Effective Manifold Design;
An Innovative Manufacturers Perspective In The World of Automation
Lynch Group Infrastructure

- Established in 1987
- 2 Manufacturing Facilities
- 60,000 Sq Feet
- 90+ Employees

- 2013 Production Forecast
  120,000+ Manifolds
Lynch Expertise

Manifold Design & Manufacturing Specialists

- Over 250 years of combined manifold design & manufacturing experience.

- Lynch has the largest dedicated manifold design team & the most advanced automated manifold manufacturing plant in North America.

- Customer Centric, First Class Service:
  - Technical Sales
  - Engineering Expertise
  - International Marketing Support
  - In-house Servo & Valve Repair
Lynch Expertise

Manifold Design & Manufacturing Tools

- Data Management Software – Autodesk Vault Professional
- Schematic Software – HyDraw CAD from VEST
- 3D CAD Software – Autodesk Inventor
- Manifold Design Add-In – MDTools from Vest (Lynch Design Standards)
- CAM Software – FeatureCAM from Delcam
- Machine Simulation – VERICUT
- ERP – SAP
- Machine Scheduling – Lynch custom software
New Request for Quote

New Order Inquiry

Request for Quotation

Checklist

Estimate

Quote

Optional: Modeling and/or HyDraw CAD
Design Requirements

or “What’s your problem”

- Thru Bolts, Tapped Holes or Brackets
- Mounting Style
- Feature Restrictions Valve or Port Locations
- Port Types And Sizes
- Environmental Protection
- Schematic Drawing or Sketches
- Material Preferences
- Anodizing, Plating, Passivation, etc.
- Aluminum, Ductile Iron, Steel, SS, etc.
- Testing and Validation
- Constant, Variable, Return
- Working and Maximum
- Simple, Detailed or Problem
- Voltage and Connector Type
- Continuous or Intermittent
- SAE BSPP Metric Flanges
- Duty Cycle
- Q Flows
- P Pressures
- Example: all valves on top, all ports on bottom
- DNV or ABS Approvals
- FEA required
- Testing and Validation
- FEA required
Work Flow
From Quote to New Order

New Order Inquiry

Request for Quotation

Checklist

Estimate

Optional: Modeling and/or HyDraw CAD

Quote

New Order

New Order Design

Reuse Models & Drawing

HyDraw CAD

If Necessary: FEA

Design Check

MDTools

Inventor

Design

Changes

Customer Approval Drawing

Approved

Final Design

Final Check

Review & Update Changes from Programming

CNC Programming
Design
Work Flow Control and Routing

Manifold Design Routing and Approvals
Using Autodesk Vault Professional

Double click on a state for summary information.
Design

Typical Approval Drawing Layout
Design
Complete Manifold Assembly

True 3D Models

1. Real representation of design allows for component interference checks due to valve orientations or special executions.
2. During Approval the Customer can validate any interference issues prior to any metal being cut.
3. Customer can incorporate models without having to utilize extra engineering resources to reverse engineer parts.
Manifolds

1. A piping system created by a series or drilling and cavities to create a circuit.
2. Cavities allow for Pressure, Flow, Directional and Load Controls.
3. Interfaces are typically to an ISO Standard to allow for ease of component interchangeability.
4. Porting is typically to ISO or industry Standards and selected to suit each application.
5. Ports and Feature ID’s are typically machine engraved to ensure they can be read even after painting.
Design
A body is just a piping system

The Internal Piping System

The negative of the manifold design. This represents only the material that will be removed.
Design
Inventor Model with MDTools Features

MDTools Advantages

1. Library allows for control and consistency of proven design data.
2. Grouping features is simple and pad limits aid in ensuring correct spacing and orientations.
3. Nets create a visual error check which can be run through the software’s own diagnostics.
4. Additionally circuit correctness, wall thickness, connection quality, and component spacing may all be run through the software’s own diagnostics.
5. Design data can be presented to manufacturing in a consistent and easy to understand form.
Wrench Clearances as defined in Machinery’s Handbook

**Table 1. Wrench Clearances for Box Wrench—12 Point**
From SAE Aeronautical Drafting Manual

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**Table 2. Wrench Clearances for Open End Engineers Wrench 15° and Socket Wrench (Regular Length)**
From SAE Aeronautical Drafting Manual; © Society of Automotive Engineers, Inc.

