Homeland Security
Science and Technology

INSTITUTE FOR INFECTIOUS ANIMAL DISEASES
A Department of Homeland Security Science & Technology Center of Excellence

Design, construction, and testing of a low-maintenance, low-cost, vehicle tire and undercarriage cleaning and disinfection facility to enhance biosecurity at concentrated animal feeding operations

Project Final Report: August 26, 2016

Program Period of Performance: February 27, 2015 – August 26, 2016

Program Contractor:	Dr. Gerald Parker / Dr. Robert DeOtte
Program Sponsor:	DHS – Science & Technology Directorate
Program Manager:	Dr. Michelle Colby / Ms. Lori Miller
Award Number:	HSHQDC-15-J-00092
Submitted:	26 August 2016

Table of Contents

1. Project Summary/Abstract

Highly infectious diseases of livestock, such as foot-and-mouth disease (FMD), are of particular concern to the Texas Panhandle and the greater High Plains. The states of Texas, Oklahoma, Kansas, Nebraska, Colorado, and New Mexico account for approximately eighty percent (80%) of fed beef in the United States. Approximately thirty percent (30%) of fed beef are within 150 miles of West Texas A&M University (WTAMU), located in Canyon, TX. Recognizing the potential for economic devastation if FMD was introduced to the High Plains, it was proposed to have engineering students at West Texas A&M University, Canyon, TX design an undercarriage and wheel wash to enhance biosecurity at concentrated animal feeding operations (CAFOs). Student teams in two successive semesters proposed designs. Although both teams demonstrated ingenuity, neither could be adopted because of practical limitations associated with construction and maintenance. To address the need for an undercarriage and wheel wash that could meet the objectives outlined in the statement of work, a unit manufactured by a commercial vendor was identified and installed at a cooperating beef cattle feedyard. On 17 August 2016 personnel from DHS, USDA APHIS, USDA NRCS, IIAD, and WTAMU were able to see the unit in operation and it adequately satisfied the requirement that a visible improvement in cleanliness of the vehicle was apparent after use of the undercarriage wash. As a result of this work USDA NRCS is interested in developing protocols for installation and operation undercarriage and wheel wash systems at livestock and poultry facilities. Further, NRCS is currently exploring mechanisms by which further research may be conducted on the wash unit installed in the Texas Panhandle.

2. Program Deliverables

Deliverable	Description/Methods	Date Completed
Phase I		
DRAFT technical design documents and engineering economic analysis of the options, including blueprints for construction	**Engineering students at WTAMU in successive semesters designed undercarriage and wheel wash systems. While the students exhibited energy, learned a great deal about animal feeding operations, and demonstrated ingenuity, neither design was deemed feasible for construction.** **With DHS approval, emphasis changed to identifying a commercially available unit.** **The Stanton Systems STB-30 was chosen. After observation of a unit at a construction site, the feedyard manager requested a modification of the design to better clean the undercarriage. Stanton Systems was able to comply.**	Wash received on site 27 June 2016 Installation completed 15 August 2016 Demonstration of unit 17 August 2016

Deliverable	Description/Methods	Date Completed
	Because this is a commercial unit, design documents were not provided.	
FINAL technical design documents and engineering economic analysis of the options, including blueprints for construction	Commercial product identified. Because this is a commercial product, there will not be design documents. Installation and specification documents appear in Appendix A.	24 August 2016
Site recommendation and draft of proposed agreement	Texas Cattle Feeders Association identified a member feedyard willing to cooperate	May 2015
Finalized agreement for installation site	Upon finalization	DHS and IIAD approved the land use agreement between Quien Sabe Feeders and WTAMU. Finalized 28 June 2016
Phase II		
Complete prototype of undercarriage wash	No prototype being developed as a commercial product was identified and installed: Stanton Systems STB30 has been installed.	15 August 2016
"As built" drawings to capture any deviations from original design (if necessary)	Installation is documented through photographs and installation instructions.	24 August 2016
FINAL report of design assumptions and lessons learned during testing		26 August 2016
Installation/user guide	Provided by Stanton Systems	24 August 2016
Presentation at the Fifth International Symposium on Managing Animal Mortalities, Products, and By-Products and Associated Health Risk	No data to present and papers were due 31 July 2015. Will seek other venues – perhaps ASABE, AVMA, NIAA.	
Presentation at the Conference of Research Workers on Animal Diseases (CRWAD) in 2014 or 2015	An abstract is in preparation for submission by 9 September 2016 deadline.	Anticipated 9 September 2016

3. Project Outcomes

The project had two major outcomes:

1. Civil and mechanical engineering students, in two different semesters, were given the opportunity to design an undercarriage and wheel wash knowing that the intent was to construct the unit once the design was approved. Neither design proved feasible because of some complex constraints that the students were unable to address. Never-the-less, the educational experience was extremely valuable as they had to learn new things to begin the design. The ABET program evaluators reviewing the civil engineering program commented on the rigor and innovation of the project and the quality of the first groups written report and presentation.
2. An affordable undercarriage and wheel wash was installed at a cooperating feedyard in the Texas Panhandle. The unit is operational and achieved the objective of providing visual evidence of cleaning. The installation and operations manuals are included in Appendix A. The material safety data sheet for the flocculent HYPERFLO AE 800 is contained within that manual.

The commercial undercarriage and wheel wash unit, Stanton Systems STB 30 – modified, provides an economical and effective means of removing significant undercarriage debris, thus reducing the potential for one mechanism of disease spread. Pictures of the unit may be found in Appendix E.

The design of the original base unit was modified. An additional central channel was installed in the bottom unit to enhance wash from below. This was done at the expense of water spraying from the side wash. Other alternatives would not fit within the allocation for this project. This does reduce efficacy for side wash.

Discussion of Photographs (Appendix E)

Figure 1 shows side and bottom jets with no vehicle driving. The heights of the jets in the wash modified for this project are similar in Figures 11, 12, and 13. Figure 2 shows the central channel installed for the Texas feedyard. Figure 3 shows a concrete truck driving through the wash in Fort Mill, SC. The “Before” pictures did not adequately show the debris before driving through and shadows make it difficult to see how clean the bottom is, but visual inspection did confirm significant cleaning. Figure 4 is the installation at the Texas Panhandle location. The picture was taken prior to installation of the concrete aprons. As stated above, to provide adequate water for the central channel, water was diverted from the side wash. Figure 5 shows the nozzles blocked for the Texas installation while the right hand side portrays a typical side wash manifold. Figures 6 and 7 show aspects of the installed wash. Figures 8 and 9 confirm that the truck was washed by passing through the undercarriage system. Figure 9 is slightly cleaner. The unit was modified to reduce the efficacy of the side wash to improve the undercarriage wash and there was not a vehicle available that had sufficient caked mud to demonstrate that cleansing. Figures 11, 12, and 13 show the height of the water jets.

Visual inspection was better in both South Carolina and Texas at supporting the concept that the vehicles were cleaned. Further documentation with dirtier vehicles and better lighting at the Texas site will provide this confirmation. The PI anticipates that at some point this will happen, though it will occur (at no additional cost to this contract) beyond the period of performance.

4. Discussion of Project Deliverables, Impact, and Conclusions

The final deliverable is an undercarriage and wheel wash that has been installed at a feedyard in the Texas Panhandle. The original concept was to have senior engineering students (civil and mechanical) design the wash system incorporating principles learned from courses in environmental engineering, structural engineering, fluid mechanics, systems controls, and engineering economy. After two attempts with students, the decision was made to search for a commercially available unit. The engineering consultant, EnviroAg Engineering identified the Stanton Systems STB 30 as appropriate for the purposes of the project.

The unit uses approximately three gallons of water per full tractor-trailer wash, an important consideration in the water constrained High Plains which includes the Texas Panhandle. Further, there is no waste water with which to deal, making operation environmentally friendly. This is accomplished in part by addition of a flocculent (Hyperfloc AE 800, AE 800 LLP Series supplied by HYCHEM, INC., 10014 N. Dale Mabry Hwy, Suite 213, Tampla, FL 33618) to the water, which provides discharge solids with only two to three percent moisture content.

Observation of a unit at a construction site in South Carolina indicated a strong potential for success. After discussions with the feedyard managers, the PI instructed Stanton Systems to make modifications to the base unit which included adding a central channel in the undercarriage wash. This required diversion of water from the side wash, but suited the feedyard operator better. Observations at the feedyard approximately 30 miles south of Amarillo, TX indicated that the objective of visibly verifiable removal of surface soil was met.

If, after further testing, the feedyard finds the unit beneficial, it is likely that other yards will install.

5. Discussion of Potential Follow-on Efforts

During the final conference call for the project, Glen Carpenter of USDA NRCS suggested that his agency is interested in finding additional funding for further research using the undercarriage and wheel wash. The land use agreement signed between West Texas A&M University and the cooperating feedyard does provide for future research opportunities. NRCS is also pursuing detailing specifications and operational procedures for biosecurity at feedyards to include under carriage and wheel wash stations.

6. Challenges Encountered

The major challenge encountered was having senior engineering students design a complex system within the one semester time frame. While students are encouraged to use off-the-shelf technology to an extent, it would not have been an adequate design experience for them to have identified the Stanton System STB 30. The students had a tendency to make the designs too complicated, thereby increasing operational expense, as they demonstrated in their economic evaluation.

The design experience was good. Both the civil and mechanical engineering programs are ABET accredited. The ABET program evaluation team for civil engineering reviewed the designs and were favorably impressed with the rigor of the experience, but they too recognized the difficulty of balancing design with the use of available technology.

The second challenge was coordinating a site visit for key personnel to view a Stanton Systems STB 30 unit in operation and reconfiguring the wash to better meet requirements of the program.

7. Steps Taken to Resolve Challenges

When it was determined that the students had not produced a fully workable design, the decision to seek a commercial unit provided the opportunity to obtain a unit that could be easily applied to livestock production biosecurity needs.

A site visit to an Earnhardt Grading construction site in Fort Mill, SC, was conducted on 9 May 2016. Attending the visit were Michelle Colby (DHS), Lori Miller (APHIS – by phone), Heather Manley (IIAD), Bill Sleigh (feedyard manager), Jeffrey Porter and Sandy Means (USDA NRCS), and Erick Emerine (EnviroAg Consultants). After observing the undercarriage and wheel wash in operation, the team was favorably impressed. However, there was concern that while the wash did a good job on wheels, it mostly missed the central undercarriage. To remedy this challenge, the unit was modified to include an additional center channel.

8. Impact of Challenges on Original Timeline

The first challenge pushed the timeline back by about two months as EnviroAg searched for a commercial unit that could be used as an alternative to a student design. However, because the unit was prefabricated and required installation only and not on-site construction, that time was recovered.

The second challenge associated with the site visit pushed the time line by about three months. If fewer people could have been involved, the visit could have happened in February 2016.

The undercarriage and wheel wash were installed before the end of the period of performance, and a site visit confirmed that the unit performed as specified in the deliverables. Further testing could not be conducted due to reaching the end of the period of performance.

9. Customer Requirements and Engagement

The STB 30 is installed at a feedyard in the Texas Panhandle and both feedyard managers have been fully engaged in the process. The first manager continues to monitor outcomes and the current manager is very supportive. The feedyard has committed resources for operation of the unit and will continue to allow research using the unit once ownership is transferred. The unit is permanently installed on the feedyard and that management is responsible for all operations and maintenance, even during research efforts.

At some level, though, the feedyard is not the customer. The customer is the industry that is trying to improve biosecurity to reduce the risk (probability times consequences) of spread of a highly infectious livestock disease such as foot and mouth disease. The industry, likewise, is engaged and monitoring outcomes.

10. Students, Post-Doctoral Fellows, and Others Trained

No post-doctoral students were involved in the project. Two groups of undergraduate students attempted to design an appropriate undercarriage and wheel wash; the first in spring-summer 2014 and the second in spring 2015. The first team consisted entirely of civil engineering majors while the second team included civil and mechanical engineering students. In all, eighteen civil and four mechanical engineering students worked on the designs.

Both teams had to research operation of livestock facilities, which was a new exposure for most of them. They explored nuances of livestock diseases, management of resources in an emergency response, and the practical application of designing with financial constraints.

The second team had to reconcile the different perspectives of mechanical and civil engineering students. Though the basic course requirements are similar, the types of design emphasized are substantially different. Learning to work as a team was a very positive outcome for those students.

11. Publications and Presentations

No publications have been submitted nor presentations made to date; however, an abstract is in preparation for submission to the Conference of Research Workers in Animal Diseases. The abstract deadline is 9 September 2016.

The undercarriage and wheel wash was discussed at the Amarillo Meat Packer Workshop on 15 August 2016.

12. Intellectual Property

Since a commercially available product was used, there is no new intellectual property and all patents remain with the vendor.

13. Technology and Innovation

An undercarriage and wheel wash used at construction sites was modified for use and installation at a feedyard to enhance routine and heightened biosecurity. The unit was modified to provide more water for washing under the vehicle, at the request of the feedyard representatives at the sacrifice of water to wash the side of the vehicles.

14. Progress or Plan Toward Technology Transition

USDA NRCS is interested in providing follow-on funding to better characterize the efficacy of the wash unit. If adequate, either with or without modification, the agency will develop guidelines for use at livestock operations such as feedyards and dairies.

15. Patents and Potential Patent Disclosures

None.

16. Leveraged Funding Directly Supporting this Effort

The time dedicated by Dr. DeOtte, WTAMU PI, and his students to the project were in-kind contributions.

USDA NRCS, as mentioned previously, hopes to secure funding for follow-on activities, but that is not secured as this project closes out.

17. Final Balances of IIAD Funding

Budget as of July 31, 2016:

Expense	Amount Budgeted	Current Balance	Current Month Expenses	Spent to Date	% Spent / Budgeted
Salaries & Benefits	N/A	N/A	N/A	N/A	N/A
Travel	N/A	N/A	N/A	N/A	N/A
Subawards	$92,536	$88,053.25	$0.00	$4,482.75	4.84%
Indirect Costs	$47,464	$45,424.35	$0.00	$2,039.65	4.30%
TOTAL	$140,000	$133,477.60	$0.00	$6,522.40	4.66%

Project has encumbered and expended remaining funds, which will be reflected in future invoices. Funds shown above in the table above reflect those that have been completely processed through the TAMU accounting system.

18. Appendices

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Appendix A – Stanton Systems STB 30 Manual

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STB 30
Portable Tire Wash

As Seen on
Modern Marvels
History Channel

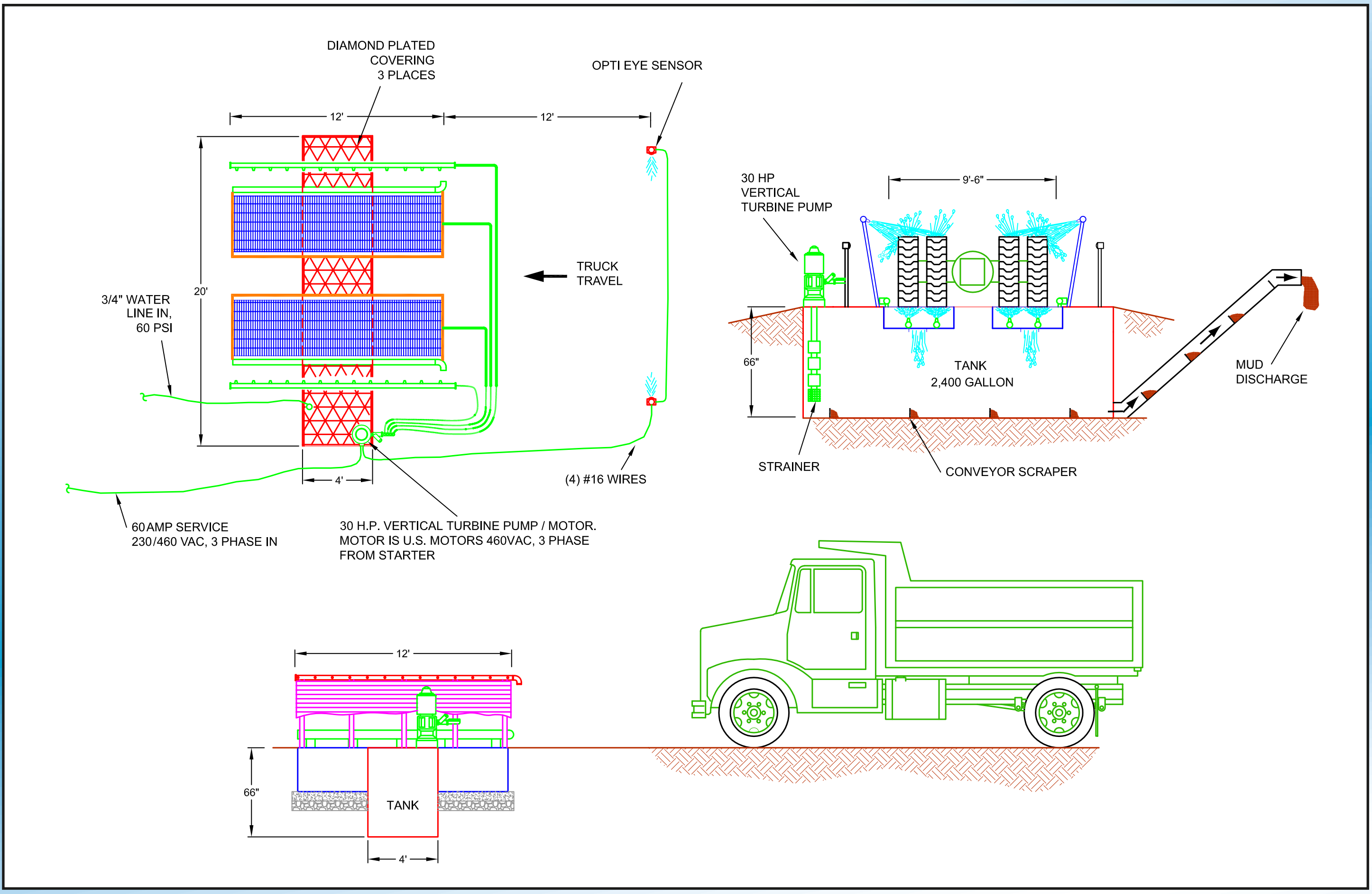
- *One Tire Rotation!*
- *230 - 460 Volts*
- *5 Year Warranty*
- *30 H.P.*
- *Installs in One Day*
- *In Stock*

STANTON SYSTEMS

Visit our website for more action videos and more photos!
www.tirewash.com

www.tirewash.com
215-956-9800

STB 30 Tire Wash



Stanton Systems ...

