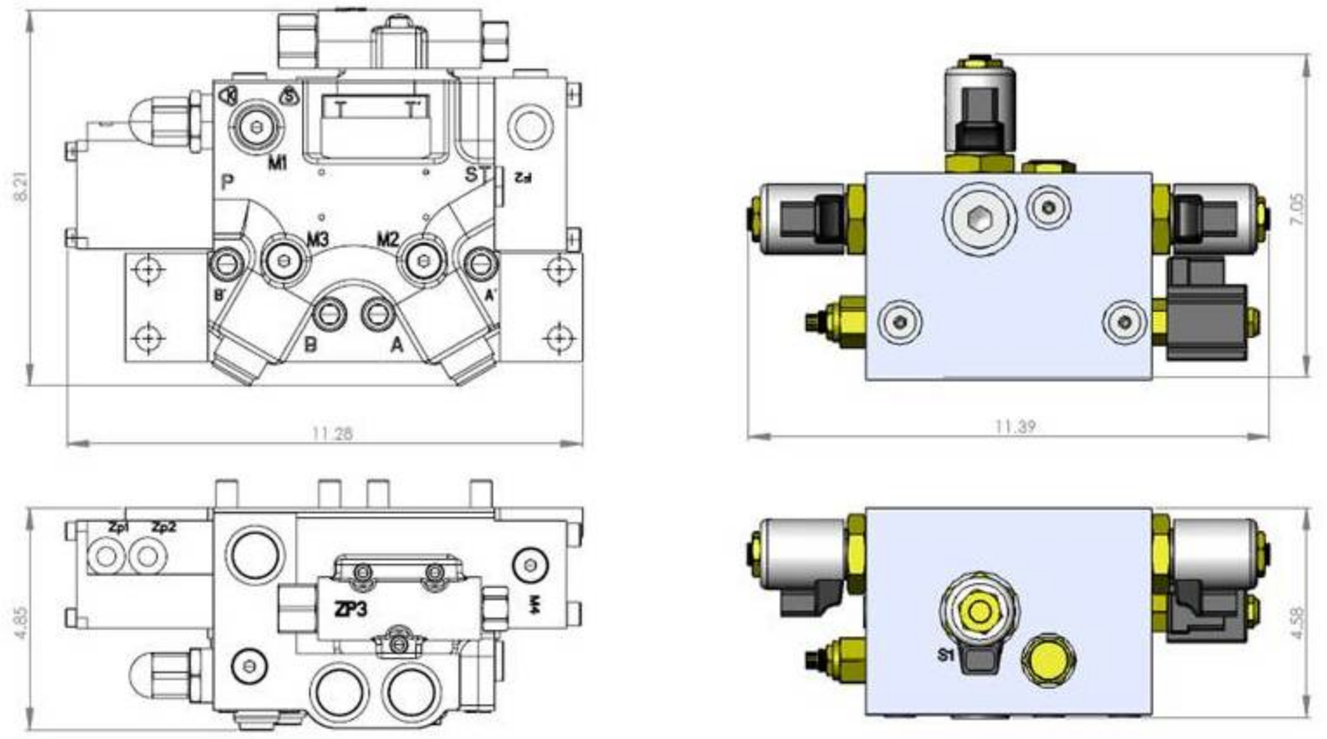
Color Model of Manifold During Free Wheel Condition