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**SAE Port Design Limits Example**

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1. SAE Port Design Limits are based on tool serviceability not on structural limits
Design
Typical Customer Design

2.75”x2.75”x3.00” Aluminum

1. Poor connections
2. Difficult to deburr
3. Difficult to service
Design
Improved Design

3.00”x3.00”x3.00”

1. Weighs less than ½ lb. more
2. Improved connections
3. Improved deburring
4. Easier installation
Design
Design – 5 Axis Machining

3.00”x3.00”x3.00”

1. Less leak points
2. Improved deburring
3. Easier plumbing and installation
4. Better flow paths
Design Pressure
5000 psi

Material
Dura-Bar 65-45-12

Cavities
Sun T-18AU
Sun T-19AU

Ports
2” Code 62 Flanges
FEA Von Mises Stress Results

Stresses

25.86 ksi max

UTS = 65 ksi min
YS = 45 ksi min

Fatigue Strength = 40 ksi
Displacement

0.001281” max

Design Edge Distance
= 1.500”

Minimum Edge Distance
for T-18AU = 1.625”
Stresses

25.89 ksi max

UTS = 65 ksi min
YS = 45 ksi min

Fatigue Strength = 40 ksi
Displacement

Design Edge Distance

= 1.625”

recommended minimum

0.001068” max

versus

0.001281” max

for 1.5” Edge Distance
Production
New Order Routing

- CNC Programming
- Manufacturing
- Post Processes
- Final Inspection
- Assembly
- Special Finish
- Testing
- Shipping

- Stand Alone
  - 3 Axis Vertical Milling (x3)
  - 4 Axis Horizontal
- FMS 52 Pallets
  - 4 Axis Horizontal
  - 5 Axis Vertical
- 16 Pallet Pool
  - 5 Axis Vertical
  - 3 + 2 Axis Vertical
- Robot Tended
  - 9 Axis Lathe
  - 5 Axis Vertical
  - 5 Axis Horizontal
Technology
24/7 ‘Lights-Out’ Operation
Technology
24/7 ‘Lights-Out’ Operation

52 Pallet FMS
(Flexible Manufacturing System)
Technology
Advanced Tooling For Advanced Machining

- Over 7000+ Cutting Tools In-House
- Tool Breakage Detection
- Automatic Tool Changers

Tool Management

FMS Tool Hive
Technology

24/7 ‘Lights-Out’ Operation
Technology
24/7 ‘Lights-Out’ Operation

5-Axis Machining Centers
Technology

24/7 ‘Lights-Out’ Operation
Technology
24/7 ‘Lights-Out’ Operation

Robotic Cells

Machine Tending Robots
Competing at a Global Level
Technology
Final Stages to Ensure Stringent Quality

- Ultrasonic Cleaning
- Manual Deburring
- Robotic Deburring
- Customized Laser Engraving
- Final Product Inspection
Technology
Metrology – Precise Measurement
Technology
Metrology – Precise Measurement

Coordinate Measuring Machinery
Technology
Inventory – Paperless Assembly – Packaging

Final Assembly
Paperless System

Over US$1 million parts in Inventory

Foam Injected Packaging for part protection during shipment
International Quality Standards

At Lynch, our Quality Management System extends beyond how we conduct business. It has become part of our company culture.

Your manifolds are fully deburred, inspected and assembled by our trained specialists to ensure perfection every time.

ISO 9001:2008

AS 9100

CGP Certified
Technology
Continuous Improvement

1785 Argentia Expansion Project – Mid Term Plans
• Automated Bar Manifold Production Cells
Rule 1
Design it with the thought that you will be the one servicing it in the future.

Rule 2
Listen to the customers’ problems and supply him the solution he needs.

Rule 3
If there are any doubts about your solution, be conservative and/or build in contingencies into the circuit.
Thank You