- Manufacturing Tire Wash systems in America since 1986
- The most economically priced tire wash systems
- 230 or 460 volts required
- Other systems available: STB 75, 100, 200
- No maintenance
- Coatings available: painted or galvanized
- Leased and rental systems available

MADE IN THE USA

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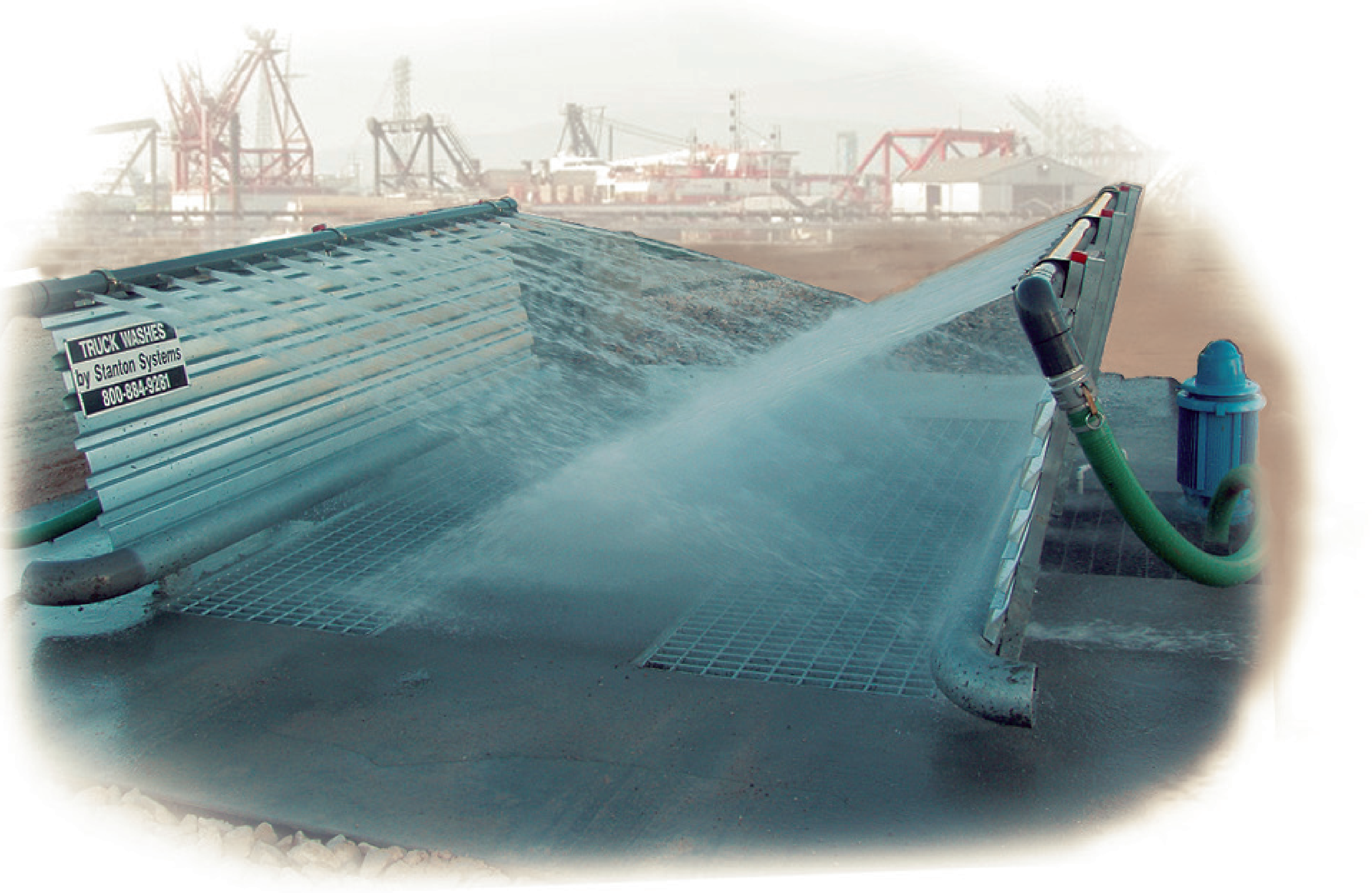
STB-30 / STB-75
Portable Tire Wash
Installation



STANTON SYSTEMS

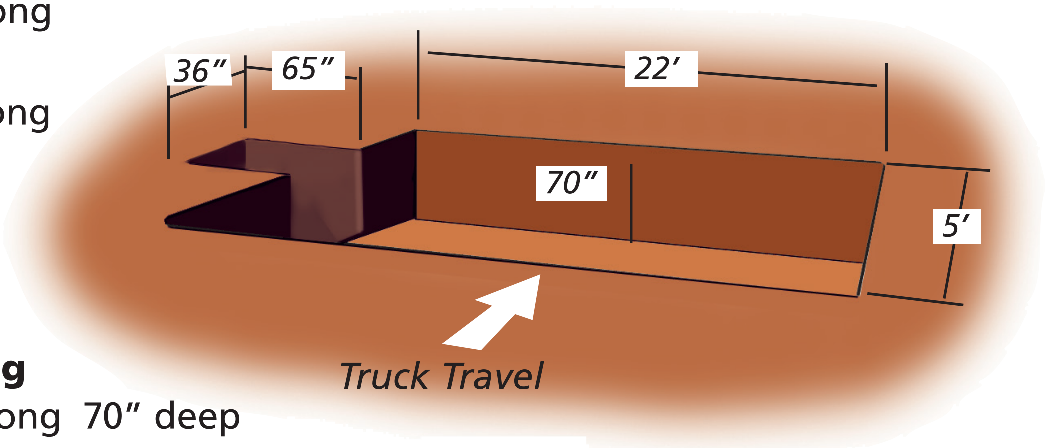
STB 30 and STB 75 Installation

Excavation:

Locate where Tank and Troughs will be laid out on ground.

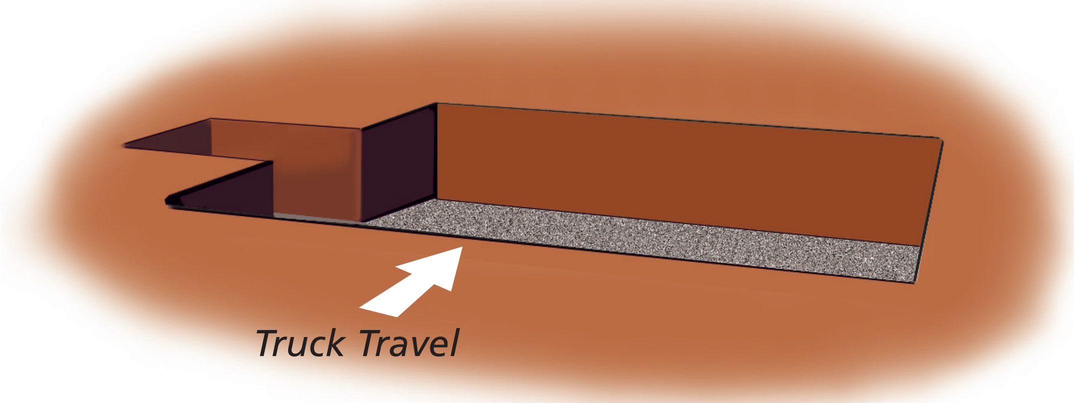
Tank Size

STB 30: 20′ wide x 4′ long
66″ deep
STB 75: 20′ wide x 8′ long
96″ deep



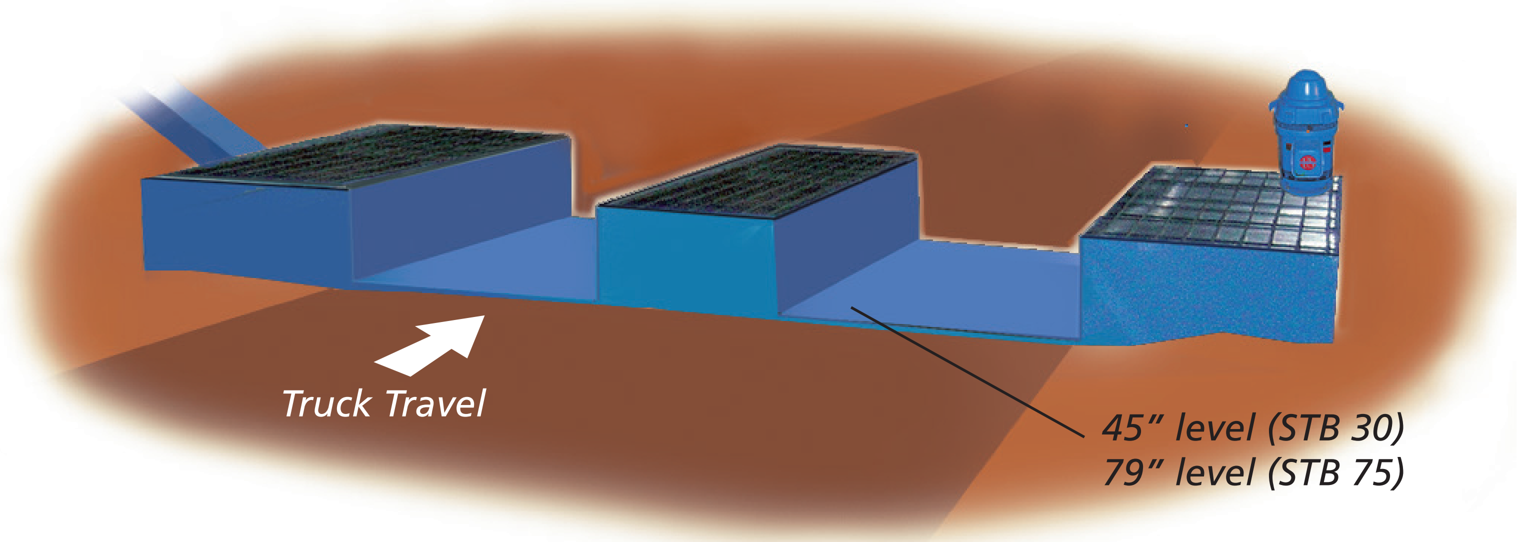
Dimensions of opening

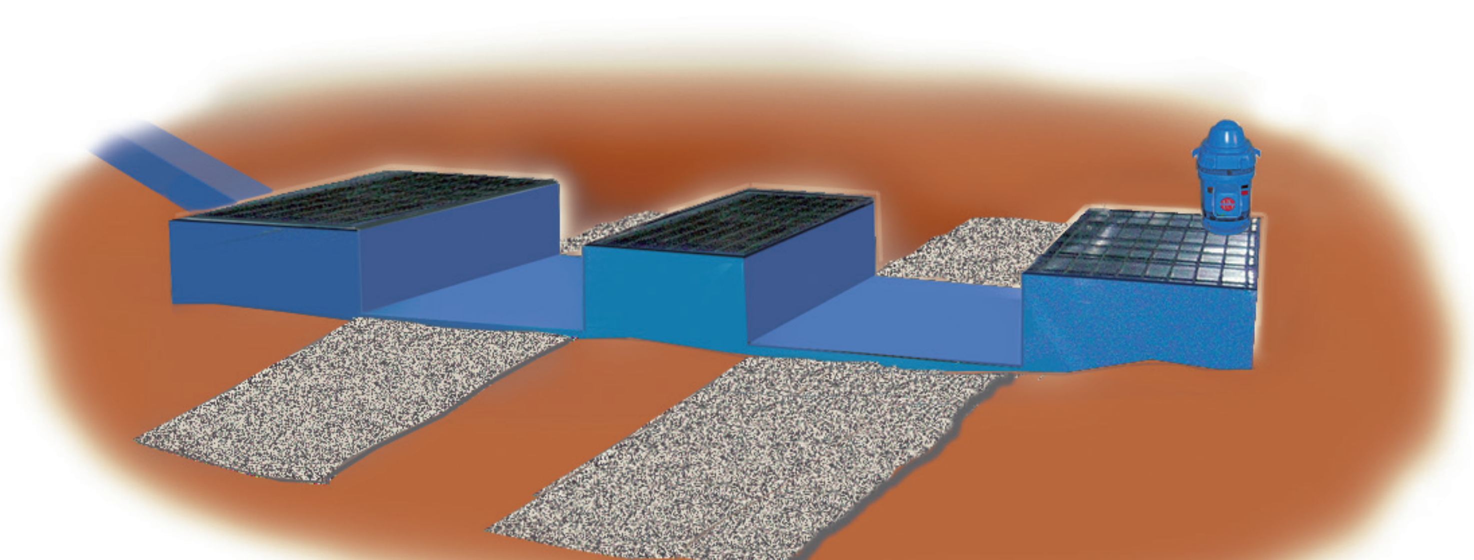
STB 30: 22′ wide x 5′ long 70″ deep
STB 75: 22′ wide x 9′ long x 100″ deep



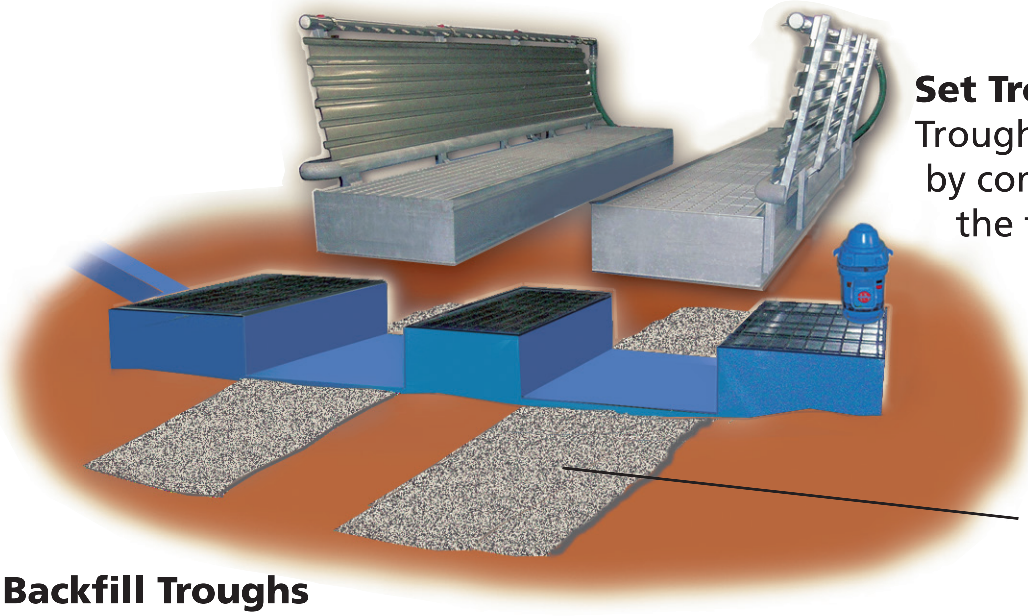
Compact 4″ of stone in excavation.

Lower Tank into opening. Backfill Tank up to the 45″ level (STB 30) or 79″ level (STB 75) on tank. Tank level is measured from bottom of tank and is marked at the factory





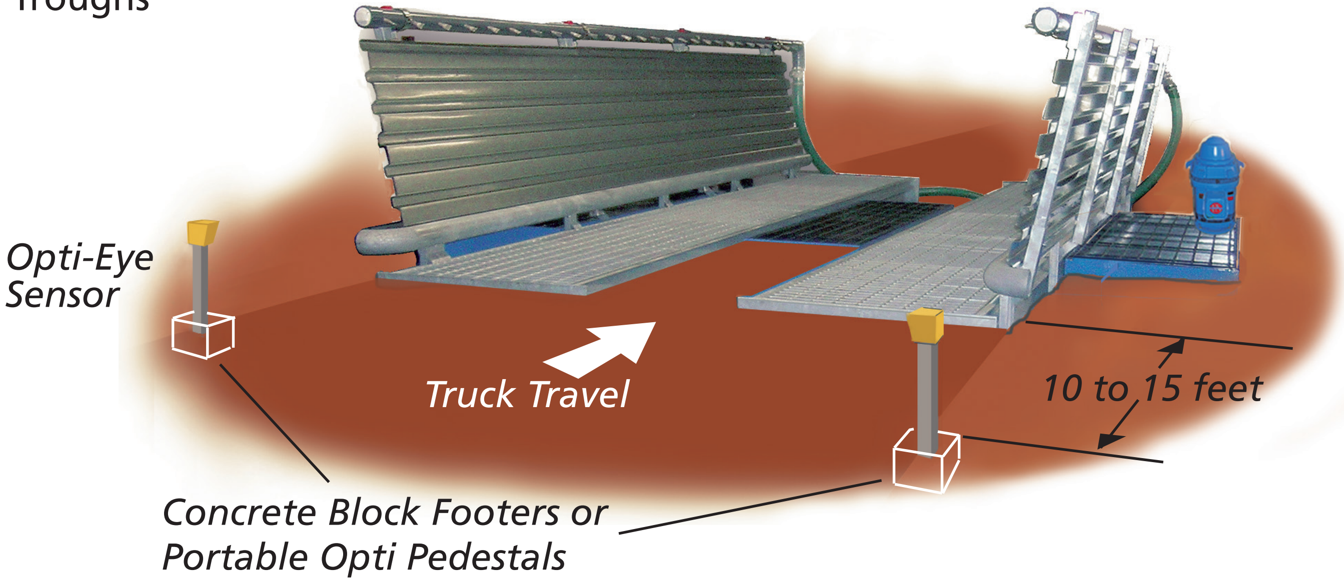
Stone and Tamp
Place 4” of stone under trough area and tamp to between 97% and 98% compaction.



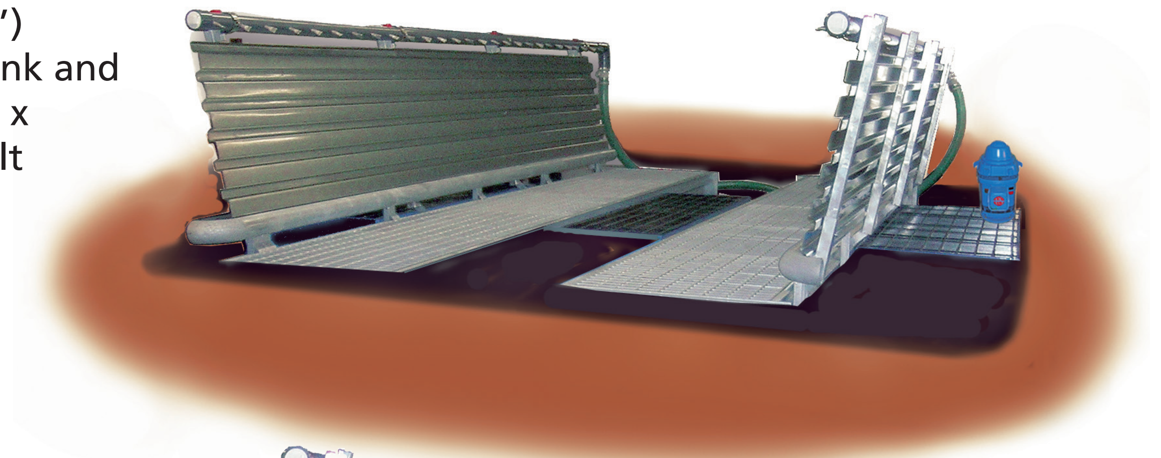
Set Troughs into Tank slots. Troughs should be supported by compacted stone not the tank.