# Bill of Materials:

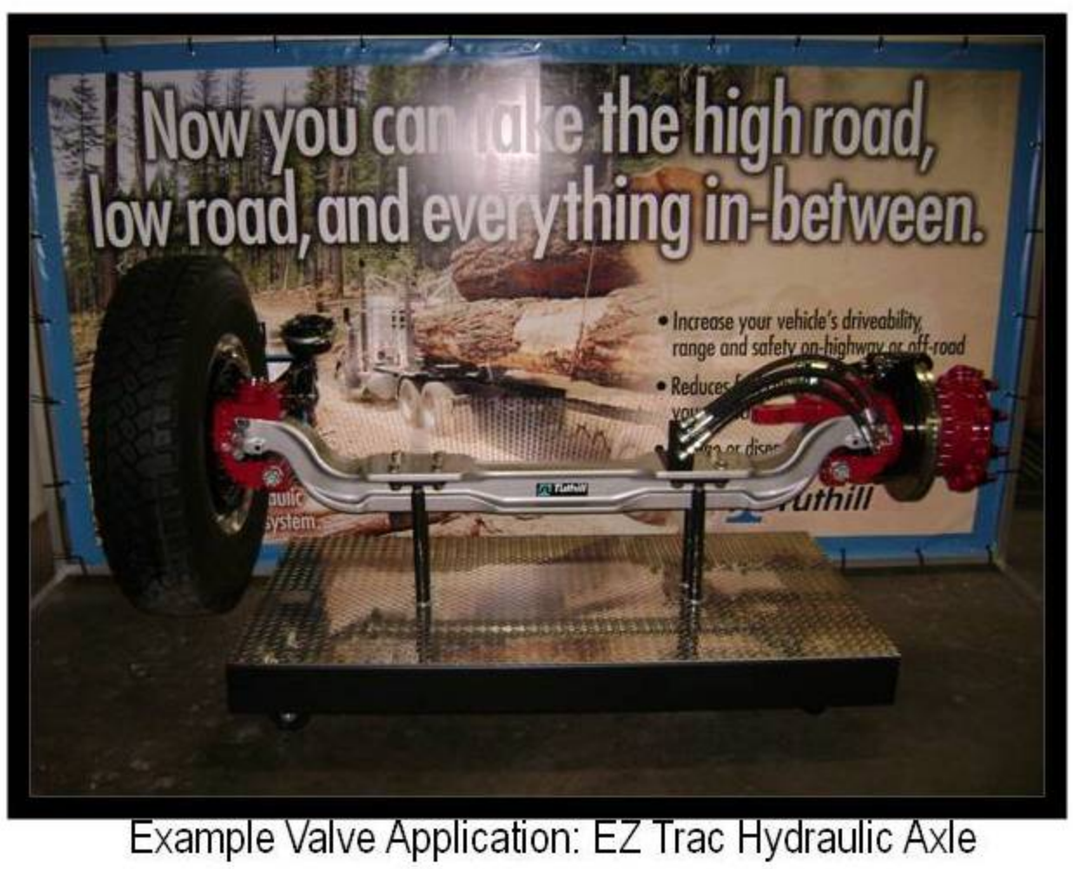
| Supplier | Description | Qty. | Unit Price | Total Price |
|---|---|---|---|---|
| Hydra Air (Parker) | Cartridge Relief Valve | 1 | 39.79 | 39.79 |
| Hydra Air (Parker) | 2-Position, 3-Way Cartridge Valve | 1 | 66.18 | 66.18 |
| EATON Vickers | 2-Position, 2-Way Cartridge Valve | 3 | *85.94* | 257.82 |
| EATON Vickers | Check Valve | 1 | *20.16* | 20.16 |
| Aeroquip | SAE 12 ORB Socket Head Plug | 1 | 1.55 | 1.55 |
| Aeroquip | SAE 06 ORB Socket Head Plug | 4 | 0.40 | 1.60 |
| Central Steel and Wire | 1018 4.5 x 4.5 x 6.25 Steel Bar | 1 | *5.67* | 35.44 |
| | | | **Total=** | **422.54** |

# Cost and Size Comparison:




Size Comparison vs. Current Valve Option




Example Valve Application: EZ Trac Hydraulic Axle

# Acknowledgments:


- Dr. Joseph Irudayaraj – ABE 485 Professor, Purdue University
  josephi@purdue.edu
- Brad Meyerholtz – Engineering Manager, Tuthill Drive Systems
  bmeyerholtz@tuthill.com
- James Smith – Senior Project Engineer, Tuthill Drive Systems
  jsmith@tuthill.com


PURDUE UNIVERSITY

*Free Wheel Valve for Hi-Speed Mobile Application.*

*Keith Mears. ABE. April 17, 2008*

Tuthill