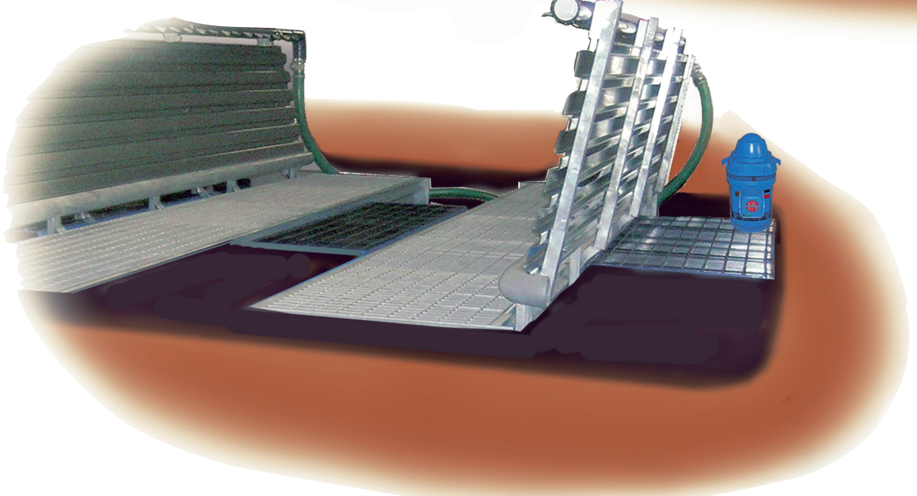
Compacted stone to be 1” higher than tank slot

Backfill Troughs
up to 5” below top of Troughs



Place asphalt (Binder course 5") apron around Tank and Troughs 20' long x 20' wide – asphalt should slope back to Troughs



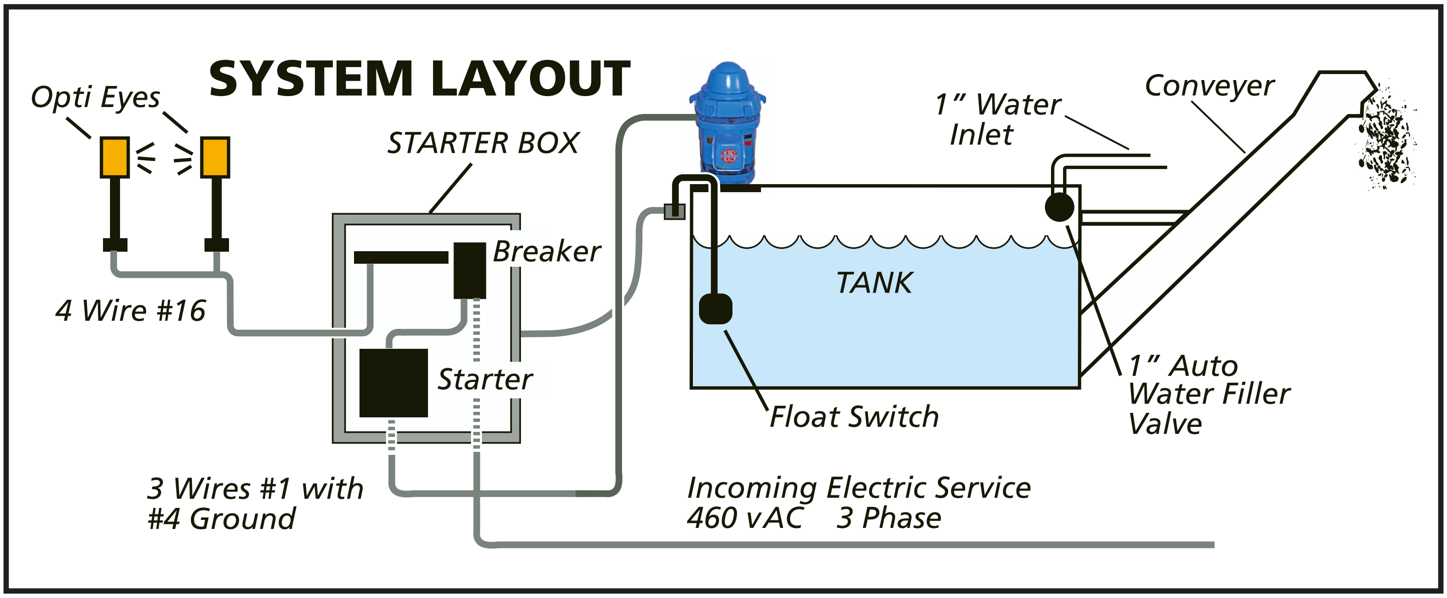


Attach hoses from Side Blasters to Pump outlets in top of Tank

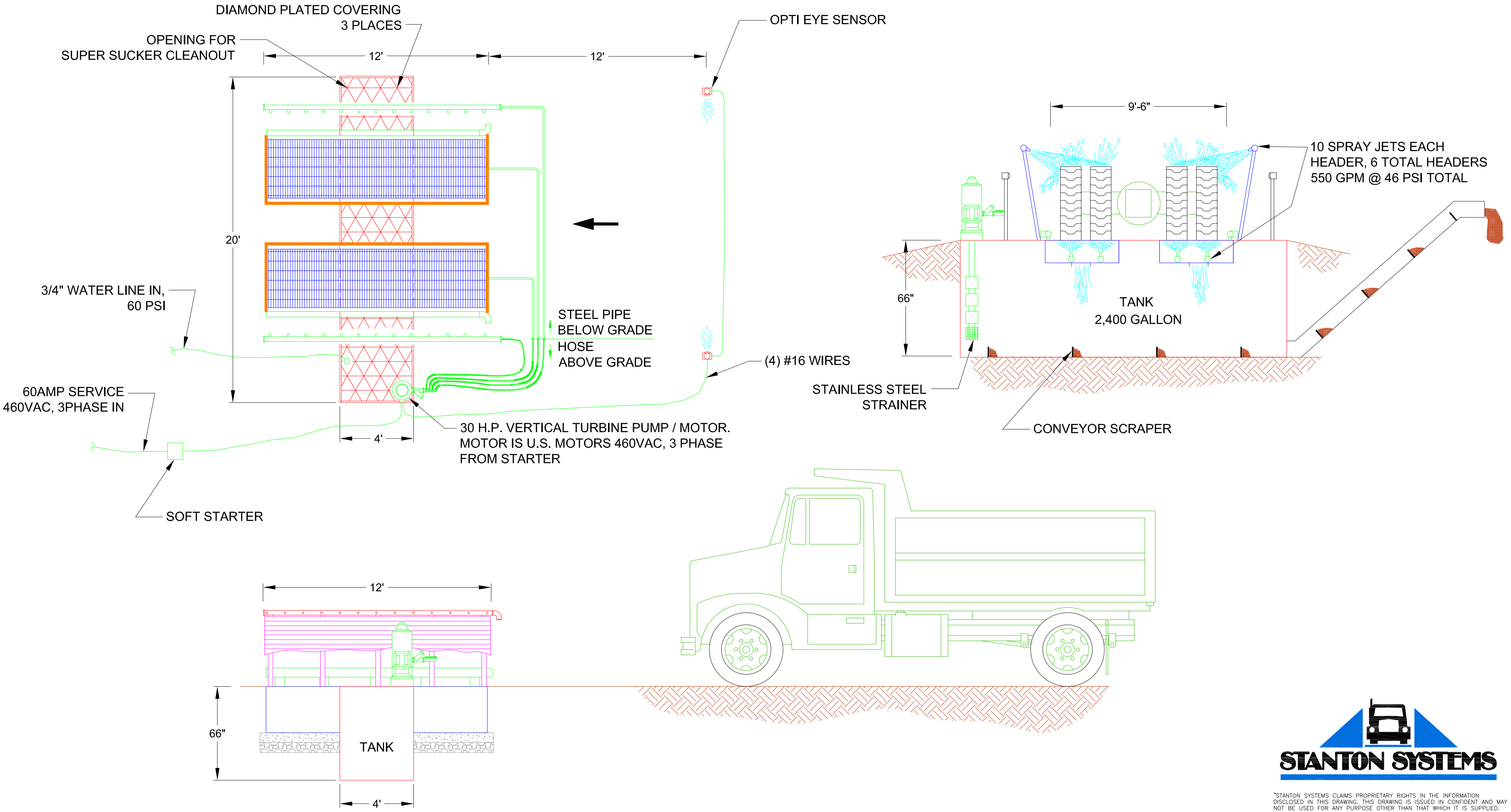
Install water line (1") to water filler valve in top of Tank

Wire Motor to Starter –

Wire 3 phase – 460 volts for 30 HP Motor, 40 amps F.L.A. into Starter box
230 volts for 30 HP Motor, 80 amps F.L.A. into Starter Box



Fill Tank with water and start system by driving truck through Opti Eyes.



STANTON SYSTEMS

STANTON SYSTEMS
50 RICHARD ROAD
IVYLAND, PA 18974
(215) 956–9800 – (215) 956–1989 (FAX)

PPL MONTOUR STATION
OVERVIEW

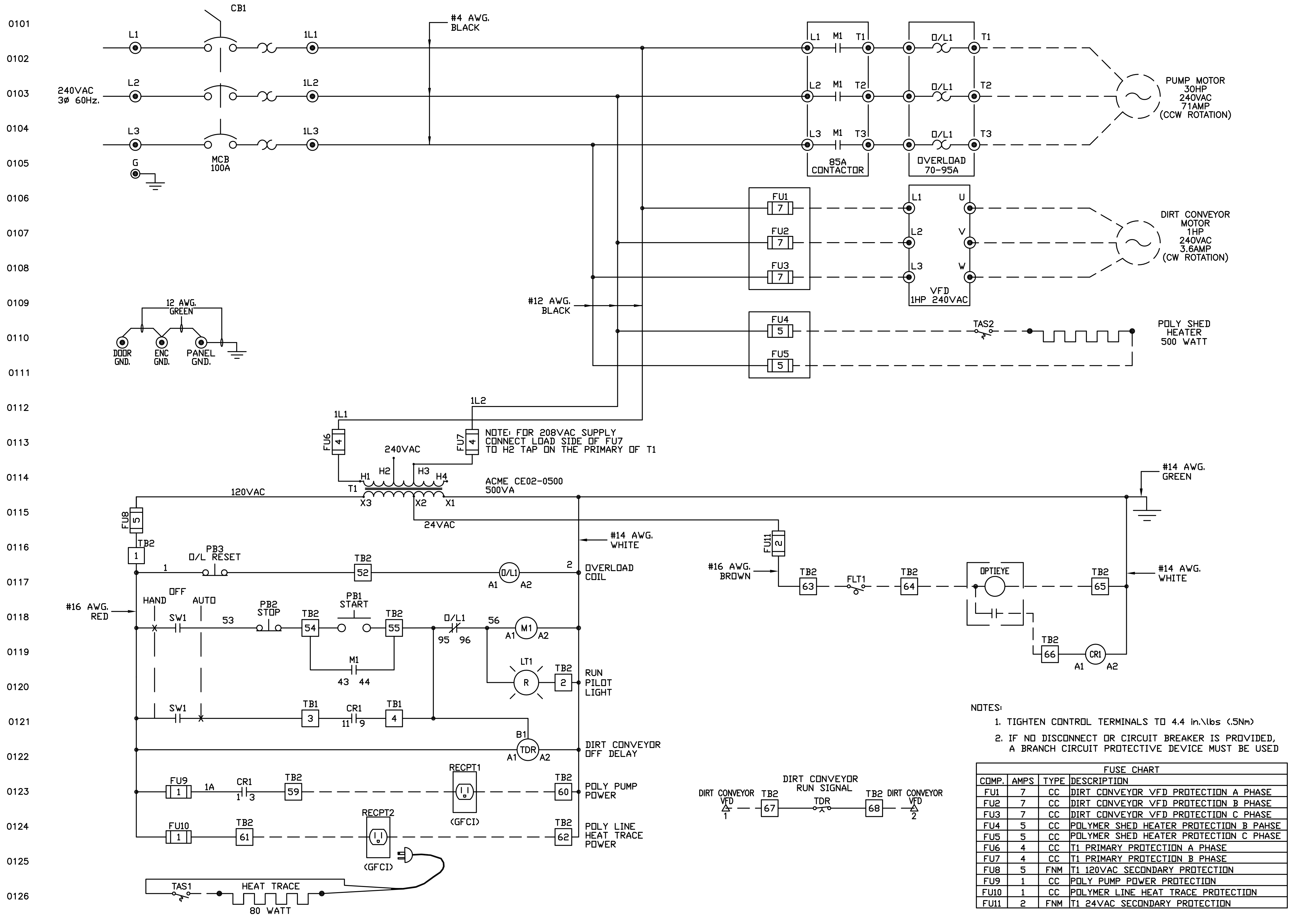
STB-30 TIRE WASH

REVISIONS	BY

DATE: 04/17/09
SCALE: NONE
DRAWN BY: N.D.S
CHECKED BY:
JOB #: PPL_OVERVIEW–1.DWG

APPROVAL TO BUILD CODE:
____ ____ ____ ____
PRINTS SHALL NOT BE USED FOR CONSTRUCTION UNLESS CODE IS SUBMITTED TO BUYER FROM STANTON SYSTEMS

SHEET:
1



NOTES:

1. TIGHTEN CONTROL TERMINALS TO 4.4 In.\lbs (.5Nm)
2. IF NO DISCONNECT OR CIRCUIT BREAKER IS PROVIDED, A BRANCH CIRCUIT PROTECTIVE DEVICE MUST BE USED

FUSE CHART

COMP.	AMPS	TYPE	DESCRIPTION
FU1	7	CC	DIRT CONVEYOR VFD PROTECTION A PHASE
FU2	7	CC	DIRT CONVEYOR VFD PROTECTION B PHASE
FU3	7	CC	DIRT CONVEYOR VFD PROTECTION C PHASE
FU4	5	CC	POLYMER SHED HEATER PROTECTION B PAHSE
FU5	5	CC	POLYMER SHED HEATER PROTECTION C PHASE
FU6	4	CC	T1 PRIMARY PROTECTION A PHASE
FU7	4	CC	T1 PRIMARY PROTECTION B PHASE
FU8	5	FNM	T1 120VAC SECONDARY PROTECTION
FU9	1	CC	POLY PUMP POWER PROTECTION
FU10	1	CC	POLYMER LINE HEAT TRACE PROTECTION
FU11	2	FNM	T1 24VAC SECONDARY PROTECTION

REVISION

NO.	DESCRIPTION	DATE	BY
0	Submitted for Approval	2/24/11	TLP
1	CPT Changes	6/9/11	KJL

STANDARD LEGEND

WIRE NODE SYMBOL MAY HAVE TERMINAL BLOCK
BENSHAW SUPPLIED TERMINAL BLOCK
TERMINAL STRIP
VFD CONTROL TERMINAL BLOCK
POWER CONNECTION
PC BOARD TERMINALS
TWISTED PAIR
TWISTED SHIELDED PAIR
SHIELDED WIRE
FIELD WIRING

MARINO
INDUSTRIAL
Systems & Services

Marino Industrial Systems & Services, Inc.
805A West Second Street
Chester, Pennsylvania 19013
PH: 610.872.3630
FX: 610.872.3720
info@marinoindustrial.com

PROJECT NAME:

Stanton Systems
Truck Wash with
Grit Conveyor &
Polymer Addition

DRAWING TITLE:

Three Line & Controls
30HP 240VAC System

DRAWING NO:
E1

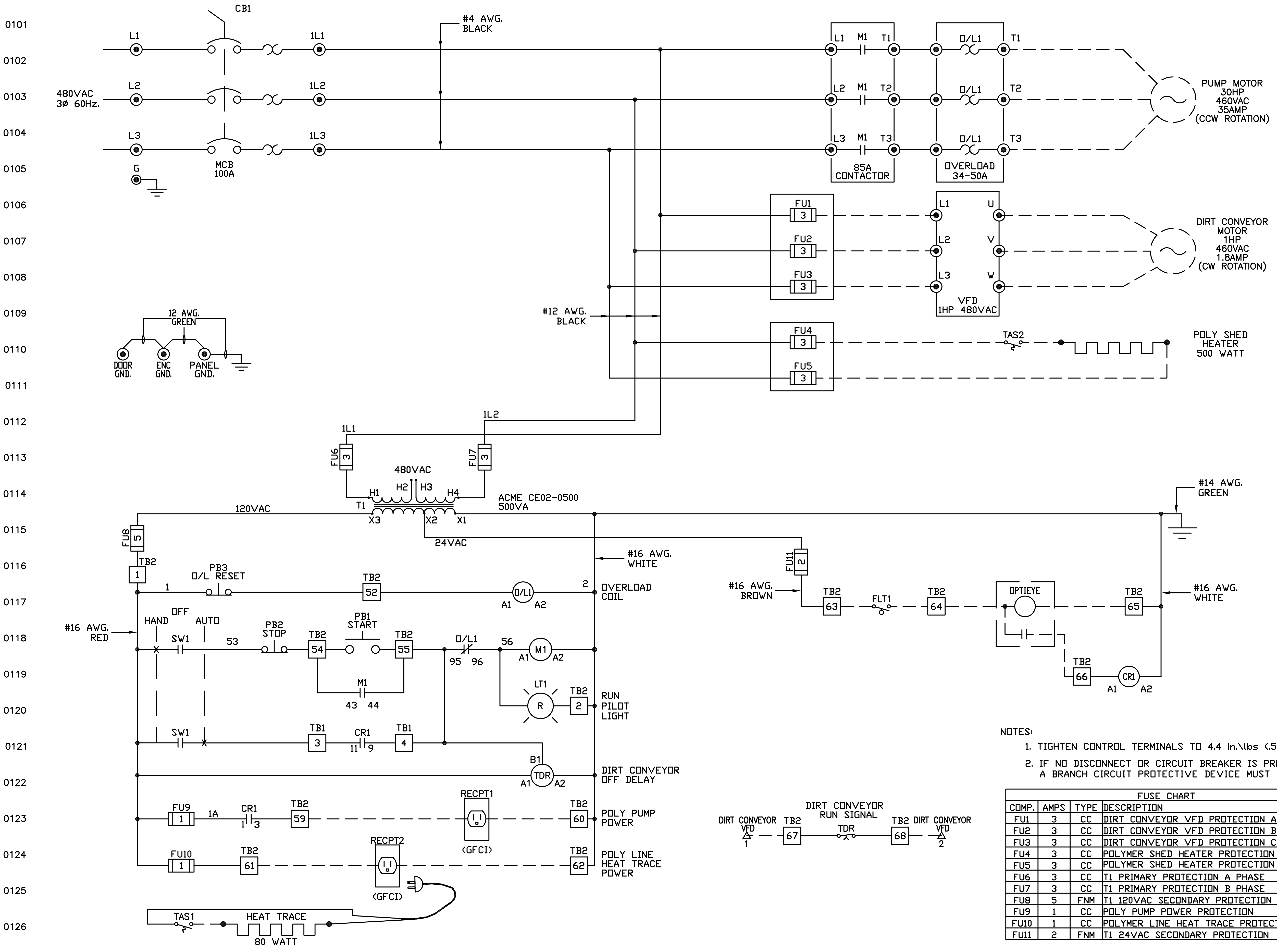
JOB#:
SCALE: N.T.S.

DRN:	TLP
CKD:	KJL
APP:	DS

SHEET 1 OF 1

FILE NAME:

REVISION			
NO.	DESCRIPTION	DATE	BY
0	Submitted for Approval	2/24/11	TLP
1	CPT Changes	6/9/11	KJL



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COMP.	AMPS	TYPE	DESCRIPTION
FU1	3	CC	DIRT CONVEYOR VFD PROTECTION A PHASE
FU2	3	CC	DIRT CONVEYOR VFD PROTECTION B PHASE
FU3	3	CC	DIRT CONVEYOR VFD PROTECTION C PHASE
FU4	3	CC	POLYMER SHED HEATER PROTECTION B PAHSE
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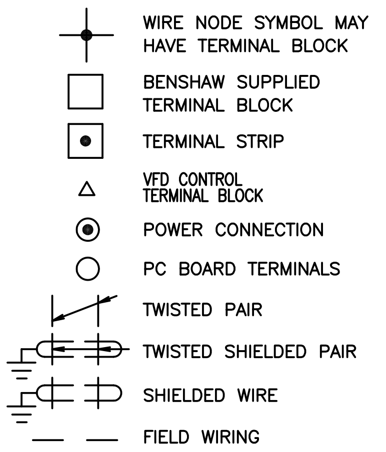
FU7	3	CC	T1 PRIMARY PROTECTION B PHASE
FU8	5	FNM	T1 120VAC SECONDARY PROTECTION
FU9	1	CC	POLY PUMP POWER PROTECTION
FU10	1	CC	POLYMER LINE HEAT TRACE PROTECTION
FU11	2	FNM	T1 24VAC SECONDARY PROTECTION

STANDARD LEGEND



MARINO
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Truck Wash with
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DRAWING TITLE:

Three Line & Controls
30HP 480VAC System

DRAWING NO:
E1

JOB#: SCALE: N.T.S.

DRN:	TLP
CKD:	KJL
APP:	DS

SHEET 1 OF 1

FILE NAME:

Stanton Systems Opti Eye Instructions

Technical Information

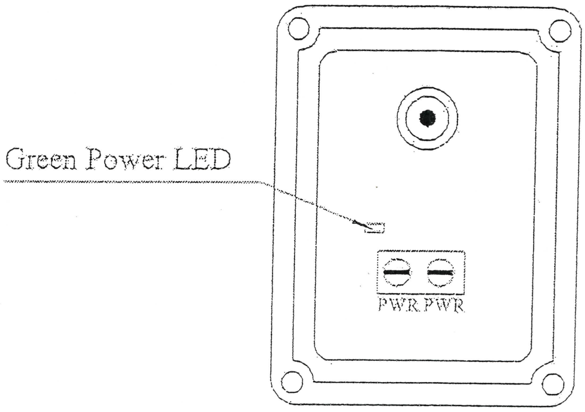
Power	12 – 24Volts AC or DC
Relay Contacts	5A @ 30VDC or 250 VAC
Extend Timer	15 – 50 seconds counter clockwise to increase
Temperature	-40F to 170F
Material	Polystyrene housing and Aluminum Hood
Dimensions	3.625 " H x 2.375" W x 2.25" D (housing)

Installation Instructions

Transmitter

Place transmitter in desired location across
from the receiver in line of sight.
Apply power to input terminals 24v.
Positive to one terminal and ground/negative
to the other terminal 24v.
Replace cover

Transmitter

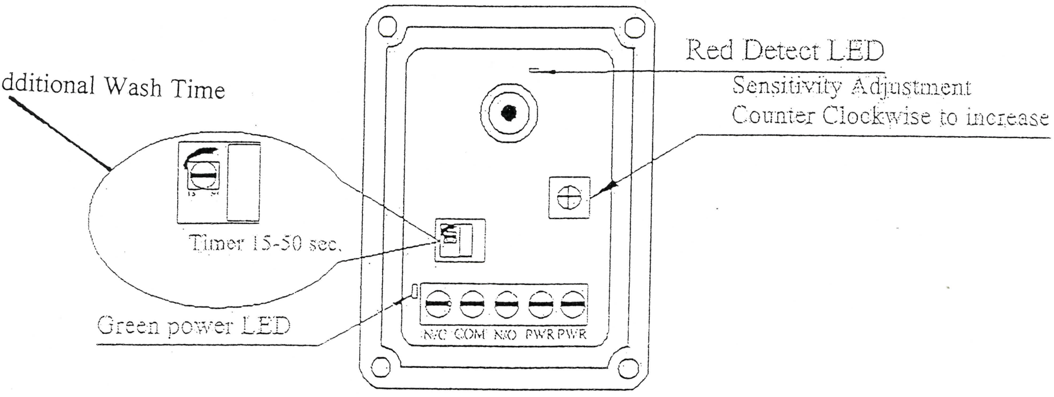


Receiver

Place receiver in desired location.
Align with transmitter in line of sight.
Attach positive power to right terminal marked (PWR) 24v.
Attach negative/ground power source to second terminal marked (PWR) 24v
Attach center terminal marked (NO) to starter where marked (NO)
Attach 4th terminal from right marked (COM) to starter where marked common
The left terminal marked (NC) is normally not used.
Replace cover

Test Operation

Receiver



Stanton Systems Opti Eye Instructions

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Replace cover

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Attach positive power to right terminal marked (PWR) 24v.
Attach negative/ground power source to second terminal marked (PWR) 24v
Attach center terminal marked (NO) to starter where marked (NO)
Attach 4th terminal from right marked (COM) to terminal strip in starter marked common
The left terminal marked (NC) is normally not used.

There is a small dial (timer) in a chrome case (1/8" x 1/8") set this timer as to how many more seconds you want the wash to stay on for after the back of the truck leaves the Eyes

Replace cover

SUBMITTAL
for

Stanton Systems
Short Coupled Vertical Turbine Pumps
serial #112996

POINTS OF INTEREST

Dimensions: All dimensions are to be verified by the contractor.

Coating: Shall consist of Simflo's standard enamel, Devoe Devguard 4308, on the exterior surfaces of the pumps.

Spare Parts: No spare parts are included.

Special Tools: No special tools are included.

Testing: No testing is included.

Minimum Submergence: The minimum submergence for this bowl model is 11", measured from the suction lip. This distance is for vortex free operation only, refer to performance curve for NPSH required. Submergence required to satisfy NPSH requirement may be greater.

Clarifications:

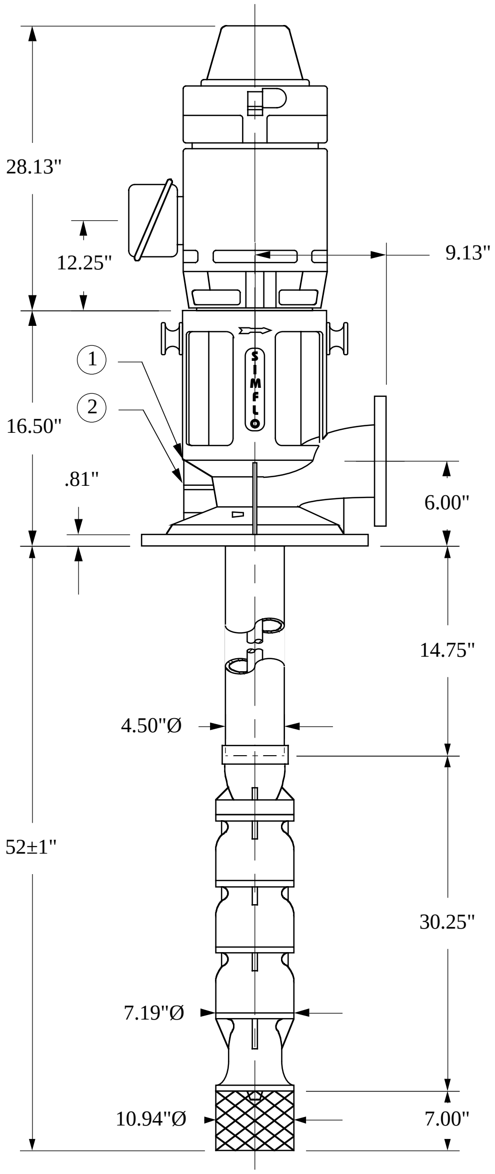
1) All anchor bolts, gauges, valves, controls, lubricants and field services are not included, and are to be provided by others.

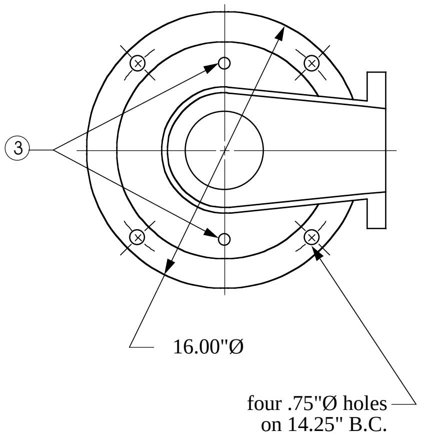
2.) The pump and driver vibration limits shall be guaranteed to meet the Hydraulic Institute Standards. If a more refined balance is specified, field balancing may achieve the desired results, which shall be the responsibility of and provided by others.

3) Pump units are duplicates of serial #112823.

Assembly: The pumps are to be assembled at the factory. The motors will be shipped separately for field installation by others.

SHORT COUPLED PUMP WITH CAST DISCHARGE HEAD





DISCHARGE FLANGE
4" 125# ANSI FF

MOTOR

MAKE U.S.Motors
ENCLOSURE WP-1
non-reversing ratchet
H.P. 30 **S.F.** 1.15
R.P.M. 3,600
PHASE 3 **CYCLE** 60
VOLTAGE 230/460
vertical hollow shaft
OTHER MOTOR INFO:

① 3/4" NPT DRAIN
② 3/4" NPT ARV/PRELUBE
③ 1/2 " NPT HOLES ON 7.50" B.C.

DATE 9-23-2011
DISTRIBUTOR Stanton systems

JOB duplicates of 112823

JOB/QUOTE # serial #112996 A-O
QUANTITY fifteen

G.P.M. 500
T.D.H. 210'
STRAINER TYPE clip-on galvanized basket

BOWL MODEL # SD7C-3

COLUMN ASSY. 1"Ø x 4"Ø
close coupled with 416 ss head shaft

FOUNDATION PLATE not specified

DISCHARGE HEAD S-150
cast iron
SEAL TYPE product lube packing assembly

IMP. DIA. 5.500"Ø±
IMP. TYPE enclosed
SPECIAL

OTHER safety guards
coated on the exterior surfaces with Simflo's
standard enamel, Devoe Devguard 4308

DATE: 9/23/2011

P.O. NO.:
Order/Line NO.: NA

TO:

Model Number: BF21
Catalog Number: HO30S1BLF
HO30S1BLF,WPI,STD,AC MTR
60,230/460V
AU,30HP,2P,A284TPA,NRR

REVISIONS:

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

HorsePower	30
Enclosure.	WPI
Poles.	02/00
RPM (Full Load).	3520
Motor Frame Size	284TPA
Phase.	3
Frequency.	60
Voltage.	230-460
Motor Type Code.	AU
Rotor Inertia (LB-FT^2)	1.18 LB-FT^2
Bearing Number PE (Shaft)	7310 BEP
Bearing Number SE (OPP)	6210-2Z-J/C3

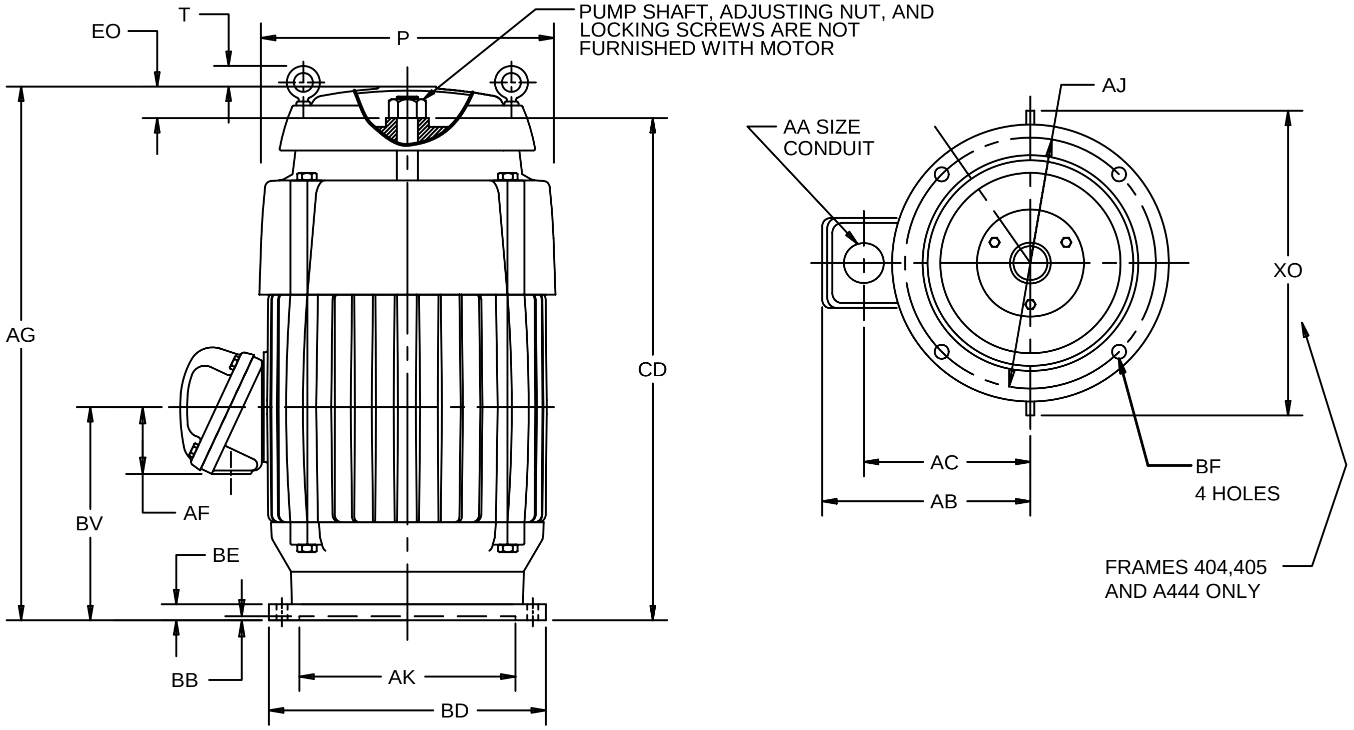
EFFECTIVE:
30-MAR-11

SUPERSEDES:
02-JUN-95

VERTICAL MOTORS
WEATHER PROTECTED TYPE 1
FRAME: 182TP THRU 286TPH
BASIC TYPE: AU

PRINT:
09-1806

SHEET:
1 OF 1



ALL DIMENSIONS ARE IN INCHES

BASIC FRAME	P ²	T	AA	AB	AC	AF	AG	BV	CD	EO	XO
180 ④	12.88	1.50	1 NPT	6.31	5.38	2.63	21.25	8.00	17.56	3.38	-
210	12.88	1.50	1 NPT	7.56	6.50	3.25	21.25	8.00	17.56	3.38	-
250	14.00	-	1 1/4 NPT	8.94	7.75	3.63	26.75 ⑤	11.50	23.38 ⑤	3.25	16.88
280	14.00	-	1 1/2 NPT	9.19	7.63	4.44	28.13	12.25	24.75	3.25	16.88

FRAME	AJ	AK	BB	BD	BE	BF
182,184,213,215TP	9.125	8.250	.19	10.00	.75	.44
254,256,284,286TP	9.125	8.250	.25	10.00	.94	.44
254,256TPA,284,286TPH	14.750	13.500	.25	16.50	.94	.69
254,256TPH,284,286TPA	9.125	8.250	.25	12.00	.94	.44

1: ALL ROUGH CASTING DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
2: LARGEST MOTOR WIDTH.
3: CONDUIT BOX MAY BE LOCATED IN STEPS OF 90 DEGREES STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.
④ FRAMES 182TP ARE TYPE AU ONLY.
⑤ DIMENSIONS SHOWN ARE FOR ALL RATINGS EXCEPT 20 HP, 4 POLE, TYPE AUE. FOR THIS RATING THE DIMENSIONS ARE: AG=28.13; CD=24.75.

TOLERANCES	8.250 AK	13.500 AK
FACE RUNOUT	.004 T.I.R.	.007 T.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.004 T.I.R.	.007 T.I.R.
"AK" DIMENSION	-.000;+.003	-.000;+.005

NAMEPLATE DATA

CATALOG NUMBER:	HO30S1BLF			NAMEPLATE PART #:	422703-004		
MODEL	BF21	FR	284TPA	TYPE	AU	ENCL	WPI
SHAFT END BRG	7310 BEP			OPP END BRG	6210-2Z-J/C3		
PH	3	MAX AMB	40 C	ID#			
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	30		RPM	3520	
VOLTS	230	460			
FL AMPS	71.0	35.0			
SF AMPS	83.0	42.0			
SF	1.15	DESIGN	B	CODE	G
NEMA NOM EFFICIENCY	88.5	NOM PF	90.7	KiloWatt	
GUARANTEED EFFICIENCY	86.5	MAX KVAR	5.2	HZ	60

HP			RPM		
VOLTS					
FL AMPS					
SF AMPS					
SF		DESIGN		CODE	
NEMA NOM EFFICIENCY		NOM PF			
GUARANTEED EFFICIENCY		MAX KVAR		HZ	

UL DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS		
AMPS		

TORQUE 1		TORQUE 2	
VFD LOAD TYPE 1		VFD LOAD TYPE 2	
VFD HERTZ RANGE 1		VFD HERTZ RANGE 2	
VFD SPEED RANGE 1		VFD SPEED RANGE 2	
SERVICE FACTOR		FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=344122	Customer PN	
Notes		Non Rev Ratchet	NRR
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)		SHAFT/Lower Oil Cap	GREASE
Altitude			
Regulatory Notes		Regulatory Compliance	
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.		Inrush Limit	
Motor Weight	300	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust		Special Note 2	
Thrust Percentage		Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	115
380V 50 Hz Max Amps		SH Watts	48
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
BF21	HO30S1BLF	3	AU	284TPA

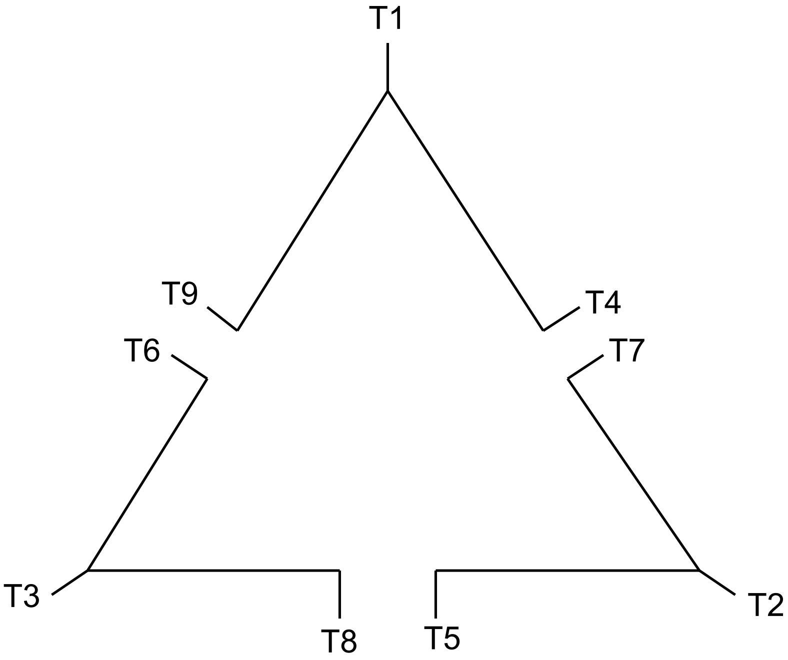
ORDER NO.	NA	LINE NO.	

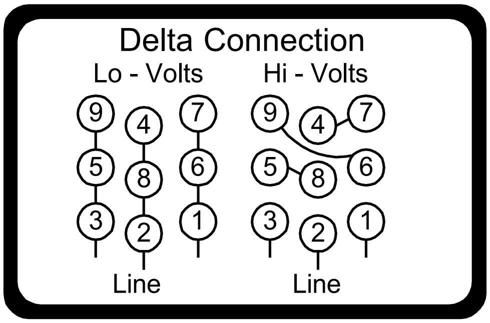
MPI:	1564	1565
HP:	30	30
POLES:	2	2
VOLTS:	460	230
HZ:	60	60
SERVICE FACTOR:	1.15	1.15
EFFICIENCY (%):		
S.F.	88.7	88.7
FULL	88.5	88.5
3/4	91.2	91.2
1/2	90.9	90.9
1/4	87	87
POWER FACTOR (%):		
S.F.	87.7	87.7
FULL	88.2	89.4
3/4	86.8	86.8
1/2	81.8	81.8
1/4	65	65
NO LOAD	9.5	9.5
LOCKED ROTOR	41	41
AMPS:		
S.F.	42	83
FULL	36	71
3/4	26.6	53
1/2	18.9	38
1/4	12.4	24.8
NO LOAD	9.2	18.4
LOCKED ROTOR	214.2	428.5
NEMA CODE LETTER	G	G
NEMA DESIGN LETTER	B	B
FULL LOAD RPM	3525	3525
NEMA NOMINAL EFFICIENCY (%)	88.5	88.5
GUARANTEED EFFICIENCY (%)	86.5	86.5
MAX KVAR	6.2	6.2
AMBIENT (°C)	40	40
ALTITUDE (FASL)	3300	3300
SAFE STALL TIME-HOT (SEC)	0	0
SOUND PRESSURE (DBA @ 1M)	75	75
TORQUES:		
BREAKDOWN{% F.L.}	231	231
LOCKED ROTOR{% F.L.}	168	168
FULL LOAD{LB-FT}	44.7	44.7

The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

Motor Wiring Diagram

9 Lead, Dual Voltage (DELTA Conn.)





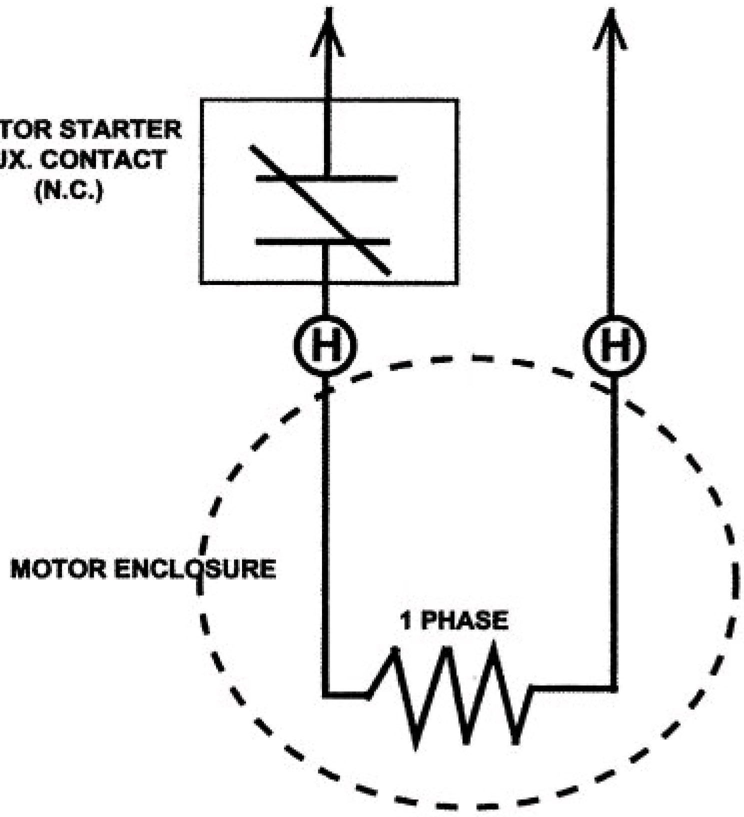
To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

Connection Plate: A109145
Connection Decal: 344122

SPACE HEATER CONNECTION DIAGRAM

SPACE HEATER LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX



THIS EQUIPMENT IS SUPPLIED WITH ANTI-CONDENSATION HEATERS. HEATERS SHOULD BE ENERGIZED WHEN EQUIPMENT IS NOT OPERATING TO PROTECT UNIT BY PREVENTING INTERNAL CONDENSATION. CONNECT THE "H" OR HEATER LEADS TO	
115 VOLTS	**48** WATTS RATING

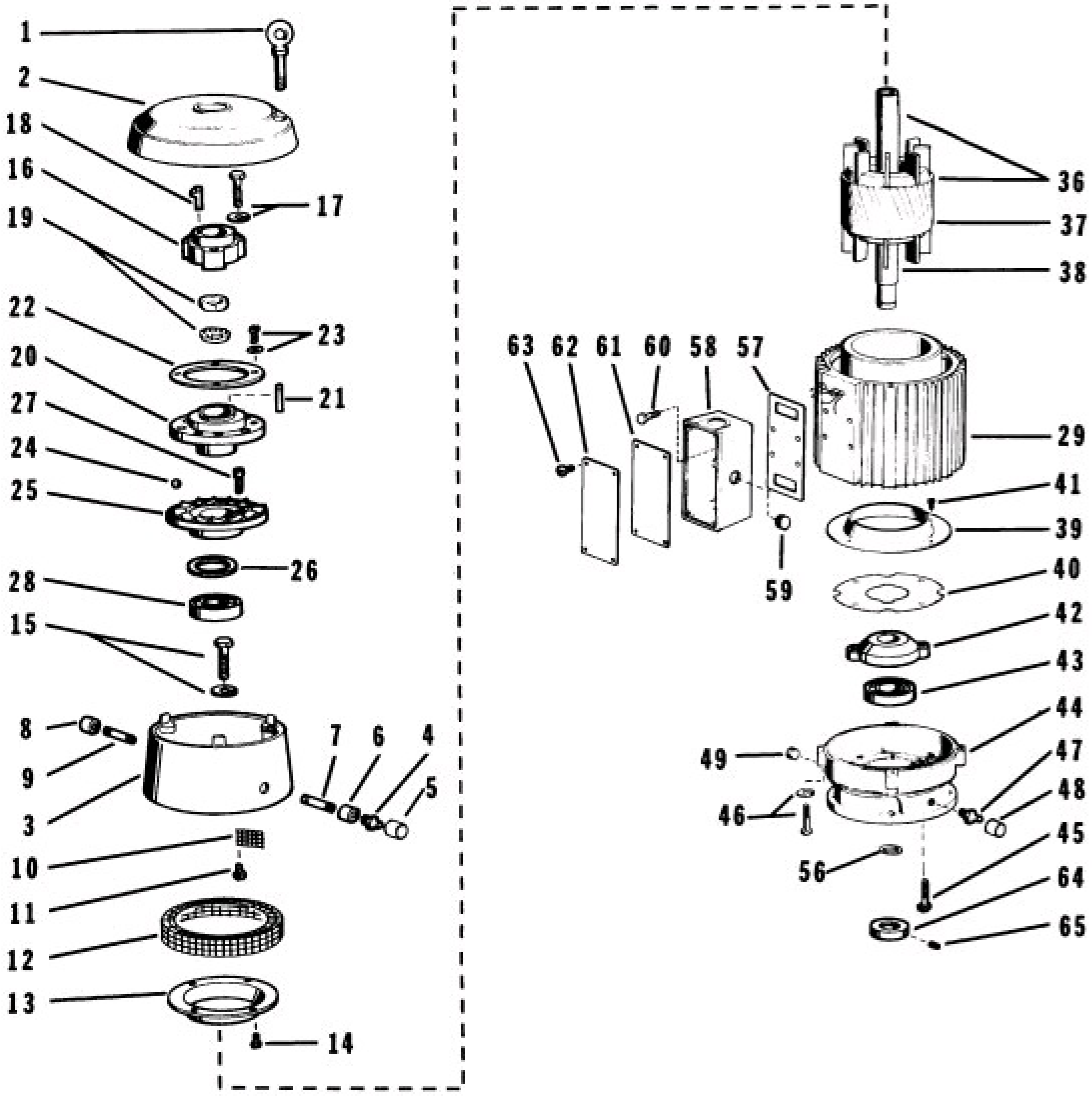
SPACE HEATER NAMEPLATE (ON MOTOR)

Revision: 7/30/2008

RENEWAL PARTS

FRAMES 254 THRU 286 - OPEN DRIPPROOF
TYPES: AU, AUE, AUI, AV, AV4, AV9, AVE, AVE4, AVI, AVI4, AU, AUE, AUI, AV, AV4, AVE, AVE4, AVI, AVI4

HIGH THRUST HOLLOSHAFT AND SOLIDSHAFT MOTORS



ITEM NO.	QTY	NAME OF PART
1	2	Eyebolt
2	1	Canopy Cap
3	1	Upper Bracket
4	1	Grease Fitting
5	1	Plastic Cap (Grease Fitting)

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest U.S. Elecrical Motors office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to USEM renewal parts numerical index. All Others: refer to your nearest USEM parts distributor.

reference: Renewal Parts Section 700, Pages 147 & 148

RENEWAL PARTS

FRAMES 254 THRU 286 - OPEN DRIPPROOF
TYPES: AU, AUE, AUI, AV, AV4, AV9, AVE, AVE4, AVI, AVI4, AU, AUE, AUI, AV, AV4, AVE, AVE4, AVI, AVI4

HIGH THRUST HOLLOSHAFT AND SOLIDSHAFT MOTORS

ITEM NO.	QTY	NAME OF PART
6	1	Pipe Coupling
7	1	Nipple Fitting
8	1	Pipe Cap (Plug)
9	1	Nipple Fitting
10	4	Bracket Screen (Intake)
11	4	Screws & Washers (Intake Screen)
12	1	Bracket Screen (Exhaust)
13	1	Air Deflector (Upper)
14	4	Screw (Air Deflector & Screen)
15	4	Screw & Lockwasher (Bracket to Stator)
16	1	Drive Coupling
17	3	Screw & Lockwasher (Drive Coupling)
18	1	Gib Key
19	1	Locknut & Lockwasher
20	1	Rotating Ratchet
21	1	Square Key
22	1	Ball Retaining Ring
23	4	Screw & Lockwasher (Ring)
24	10	Steel Balls (Optional)
25	1	Stationary Ratchet
26	As Req	Shims
27	3	Socket Head Cap Screw (Stationary Ratchet)
28	1	Ball Bearing (Upper) (Refer to Section 775)
29	1	Wound Stator Assembly
30-35	-	NOT USED IN THIS ASSEMBLY

ITEM NO.	QTY	NAME OF PART
36	1	Rotor Assembly (Includes Items 37 & 38
37	1	Rotor Core
38	1	Rotor Shaft
39	1	Air Deflector (Lower)
40	1	Bracket Screen
41	4	Screw (Air Deflector)
42	1	Bearing Cap (Lower)
43	1	Ball Bearing (Lower) (Refer to Section 775)
44	1	Lower Bracket
45	2	Screw & Lockwasher (Bearing Cap)
46	4	Screw & Lockwasher (Bracket to Stator)
47	1	Grease Fitting
48	1	Plastic Cap (Grease Fitting)
49	1	Pipe Plug
50-55	-	NOT USED IN THIS ASSEMBLY
56	1	Water Deflector
57	1	Gasket (Outlet Box to Base)
58	1	Outlet Box Base
59	1	Pipe Plug
60	4	Screw
61	1	Gasket (Outlet Box Cover)
62	1	Outlet Box Cover
63	4	Screw
64	1	Stabilizer Bushing (Optional)
65	1	Screw (Optional)

* With optional Stabilizer Bushing, delete Item No. 56 and add Items 64 & 65

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest U.S. Elecrical Motors office for assistance.

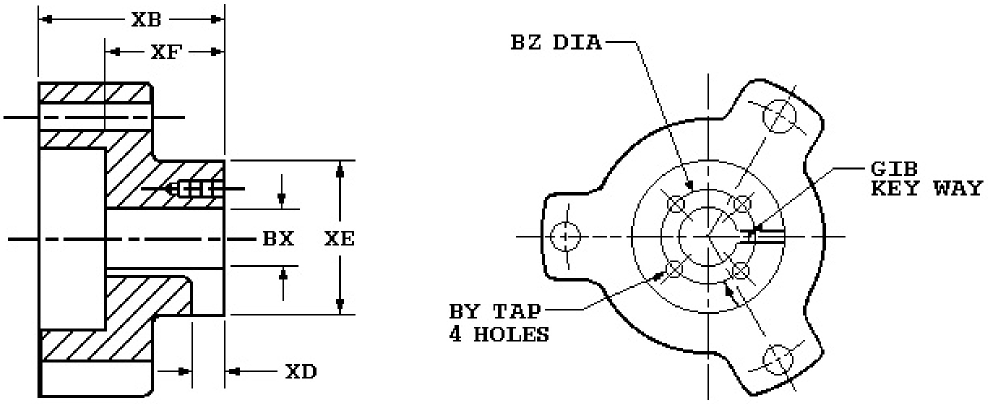
BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to USEM renewal parts numerical index. All Others: refer to your nearest USEM parts distributor.

reference: Renewal Parts Section 700, Pages 147 & 148

VERTICAL HOLLOSHAFT COUPLING DIMENSIONS

Standard Coupling Dimensions



Coupling Part Number	102999
BX Nominal	1
Actual Bore	1.001
BY	10-32
BZ	1 3/8
XB	2 9/16
XD	13/32
XE	2 1/4
XF	1 5/8
SQ. KEY	1/4

Notes:

1. All Rough casting dimensions may vary by 0.25" due to casting variations.
2. All tapped holes are Unified National Course, Right Hand thread.
3. Coupling bore dimension "BX" is machined with a tolerance of - .000", +.001" up to 1.50" bore inclusive. Larger bores: -.000", +.002".

TYPICAL REED CRITICAL FREQUENCY DATA

USEM MODEL NO: BF21
USEM CATALOG NO: HO30S1BLF

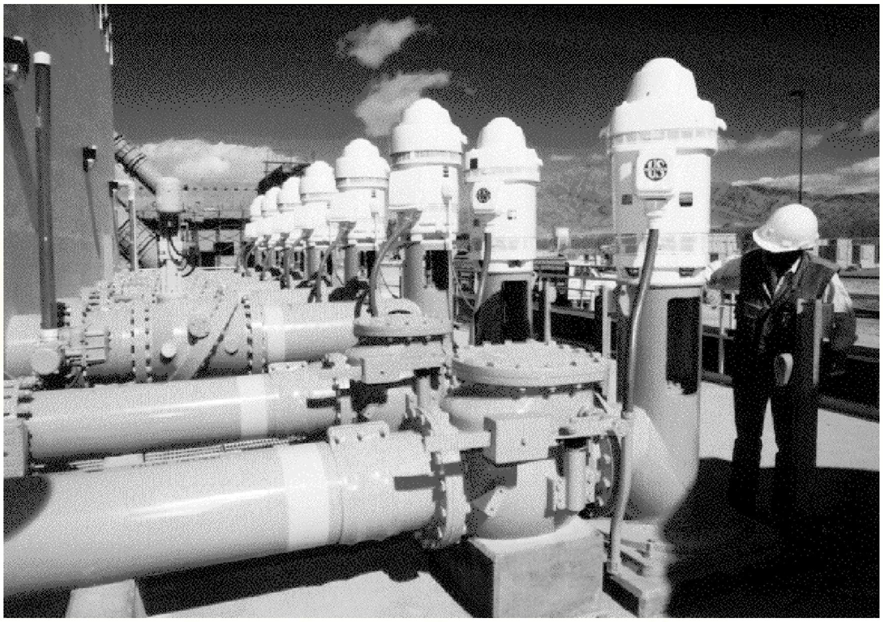
Frame: 284TPA Type: AU

REED CRITICAL FREQUENCY:	75	HZ
CENTER OF GRAVITY:	11	IN
DEFLECTION @ CENTER OF GRAVITY:	0.0017	IN
UNIT WEIGHT:	350	LBS.
BASE DIAMETER:	ALL	IN.
MAXIMUM MOTOR DIAMETER:	14.00	IN.
DATE:	9/23/2011	

Product Data Sheet

Vertical A.C. Motors

Weather Protected Type I
Holloshaft® High Thrust



- For use on turbine, mix flow and propeller pumps
- 3 - 4000 Horsepower
- 3600 through 514 rpm
- Low and medium voltage through 6900 volts
- Three phase, 60 and 50 hertz
- Three efficiency levels - standard efficient, energy efficient and premium efficient

Product Overview

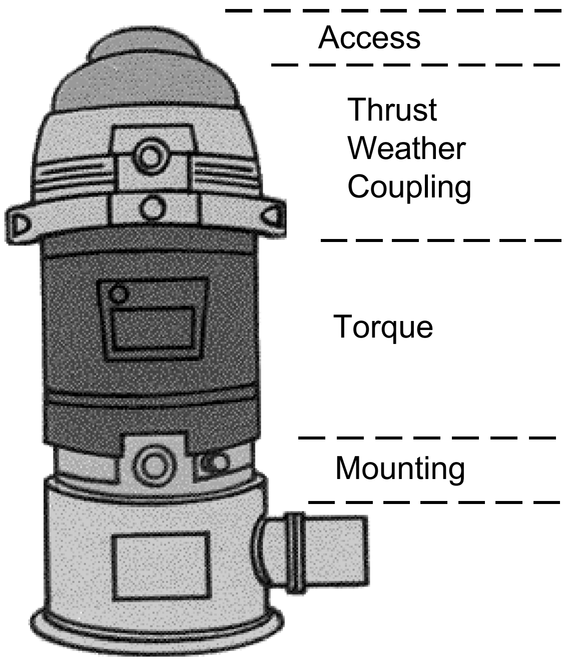
Our Weather Protected Type I (WPI) Holloshaft® motors are constructed to minimize the entrance of rain, snow and airborne particles. Our enclosures exceed NEMA requirements because U.S. Motors has built in the extra protection needed for rugged outdoor applications. The ventilation system is designed to provide optimum cooling to the thrust bearing and electrical components and is available in all motor sizes.

These motors allow for easy pump impeller adjustment and maintain alignment of pump base to motor drive clutches. Steady bushings are available to give the mechanical characteristics of a solid shaft motor.

In our design concept, the high thrust vertical motor is arranged into four functional zones - the top zone is small and light to assure simplified access to the coupling area and inspection of the thrust bearing. Below this is the coupling area and the essential elements of thrust bearings with a large weather protected air intake to cool the motor and thrust bearing.

Next, the center, or winding section, develops the driving torque and includes the latest Insulife insulation systems. And below, the mounting base is compact and designed for momentary upthrust of the pump.

The benefit of the four zone design is a motor which is more easily installed and serviced and which allow operator protection and convenience.



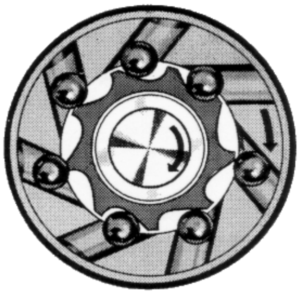
All open type vertical motors offered by U.S. Motors features a NEMA WPI enclosure as standard. It is designed to minimize the entrance of contaminants and airborne debris while protecting the internal components. Also, it is designed to prevent a 3/4 inch diameter rod from passing into the motor.

A unique feature of U.S. Motors' WPI design is the motor's air flow pattern. Cooling air is drawn in through the motor and exhausted in such a way to avoid drawing any pumped fluids into the motor should the pump's packing seal or mechanical seal fail. Furthermore, corrosion resistant screens and grills cover all openings preventing snakes, rodents, etc., from entering the motor. This is our standard product for outdoor service.

Construction Features

Vertical motors with bearing configurations tailored to your specific needs is a hallmark of our product offering. U.S. Motors engineers can select from ball, angular contact, spherical roller and plate type bearing options to provide maximum bearing life regardless of the thrust conditions. U.S. Motors thrust bearing capacities are among the highest in the industry.

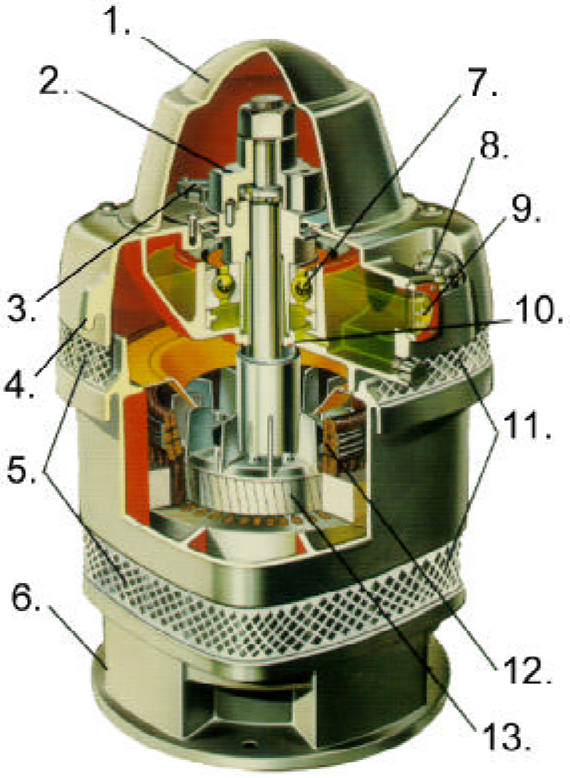
Our non-reverse ratchet, The Ball-O-Matic®, is without question the finest ratchet available. The Ball-O-Matic prevents reverse rotation within 4.5 degrees of rotation, has unlimited depth setting and can be used in explosionproof applications.



The Ball-O-Matic

The following diagram shows the typical Holloshaftâ construction features:

1. **Lightweight Top Cover**
2. **Coupling** readily accessible
3. **Lockbar** holds shaft during adjustments
4. **Lifting Lugs** positioned for stability
5. **Protected Air Openings** exceed NEMA WPI requirements
6. **Precision Machined Mounting Base**, ample clearance for mounting bolt installation
7. **Rugged Bearing** withstands heavy load thrusts
8. **Large Plug** simplifies oil fills
9. **Sight Gauge Window** for quick oil level reading
10. **Metered Oil Flow** minimizes churning
11. **Dual Air Flow** system for uniform cooling of motor top and bottom
12. **Windings** Protected by new, synthetic materials
13. **Solid Die Cast Rotor** with integral fan blades



Vertical Holloshaft WPI

All vertical products are supplied with the Insulife® winding system. For low voltage NEMA frame products, the copper wound stator core is insulated with non-hydroscopic Class F or H rated materials, and is then treated with polyester varnish for extra moisture protection. Vacuum pressure impregnation (VPI) is an available option on frames 320 and larger.

Medium voltage form wound motors are wound with Class F or Class H materials and are treated with two complete cycles of 100% solid epoxy VPI. This produces a minimum of 6 mils insulation build. U.S. Motors does not manufacture random wound medium voltage motors for quality reasons. Our Everseal® sealed winding system is an available option for form wound machines.

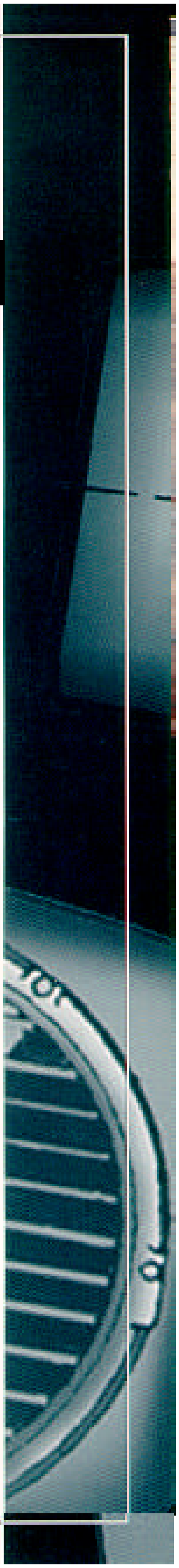
Another option available on our Vertical Motors is Inverter Grade® Insulation System. U.S. Motors was the first motor company to recognize that the pulse width modulation (PWM) adjustable frequency technology offered substantial payoff in better equipment control and increased energy savings, but it also created new challenges for existing motor insulation systems.

Our Inverter Duty product offers an Inverter Grade® insulation system with superior pulse endurance to withstand the waveform stresses produced by the PWM drives. In addition to the pulse resistant magnet wire, our protection system includes additional lacing on end turns, phase paper and additional dips and bakes. This system meets the stringent requirements outlined in NEMA MG-1, Part 31.

Many extra features, accessories and manufacturing steps have been incorporated into our vertical motor designs to improve the overall performance and greatly extend motor life. Available modifications include special altitude, special ambient temperatures, special balance and copper bar rotors. Available accessories include current transformers, space heaters, lightning arrestors and protective devices for bearings, windings and vibration.

Contact your U.S. Motors representative to learn more about our full compliment of accessories and modifications on our vertical motors to provide you with the exact product for your application.

Stock, conversion or built-to-order, U.S. Motors has your vertical motor solution.



Variable Frequency Drives (VFD)

Nidec Motor Corporation's Inverter Grade® insulated motors exceeded NEMA®† MG-1 Part 30 & 31 before the standards were established.

We are a leader in the development of electric motors to withstand pulse width modulated (PWM) drives evolution from power transistors to higher switching frequency insulated gate bipolar transistors (IGBTs).

Today, as the need for light and medium duty motor inverter applications grows, Nidec Motor Corporation provides products to meet these demands.

Through continued research and development, Nidec Motor Corporation has included the insulation wire from its Inverter Grade® motors on all Premium, Energy and Standard Efficient motors, enhancing their potential inverter compatibility.

Inverter compatibility with motors is complex. As a result, many variables must be considered when determining the suitability of certain types of motors. These variables include:

- Torque requirements (Constant or Variable)
- Speed Range
- Line/System Voltage
- Cable Length between VFD & Motor
- Drive Switching (Carrier) Frequency
- Motor Construction

Wider speed ranges, higher voltages, higher switching frequencies and increased cable lengths all add to the severity of the application and therefore the potential for premature motor failure. Nidec Motor Corporation has differentiated its products into families for your ease of selection for various inverter applications.

Warranty Guidelines

The information within this section refers to the motor and drive application guidelines and limitations for warranty.

Hazardous Location Motors

Use of a variable frequency drive with the motors in this catalog, intended for use in hazardous locations, is only approved for Division 1, Class I, Group D hazardous location motors with a T2B temperature code, with a limitation of 2:1 constant torque or 10:1 variable torque output. No other stock hazardous location motors are inherently suitable for operation with a variable frequency drive. If other requirements are needed, including non-listed Division 2, please contact your Nidec Motor Corporation territory manager to conduct an engineering inquiry.

Applying Inverter Grade® Insulated Motors on Variable Frequency Drives

The products within this catalog labeled "Inverter Duty" or "Vector Duty" are considered Inverter Grade® insulated motors. Inverter Grade® motors exceed the NEMA®† MG-1 Part 31 standard.

Nidec Motor Corporation provides a three-year limited warranty (see page ix) on all Inverter Grade® insulated motors and allows long cable runs between the motor and the VFD (limited to 400 feet without output filters). These motors may be appropriate for certain severe inverter application or when the factors relating to the end use application are undefined (such as spares).

Nidec Motor Corporation's U.S. Motors® brand is available in the following Inverter Grade® insulated motors:

- Inverter Duty motors good for 10:1 Variable Torque & 5:1 Constant Torque, including Vertical Type RUSI
- Inverter Duty motors good for 10:1 Constant Torque
- ACCU-Torq® and Vector Duty Motors with full torque to 0 Speed & 1024 PPR, 5-28VDC Encoder
- 841 Plus® motors that meet IEEE®† 841 Standards and are suitable for 5:1 Constant Torque

Applying Premium Efficient Motors on Variable Frequency Drives

Meet NEMA®† MG-1, Section IV, Part 31.4.4.2. They can be used with adjustable frequency drives under the following parameters: Up to 4:1 speed range on constant torque loads, standard two-year limited warranty (see page ix).

Cable Distances for Applying Premium Motors			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	196 ft	481 ft	295 ft
6 Khz	168 ft	340 ft	209 ft
9 Khz	113 ft	278 ft	170 ft
12 Khz	98 ft	241 ft	148 ft
15 Khz	88 ft	215 ft	132 ft
20 Khz	76 ft	186 ft	114 ft

Applying Standard & Energy Efficient Motors on Variable Frequency Drives

Meet NEMA®† MG-1, Section IV, Part 30.2.2.8. They can be used with adjustable frequency drives under the following parameters: Up to 2:1 speed range on constant torque loads, one year limited warranty (see page ix).

Cable Distances for Applying EPAct & Standard Motors			
Maximum Cable Distance VFD to Motor			
Switching Frequency	460 Volt	230 Volt	380 Volt
3 Khz	103 ft	435 ft	218 ft
6 Khz	73 ft	307 ft	154 ft
9 Khz	59 ft	251 ft	126 ft
12 Khz	51 ft	217 ft	109 ft
15 Khz	46 ft	194 ft	98 ft
20 Khz	40 ft	168 ft	85 ft

All Nidec Motor Corporation motors have 40°C ambient, 1.0 SF on Inverter Power, 3300 ft. max altitude, 460 voltage or less line power, up to 10:1 speed range on Variable Torque and Class F Insulation. 575-volt motors can be applied on inverters when output filters are used.

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*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.
† All marks shown within this document are properties of their respective owners

Motor/ Inverter Compatibility

Thermal Overloads and Single Phase Motors

Motors with thermal overloads installed may not operate properly on a VFD. The current carrying thermal overload is designed for sine wave power. Operation on a VFD may cause nuisance tripping or potentially not protect the motor as would be expected on line power. Thermostats or thermistors installed in the motor and connected properly to the VFD may provide suitable thermal overload protection when operating on a VFD. (Consult Codes)

Single phase motors and other fractional horsepower ratings are not designed to be operated on a VFD. Within Nidec Motor Corporation standard products, all motors NEMA®† 48 frame (5.5" diameter) and smaller are not suitable for VFD applications. Three phase 56 and 143/145 frame applications should be noted on the catalog price page; or if in doubt ask an Nidec Motor Corporation technical representative for recommendations on compatibility with a VFD.

Slow Speed Motors

Motors with a base design of slower than six poles require special consideration regarding VFD sizing and minimizing harmonic distortion created at the motor terminals due to cable installation characteristics. Additional external PWM waveform filters and shielded motor cables designed for PWM power may be required to provide acceptable motor life. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

690V Applications

Motors that will be applied to 690Vac PWM VFDs require the use of an external filter to limit peak voltage spikes and the use of an Inverter Grade® motor. Where available, an alternative to using an output filter is to upgrade to a 2300V insulation system.

Low Voltage TITAN® Motors

The use of 449 frame and larger motors on PWM type VFDs should use the cable length limits of the second chart from the previous page as a guide for inverter application or consider the use of an external filter and shielded motor cables designed for PWM power to minimize harmonic distortion and peak voltages at the motor terminals. Harmonic distortion on the output waveform should be kept to a minimum level (less than 10%).

Bearing Currents related to PWM waveform

Due to the uniqueness of this condition occurring in the field, protection of the motor bearings from shaft currents caused by common mode voltages is not a standard feature on sinewave or Inverter Duty motor products, unless explicitly noted. Some installations may be prone to a voltage discharge condition through the motor bearings called fluting.

Fluting damage is related to characteristics of the PWM waveform, VFD programming and characteristics and installation.

Bearing fluting as a result of VFD sine wave characteristics may be prevented by the installation of a shaft grounding device such as a brush or ring and/or correction of the installation characteristics causing the shaft voltage condition.

Multiple Motors on a Single VFD

Special considerations are required when multiple motors are powered from a single VFD unit. Most VFD manufacturers can provide guidelines for proper motor thermal considerations and starting/stopping of motors. Cable runs from the VFD and each motor can create conditions that will cause extra stress on the motor winding. Filters may be required at the motor to provide maximum motor life.

Grounding and Cable Installation Guidelines

Proper output winding and grounding practices can be instrumental in minimizing motor related failures caused by PWM waveform characteristics and installation factors. VFD manufacturers typically provide detailed guidelines on the proper grounding of the motor to the VFD and output cable routing. Cabling manufacturers provide recommended cable types for PWM installations and critical information concerning output wiring impedance and capacitance to ground.

Vertical Motors on VFDs

Vertical motors operated on VFD power present unique conditions that may require consideration by the user or installation engineer:

- Slowest rpm that can be utilized and not cause the non-reversing ratchet to operate properly (in the range of 200 –300 rpm)
- Unexpected / unacceptable system vibration and or noise levels caused by the torque pulsation characteristics of the PWM waveform, a system critical frequency falling inside the variable speed range of the process or the added harmonic content of the PWM waveform exciting a system component
- Application related problems related to the controlled acceleration/deceleration and torque of the motor on VFD power and the building of system pressure/ load.
- The impact the reduction of pump speed has on the down thrust reflected to the pump motor and any minimum thrust requirements of the motor bearings
- Water hammer during shutdown damaging the non-reversing ratchet

Humidity and Non-operational Conditions

The possible build-up of condensation inside the motor due to storage in an uncontrolled environment or non-operational periods in an installation, can lead to an increased rate of premature winding or bearing failures when combined with the stresses associated with PWM waveform characteristics. Moisture and condensation in and on the motor winding over time can provide tracking paths to ground, lower the Megohm resistance of the motor winding to ground and lower the Corona Inception Voltage level of the winding.

Proper storage and maintenance guidelines are important to minimize the potential of premature failures. Space heaters or trickle voltage heating methods are the preferred methods for drying out a winding that has low megaohm readings. Damage caused by these factors are not covered by the limited warranty provided unless appropriate heating methods are properly utilized during non-operational periods and prior to motor start-up.

NEMA®† Application Guide for AC Adjustable Speed Drive Systems: http://www.nema.org/stds/acadjustable.cfm#download

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*This information applies only to Integral Horsepower (IHP) motors as defined on the Agency Approval page, under UL®† & CSA®† listings where indicated.

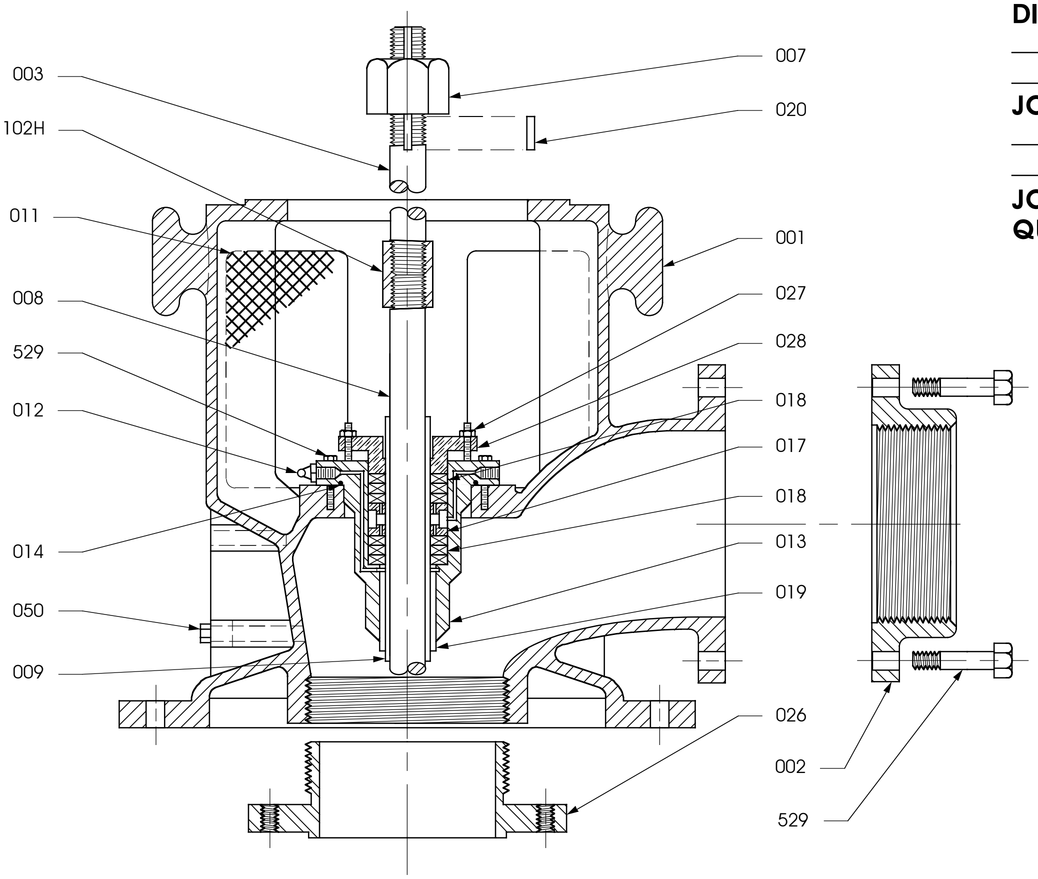
† All marks shown within this document are properties of their respective owners

HI STANDARD DISCHARGE HEAD WITH PRODUCT LUBE PACKING GLAND

DATE 9-23-2011
DISTRIBUTOR Stanton systems

JOB duplicates of 112823

JOB/QUOTE # serial #112996 A-O
QUANTITY fifteen S-150



CATALOG NUMBER	QUAN-TITY	PART NAME	STANDARD MATERIAL (A.S.T.M. DESIGNATION)	SPECIFICATION REQUIREMENT
001	1	HEAD, DISCHARGE	CAST IRON A-48 CLS 30	
002	0	FLANGE, DISCHARGE (THREADED)	CAST IRON A-48 CLS 30	not specified
003	1	SHAFT, MOTOR	STEEL A-108 GR 1045	
005	0	COUPLING, FLG'D MOTOR (NOT SHOWN)	STEEL	not applicable, VHS motor
007	1	NUT, HEAD	BRONZE B-584-836	
008	1	SHAFT, HEAD	~~STEEL A-108 GR 1045~~	416 ss
009	0	SLEEVE, SHAFT	STAINLESS STEEL	not specified
010D	0	GASKET, DISCHARGE RING(NOT SHOWN)	RUBBER	not specified
011	1	GUARD, SAFETY	STEEL	
012	1	FITTING, GREASE	COMMERCIAL	
013	1	BOX, PACKING	CAST IRON A-48 CLS 30	
014	1	O-RING, PACKING BOX	BUNA	
017	1	RING, LANTERN	BRONZE B-505-932	
018	6	RING, PACKING	GRAPHITE	
019	1	BEARING, PACKING BOX	BRONZE B-505-932	
020	1	KEY, GIB	COMMERCIAL	
529	4	BOLT, PACKING BOX	COMMERCIAL	
026	0	FLANGE ADAPTER	STEEL	not specified
027	2	STUD AND NUT	STAINLESS STEEL/ BRASS	
028	1	GLAND, PACKING	BRONZE B-584-836	
529	0	BOLT, DISCHARGE FLANGE	COMMERCIAL	not specified
050	1	PLUG, PRE-LUBE	COMMERCIAL	
102H	1	COUPLING, HEAD SHAFT	STEEL A-108 GR 1018	
529	0	BOLTS, FOUND. PLATE (NOT SHOWN)	COMMERCIAL	not specified

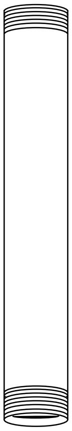
THREADED PRODUCT LUBE COLUMN TO BOWL SINGLE SECTION

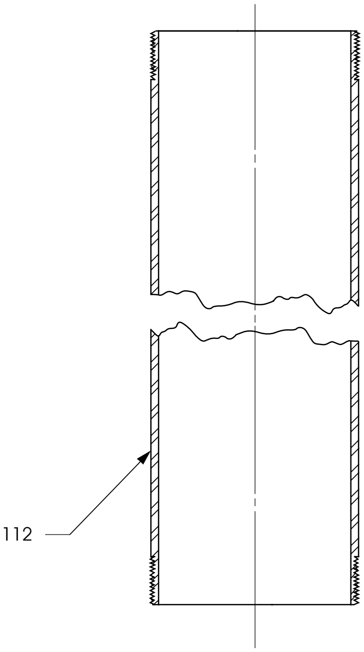
DATE 9-23-2011
DISTRIBUTOR Stanton systems

JOB duplicates of 112823

JOB/QUOTE # serial #112996 A-O
QUANTITY fifteen

NOTE: Head shaft (#008) extends through column to connect to bowl shaft (#208).





CATALOG NUMBER	QUAN-TITY	PART NAME	STANDARD MATERIAL (A.S.T.M. DESIGNATION)	SPECIFICATION REQUIREMENT
112	1	PIPE, COLUMN (THREADED)	STEEL A-53B	

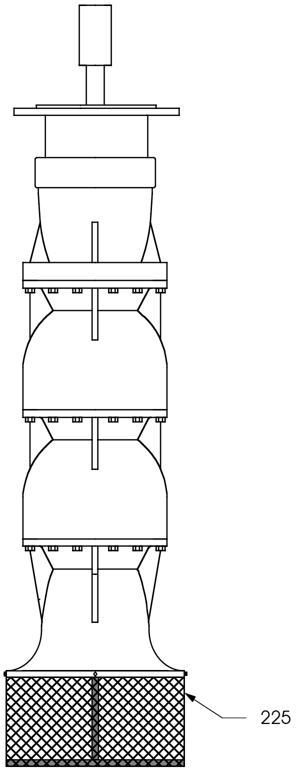
PRODUCT LUBE BOWL ASSEMBLY W/ INTEGRAL SUCTION BELL

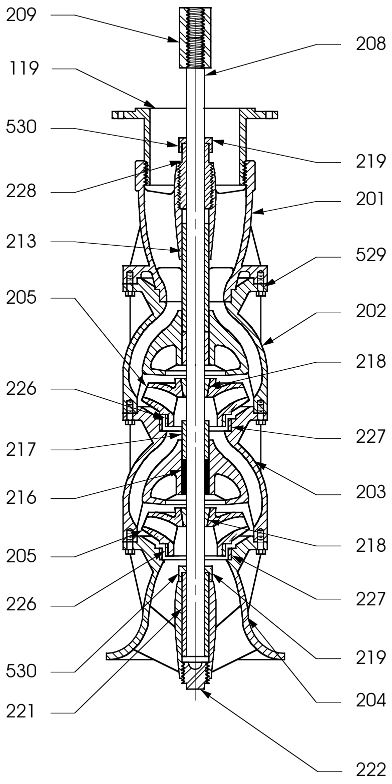
DATE 9-23-2011
DISTRIBUTOR Stanton systems

JOB duplicates of 112823

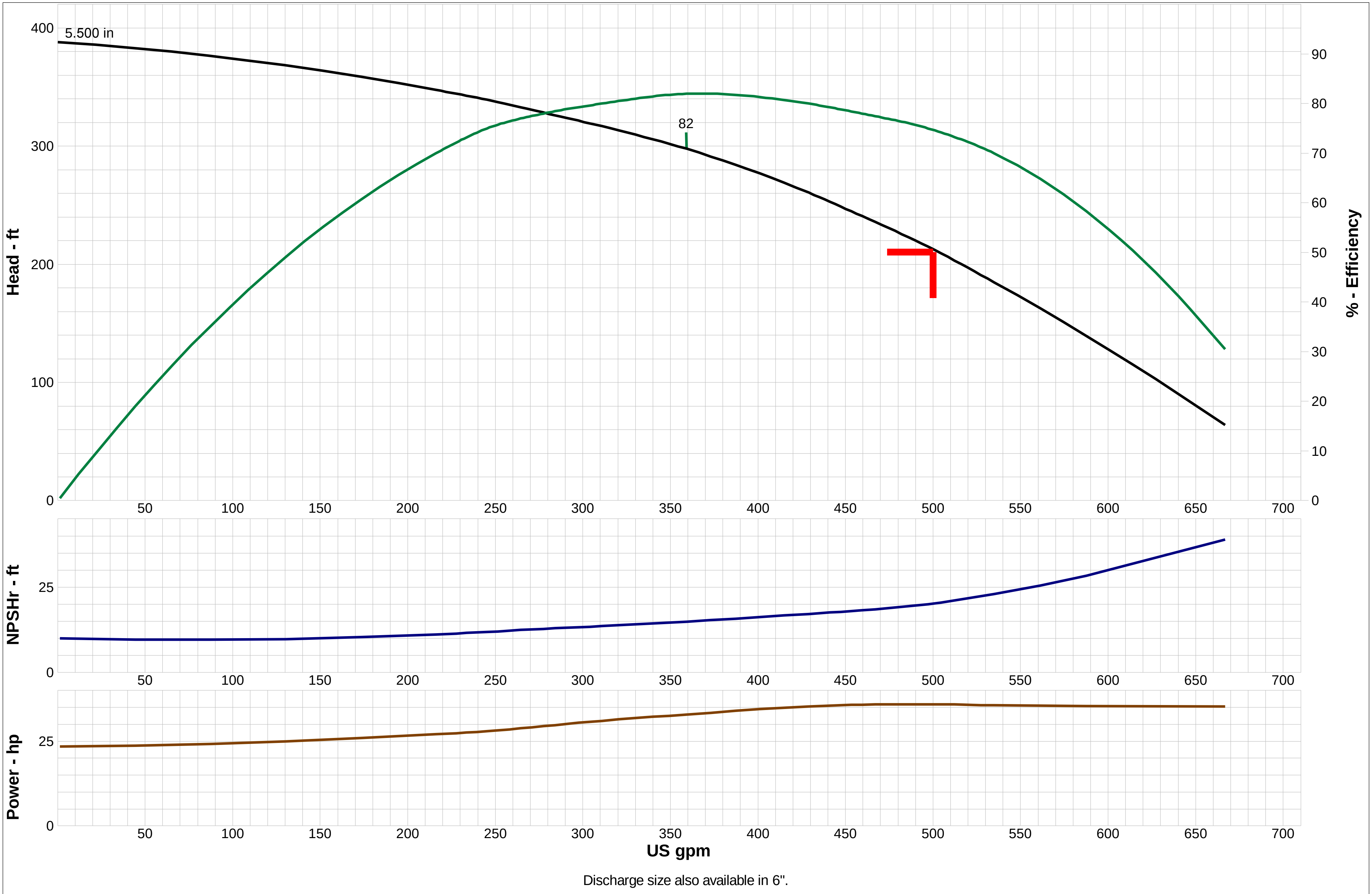
JOB/QUOTE # serial #112996 A-O
QUANTITY fifteen SD7C-3

Note: Bowls are vitreous porcelain enamel or fusion bonded epoxy lined.





CATALOG NUMBER	QUAN-TITY	PART NAME	STANDARD MATERIAL (A.S.T.M. DESIGNATION)	SPECIFICATION REQUIREMENT
119	0	ADAPTER, COLUMN, FLANGED	FABRICATED STEEL	not specified
201	1	CASE, DISCHARGE HOUSING	CAST IRON A-48 CLS 30	
202	1	BOWL, TOP HOUSING	CAST IRON A-48 CLS 30	
203	2	BOWL, INTERMEDIATE HOUSING	CAST IRON A-48 CLS 30	
204	1	CASE, SUCTION HOUSING, W/ SUCTION BELL	CAST IRON A-48 CLS 30	
205	3	IMPELLER (ENCLOSED)	BRONZE B-584-836	
208	1	SHAFT, BOWL	SS A-582 GR 416	
209	1	COUPLING, BOWL SHAFT	STEEL A-108 GR 1018	
213	1	BEARING, DISCHARGE CASE (LOWER)	BRONZE B-505-932	
216	2	BEARING, INTERMEDIATE BOWL	NEOPRENE	
217	0	BEARING, INTERMEDIATE BOWL	BRONZE B-505-932	not specified
218	3	COLLET, IMPELLER	STEEL A-108 GR 1020	
219	2	COLLAR, SAND	BRONZE B-505-932	
530	2	SET SCREW, SAND COLLAR	SS GR 416	
221	1	BEARING, SUCTION CASE	BRONZE B-505-932	
222	1	PLUG, GREASE	COMMERCIAL	
529	0	SCREW, CAP	COMMERCIAL	not applicable, threaded bowls
225	1	SCREEN, BASKET (CLIP ON)	FAB. STEEL	standard galvanized
226	0	RING, IMPELLER WEAR	BRONZE B-584-836	not specified
227	0	RING, BOWL WEAR	CAST IRON A-48 CLS 30	not specified
228	0	BEARING, DISCHARGE CASE (UPPER)	BRONZE B763-836	not applicable to SD7C model



Discharge size also available in 6".

Company: Stanton
Name: 112996
9/23/2011

SIMFLO PUMPS INC.
Catalog: Simflo Pumps.60, Vers 1
VERTTURBINE - 3600
Design Point: 500 US gpm, 210 ft

Size: SD7C 3 stage
Speed: 3450 rpm
Dia: 5.500 in

DEVGUARD™ 4308

Alkyd Industrial Gloss Enamel

Cat. # 4308-XXXX

PRODUCT DESCRIPTION

Generic: Alkyd

General Description: A premium quality alkyd gloss enamel for use on machinery, equipment, piping and tanks. Toughness and fast dry provide maintenance with minimum plant interruption. Free of mercury, lead and chromate hazards.

Typical Uses: Ideal for safety equipment and pipe identification. Provides excellent protection to metal surfaces as well as masonry, wood and wallboard. Also used as a trim enamel.

Special Qualifications: Suitable for use on structural surfaces or surfaces where there is a possibility of incidental food contact in commercial food preparation establishments, food processing plants and federally inspected meat and poultry plants. USDA no longer requires or furnishes product certification letters.

FEATURES

Advantages:

- Durable high gloss finish
- Interior or exterior usage
- Protects against atmospheric corrosion
- Excellent flow and leveling
- High hiding
- Washable and scrubbable
- Good abrasion resistance
- Easy application - brush, roll or spray
- Excellent resistance to grease, oil and water
- Performance alternate for Federal Specifications TT-E-489H, TT-P-61E, TT-E-506K, and TT-E-505A

SPECIFICATION DATA

Color: White, custom & ready-mix colors

Finish: Gloss, 85 units minimum @ 60°

Clean-up Solvent: Mineral Spirits or VM&P Naphtha

Weight/Gallon: 9.3 lbs./gal. (1.11 kg/L) - varies with color

VOC: 3.57 lbs./gal. (428 g/L) - varies with color

Solids By Volume: 45% ± 1% - varies with color

Theoretical Coverage at 1.0 Mil Dry: 722 sq. ft./gal. (18 m^2/L)

Practical Coverage: Apply at 282-353 sq. ft./gal. (8-9 m^2/L). Actual coverage may vary depending on substrate and application method.

Recommended Film Thickness: 2.0-2.5 mils (50-63 microns) dry - 4.5-5.5 mils (113-138 microns) wet

Systems: Please consult the appropriate system guide, the particular job specification or your ICI Devoe Coatings' Industrial Coatings Specialist for proper systems using this product. Systems must be selected considering the particular environment involved.

Service Temperature Limit: 200°F (93°C) in air

Flame Spread Rating: Class A (0-25) over non-combustible surfaces

Flash Point: 105°F (41°C)

Dry Time @ 77°F (25°C) & 50% RH:
To touch - 1 hour
To handle - 4-6 hours
To recoat - Overnight

Warning: The above table provides general guidelines only. Always consult your ICI Devoe Coatings Specialist for appropriate recoat windows since the maximum aged recoat time of this product may be significantly shortened or lengthened by a variety of conditions, including, but not limited to humidity, surface temperature, and the use of additives or thinners. The use of accelerators or force curing may shorten the aged recoat of individual coatings. The above recoat windows may not apply if recoating with a product other than those listed above. If the maximum aged recoat window is exceeded, please consult your ICI Industrial Coatings Specialist for appropriate recommendations to enhance adhesion. Failure to observe these precautions may result in intercoat delamination.

Shelf Life: 1 year minimum - unopened

PROPERTY	TEST METHOD	RESULTS
Abrasion Resistance	ASTM D 4060, CS-10 wheels, 500g load, 1000 cycles	40mg loss
Pencil Hardness	ASTM D 3363	2B - B
Flexibility	ASTM D 522, Method B, 1/8"	No cracking or flaking
	ASTM D 522, Method A	15.5%
Salt Spray (Fog) Resistance	ASTM B 117, 500 hours	1/16" rust creepage at scribe

DANGER! COMBUSTIBLE. HARMFUL OR FATAL IF SWALLOWED. Read label and Material Safety Data Sheet Prior to Use. See other cautions on last page. DSF2-0790

GENERAL SURFACE PREPARATION

All surfaces must be sound, dry, clean, and free of oil, grease, dirt, mildew, form release agents, curing compounds, efflorescence, loose and flaking paint and other foreign substances.

New Surfaces: **Steel** - Prime with metal primer DEVGUARD 4100 or 4120. **Galvanized Metal and Aluminum** - Prime with metal primer DEVGUARD 4120. **Wood** - Interior, prime with alkyd primer ULTRA-HIDE 1120. Exterior, spot prime knots with latex primer DULUX PROFESSIONAL Primer 2000. Prime entire surface with alkyd primer ULTRA-HIDE 2110. **Drywall** - Prime with latex primer GRIPPER 3210. **Concrete, Plaster and Masonry** - Cure at least 30 days before painting. pH must be 10.0 or lower. Remove laitance and roughen unusually slick poured or precast concrete by acid etching or sandsweeping. Follow acid manufacturer's application and safety instructions. Rinse thoroughly with water and allow to dry. Remove loose aggregate. Interior, prime with latex primer GRIPPER 3210. Exterior, prime with latex primer DULUX PROFESSIONAL Primer 2000. For alkaline conditions, use GRIPPER 3210. Fill block with latex filler BLOXFIL® 4000 or ULTRA-HIDE 3010.

Previously Painted Surfaces: Wash to remove contaminants. Rinse thoroughly with water and allow to dry. Dull glossy areas by light sanding. Remove sanding dust. Remove loose paint. Scrub heavy chalk exterior areas and overhead areas such as eaves with soap and water. All existing mildew must be removed by washing with a solution of 16 oz. (473 mL) liquid household bleach and two oz. (59 mL) non-ammoniated liquid detergent per gallon (3.785 L) of water. Rinse surfaces clean with water and allow to dry for 24 hours. Prime bare areas with primer specified under **New Surfaces**. Prime severely weathered exterior surfaces with alkyd primer ULTRA-HIDE 2110. Surfaces in good condition generally may be done with one coat.

DIRECTIONS FOR USE

Tinting: Tint the appropriate base with ICI Colorants. For improved hiding and deeper colors, tint the Neutral Base with Industrial Colorants.

Spreading Rate: Apply at 282-353 sq. ft./gal. (8-9 m^2/L) or 4.5-5.5 mils wet (2.0-2.5 mils dry). Actual coverage may vary depending on substrate and application method. For best hiding, tint primers toward finish coat color. Certain shades of yellow, orange, pink and red may require multiple coats.

Important: Alkyd or oil-based enamels may yellow in time in the absence of light, especially sunlight.

Application: Mix thoroughly before use. May be applied by brush, roll or spray. No thinning required. For airless spray use a .013" tip. Adjust pressure as needed. Do not apply in damp weather or when surface or air temperature is below 40°F (4°C). Two coats will provide best durability and uniformity. Surfaces coated with this product may become slippery when wet. For additional slip resistance in areas of pedestrian traffic, add one pound per gallon of coarse pumice or other texturing material. Brushing and rolling may require multiple coats to achieve correct film thickness and/or hiding.

Drying Time: At 77°F (25°C) and 50% R.H., dries to touch in one hour, to handle in four to six hours, and to recoat overnight. Low temperature, high humidity, thick films or poor ventilation will increase these times.

Clean-up: Clean immediately with mineral spirits or VM&P Naphtha.

PRECAUTIONS

DANGER! COMBUSTIBLE LIQUID AND VAPOR. HARMFUL OR FATAL IF SWALLOWED. ASPIRATION HAZARD - CAN ENTER LUNGS AND CAUSE DAMAGE. HARMFUL IF INHALED. MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS, INCLUDING DIZZINESS, HEADACHE OR NAUSEA. CAUSES EYE, SKIN AND RESPIRATORY TRACT IRRITATION. OVEREXPOSURE MAY CAUSE LIVER, KIDNEY DAMAGE. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE LUNG CANCER AND OTHER LUNG DAMAGE IF INHALED. WHEN TINTED, CONTAINS ETHYLENE GLYCOL WHICH CAN CAUSE SEVERE KIDNEY DAMAGE WHEN INGESTED AND HAS BEEN SHOWN TO CAUSE BIRTH DEFECTS IN LABORATORY ANIMALS. USE ONLY WITH ADEQUATE VENTILATION. KEEP OUT OF THE REACH OF CHILDREN. NOTICE: Products in this series may contain solvents. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. For emergency information call (800) 545-2643. For additional safety information, refer to the Material Safety Data Sheet for this product. Keep away from heat, sparks and flame. **Do not** smoke. Vapors may ignite. Extinguish all flames, burners, stoves, heaters and pilot lights and disconnect all electrical motors and appliances before use and until all vapors are gone. If sanding is done, wear a dust mask to avoid breathing of sanding dust. Do not breathe vapors or spray mist. If you experience eye watering, headaches, or dizziness, leave the area. If properly used, a respirator may offer additional protection. Obtain professional advice before using. Close container after each use. **FIRST AID:** In case of skin contact, wash off **quickly** with plenty of soap and water, remove contaminated clothing. For eye contact flush **immediately** with large amounts of water, for at least 15 minutes. **Obtain emergency medical treatment.** If swallowed, **obtain medical treatment immediately**. If inhalation causes physical discomfort, remove to fresh air. If discomfort persists or any breathing difficulty occurs, **get medical help. Note: These warnings encompass the product series. Prior to use, read and follow product specific MSDS and label information.**

DS45-0597

SHIPPING

Freight Classification: Paint
Flash point: 105°F (41°C)
Packaging: 1 gallon (3.785L)
5 gallons (18.925L)

Shipping Weight: 4 gallon case - 44 lbs. (20.0 kg)
5 gallon pail - 54 lbs. (24.5 kg)

4308-XXXX (12/99)
Ad Stock #68616A

RUSTGUARD 4140

Q.D. Shop Coat Primer

Cat. # 4140-6120 Gray/4140-7100 Red

PRODUCT DESCRIPTION

Generic: Alkyd

General Description: An all-purpose rust inhibitive interior/exterior alkyd shop coat primer for topcoating with conventional alkyd coatings. Dries in 30 minutes with four hour recoat.

FEATURES

Advantages:

- Fast dry
- Corrosion resistant
- Interior or exterior usage
- Easy application

Limitations of Use: Not recommended for immersion service.

SPECIFICATION DATA

Color: Gray & Red

Finish: Flat

Clean-up Solvent: Mineral Spirits or VM&P Naphtha

Weight/Gallon: 12.9 lbs./gal. (1.55 kg/L)

VOC: 2.8 lbs./gal. (340 g/L)

Solids By Volume: 56% ± 1%

Theoretical Coverage at 1.0 Mil Dry: 898 sq. ft./gal. (20 m^2/L)

Practical Coverage: Apply at 300-450 sq. ft./gal. (7.4-11.0 m^2/L). Actual coverage may vary depending on substrate and application method.

Recommended Film Thickness: 2.0-3.0 mils (50-75 microns) dry - 3.6-5.4 mils (90-135 microns) wet

Systems: Please consult the appropriate system guide, the particular job specification or your ICI Devoe Coatings' Industrial Coatings Specialist for proper systems using this product. Systems must be selected considering the particular environment involved.

Service Temperature Limit: 200°F (93°C) in air

Flame Spread Rating: Class A (0-25) over non-combustible surfaces

Flash Point: 69°F (20.5°C)

Dry Time @ 77°F (25°C) & 50% RH:
To touch - 30 minutes
To recoat - 4 hours

Warning: The above table provides general guidelines only. Always consult your ICI Devoe Coatings Specialist for appropriate recoat windows since the maximum aged recoat time of this product may be significantly shortened or lengthened by a variety of conditions, including, but not limited to humidity, surface temperature, and the use of additives or thinners. The use of accelerators or force curing may shorten the aged recoat of individual coatings. The above recoat windows may not apply if recoating with a product other than those listed above. If the maximum aged recoat window is exceeded, please consult your ICI Industrial Coatings Specialist for appropriate recommendations to enhance adhesion. Failure to observe these precautions may result in intercoat delamination.

Shelf Life: 1 year minimum - unopened

PROPERTY	TEST METHOD	RESULTS
Adhesion	ASTM D 3359	Excellent: 5A No peeling or removal

DANGER! FLAMMABLE. HARMFUL OR FATAL IF SWALLOWED. Read label and Material Safety Data Sheet Prior to Use. See other cautions on last page.

GENERAL SURFACE PREPARATION

All surfaces must be sound, dry, clean and free of oil, grease, dirt, mildew, form release agents, curing compounds, efflorescence, loose and flaking paint and other foreign substances.

New Surfaces: **Steel** - Best results are obtained over a surface sandblasted to a Commercial Blast (SSPC-SP6). Performance over hand or power-tool cleaned surfaces is dependent on the degree of cleaning. Prime with this product.

Previously Painted Surfaces: Wash to remove contaminants. Rinse thoroughly with water and allow to dry. Dull glossy areas by light sanding. Remove sanding dust. Remove loose paint. Scrub heavy chalk areas and overhead areas such as eaves with soap and water. Remove all mildew by washing with a solution of 16 oz. (473 mL) liquid household bleach and two oz. (59 mL) non-ammoniated liquid detergent per gallon (3.785 L) of water. Rinse surfaces clean with water and allow to dry for 24 hours. All areas failed by rusting, peeling, blistering, etc., must be wire brushed and scraped to remove all loose or loosely adhering material. Prime bare areas with primer specified under **New Surfaces**. For optimum performance in more corrosive areas, entire surface should be abrasive blast cleaned and primed with this product.

DIRECTIONS FOR USE

Tinting: Do not tint.

Spreading Rate: Apply at 300-450 sq. ft./gal. (7.4-11.0 m^2/L). Actual coverage may vary depending on substrate and application method.

Application: Mix thoroughly before use. May be applied by brush, roll or spray. No thinning required. For airless spray, use a .017" tip. Adjust pressure as needed. Do not paint in damp weather or when the surface or air temperature is below or expected to be below 50°F (10°C). Brushing and rolling may require multiple coats to achieve correct film thickness and/or hiding.

Drying Time: At 77°F (25°C) and 50% R.H., dries to touch in 30 minutes, to recoat in four hours and through dry in eight hours. Low temperature, high humidity, thick films or poor ventilation will increase these times.

Clean-up: Clean immediately with mineral spirits or VM&P Naphtha.

PRECAUTIONS

DANGER! FLAMMABLE LIQUID AND VAPOR. HARMFUL OR FATAL IF SWALLOWED. ASPIRATION HAZARD - CAN ENTER LUNGS AND CAUSE DAMAGE. HARMFUL IF INHALED. MAY CAUSE CENTRAL NERVOUS SYSTEM EFFECTS, INCLUDING DIZZINESS, HEADACHE OR NAUSEA. CAUSES EYE, SKIN AND RESPIRATORY TRACT IRRITATION. OVEREXPOSURE MAY CAUSE KIDNEY DAMAGE. CONTAINS CRYSTALLINE SILICA WHICH CAN CAUSE LUNG CANCER AND OTHER LUNG DAMAGE IF INHALED. USE ONLY WITH ADEQUATE VENTILATION. KEEP OUT OF THE REACH OF CHILDREN. NOTICE: This product contains solvents. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal. Keep away from heat, sparks and flame. **Do not** smoke. Vapors may ignite. Extinguish all flames, burners, stoves, heaters and pilot lights and disconnect all electrical motors and appliances before use and until all vapors are gone. If sanding is done, wear a dust mask to avoid breathing of sanding dust. Do not breathe vapors or spray mist. If you experience eye watering, headaches, or dizziness, leave the area. If properly used, a respirator may offer additional protection. Obtain professional advice before using. Close container after each use. **FIRST AID:** In case of skin contact, wash off **quickly** with plenty of soap and water, remove contaminated clothing. For eye contact flush **immediately** with large amounts of water, for at least 15 minutes. **Obtain emergency medical treatment.** If swallowed, **obtain medical treatment immediately.** If inhalation causes physical discomfort, remove to fresh air. If discomfort persists or any breathing difficulty occurs, **get medical help. Note: These warnings encompass the product series. Prior to use, read and follow product-specific MSDS and label information.**

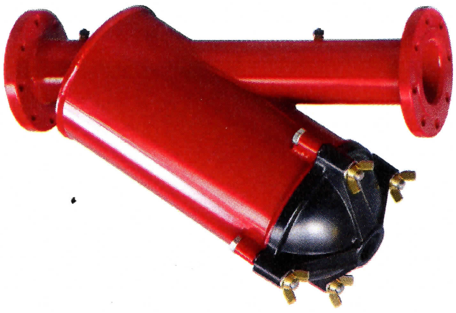
DS198-1198

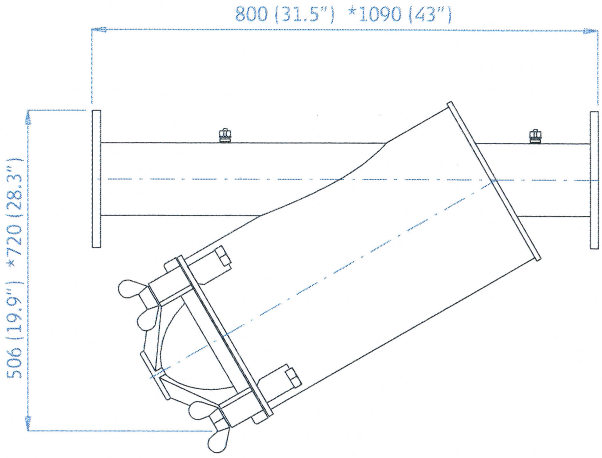
SHIPPING

Freight Classification:	Paint, 3, PG II, UN1263 (Flammable Liquid)
Flash Point:	69°F (20.5°C)
Packaging:	1 gallon (3.785L) 5 gallons (18.925L)
Shipping Weight:	4 gallon case - 58 lbs. (26.4 kg) 5 gallon pail - 70 lbs. (31.8 kg)

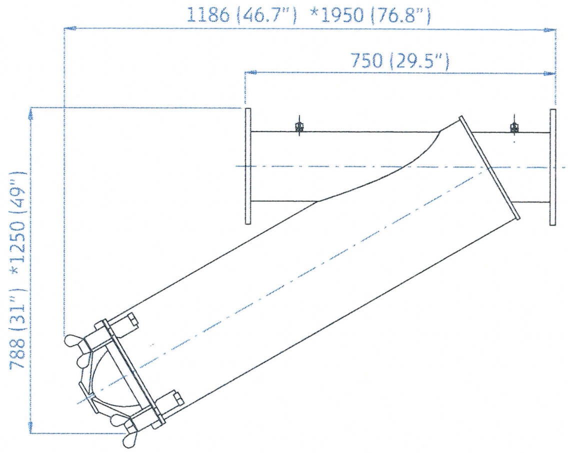
4140-XXXX (12/99)
Ad Stock #68608A

4" Super In-Line / 6" In-Line

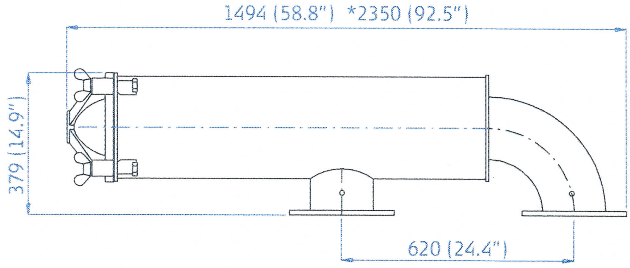




6" Super In-Line / 6" In-Line



6" Super Modular / 8" Modular



Technical Specifications

Filter Type	4" Super In-Line	6" In-Line	6" Super In-Line	8" In-Line
General Data				
Maximum flow rate*	100 m^3/h (352 US gpm)	160 m^3/h (704 US gpm)	160 m^3/h (704 US gpm)	300 m^3/h (1320 US gpm)
Inlet/Outlet diameter	4" (100 mm)	6" (150 mm)	6" (150 mm)	8" (200 mm)
Standard filtration degrees	3500, 2500, 1500, 800, 500, 300, 200, 130, 100, 50 micron			
Max. working pressure	10 bar (150 psi)			
Max. working temperature	60°C (140°F)			
Weight (empty)	38 kg (83.7 lb)	43 kg (94.7 lb)	56 kg (123.4 lb)	65 kg (143.2 lb)

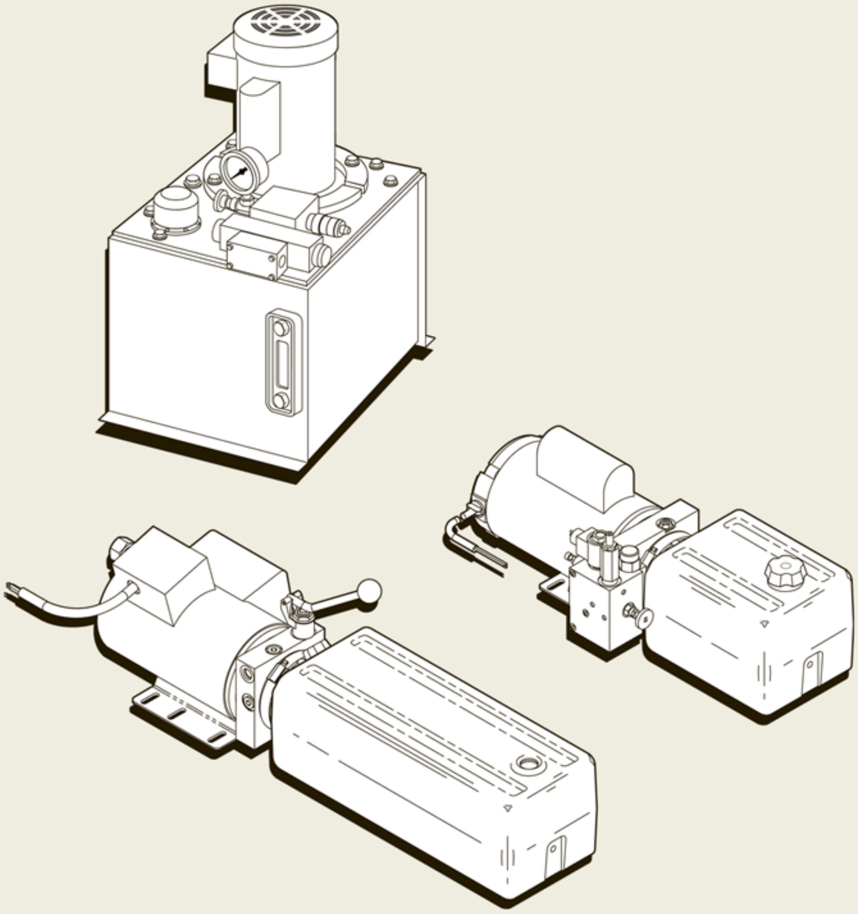
* Consult Amiad for optimum flow depending on filtration degree & water quality.

Engineering Data

Screen Data				
Filter area	2740 cm^2 (424.7 in^2)	2740 cm^2 (424.7 in^2)	5720 cm^2 (886.6 in^2)	5720 cm^2 (886.6 in^2)
Screen types	Weave Wire Screen, Perforated Screen			

Construction Materials*	
Filter Housing	Phosphate pre-treated steel 37-2 with Polyester coating
Filter Lid	SMC Polyester
Seals	Nitril Rubber
Weave Wire Screen	St. St. 316 with Nitril rubber seals
Perforated Screen	St. St. 316 with Nitril rubber seals

* Amiad offers a variety of construction materials. Consult us for specifications



motion and progress

Reference: 500-P-000002-E-00

Contents

Page

1 General information

1.1 Introduction

This catalogue illustrates the technical specifications for Bucher Hydraulic's A.C. range of Hydraulic Power Units. Designed for campactness and durability, millions of A.C. Series systems have been sold worldwide for actuating mobile, material handling, transport, construction, defense, access, machine tool, ergonomic, and other labor saving devices.
The Bucher Hydraulic name is synonymous with precise and cost efficient designs, robust construction and rapid backup service. Only eliminate "under the direction oft he Jack Family". Reliable service and "Quality Machinery Since 1856" to around the world.

1.2 Mission Statement

Bucher Hydraulics designs, manufactures and delivers innovative fluid power solutions and provides unparalleled support for its customers.

1.3 Quality Policy

Bucher Hydraulics will provide its customers with products and services of continually improving quality to the mutual satisfaction of all parties.

1.4 Bucher Hydraulics Value Statement

- Bucher Hydraulics will be honest, moral and ethical.
- Bucher Hydraulics will accept responsibility for its actions.
- Bucher Hydraulics will treat people with equality.
- Bucher Hydraulics will make a profit.

1.5 Prototype Policy

We invite you to try our Prototype Program for Solutions to Your Special Hydraulic Needs.

While Monarch offers a broad line of hydraulic systems and components, it is impossible to anticipate the needs of every customer, especially those developing new products. Our unique prototype program allows us to respond to your specific needs when an existing "catalogue model" does not fit your application.

To participate in this program, simply submit a print, schematic, or sketch of the hydraulic power pack that you need along with a purchase order. We will review the system requirements with you and then manufacture the system that we believe will satisfy your objectives. The unit will be invoiced at an agreed upon price and marked Prototype.

You have 90 days free use of this product for testing and evaluation from the date of invoice. At the end of this period you can (1) extend the testing and evaluation period for an additional 90 days or (2) purchase the unit as invoiced (and order more if needed) or (3) return the unit via prepaid transportation for full credit.
There is no risk to you. Just the opportunity to solve your hydraulic problem with the performance and quality of Monarch Hydraulics.

⚠ **ATTENTION!**

- Always wear eye protection and protective clothing.
- Remove jewelry and objects that might conduct electricity while working on power units.
- Hydraulic fluid does pose a fire hazard, can cause burning or skin irritation if not propely handled.
- Fluid under pressure can pierce the skin and enter the bloodstream causing death or serious injury.
- Devices being operated by the hydraulic system should be immobilized so they cannot moce and cause injury while being inspected or repaired.
  Disconnect from electrical source.
- Prior to performing any maintenance make sure the equipment is turned off and that any stored energy, for example pressure, is released. Also, extended equipment or cylinders should be lowered and mechanically locked as required.
- Bucher Hydraulics is not responsible for misuse or misapplication of porduct. If you have any questions about application, please contact local dealer.
- Fluids should be contained and disposed of properly.

1.6 Features and Benefits

Standard M-4300 series Features:

- Flexible coupling extends pump life, eliminates misalignment
- All powdered metal gears
- Hardcoated pump end plates for unmatched durability in demanding environments and severe duty applications
- Externally adjustable relief valve with lock nut
- 1 year limited warranty on system
- Monarch's personal customer service
- 24 hour shipment on most parts orders
- Over two million power units sold
- Worldwide distributor network

Options

- Pressure gauges
- Sae ports on most models
- Complete selection of nfpa do3 control valves and auxiliary valves
  - Cross port relief
  - Pressure reducing
  - Single and double flow control
  - Direct and pilot operated check
  - Sequence
  - Counter balance
  - Relief
- Pressure switches
- Water/oil heat exchangers
- Float switches
- Reservoirs
- 56 frame air motor
- Explosion proof, 50 hertz, chemical duty, dual frequency, metric frame, high torque and special duty electric motors
- Gasoline and diesel engines
- Close coupled motors available on many systems

2 How to Use This Product Guide

- Select the Circuit that will satisfy your design objectives (refer to page 4.0). Contact the Monarch Factory or your Distributor if you require assistance.
- Select the Model that will provide the desired performance (Flow/Pressure) and Valve Activation (Solenoid or Manual) listed in the Power System Selection Guide (refer to page ??).
- Follow the “How To Order Your M-4XXX Power System” provided after each Model description. Only the recommended combinations are listed for the particular system. Custom configurations are available and should be discussed with the Monarch Factory or your Distributor.
- The operating and design characteristics for all of the basic components are listed on pages ??-?? of this guide.

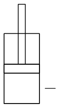
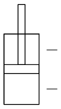
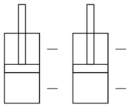
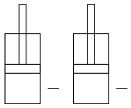
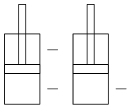
  Select Pump and HP on Page 9, 12, or 13.
  Select Motor on Pages 10 or 12.
  Select Reservoir on Page 14 - 17.
  Select Valve(s) on Pages 19 - 20.
  Select Accessories on Page 21.

Example:

Order Your Hydraulic Power System As Follows:
Select Circuit: Pump/Motor/Reservoir. Page 8.
Select Model: M-4304. Page 8.
Performance Required: 1.0 GPM @ 2000 PSI. Reference Page 9
Select Pump: 12172-270 (51) (1.02 GPM @ 1725 RPM). Page 9
Select Motor: 08747 (1-1/2 HP, 1725 RPM). Page 10
Select Reservoir: 06073, Page 14
Accessories: 12172-270
Model Code: M-4304-08747-06073
Horizontal Mounting

- Nominal Dimensions are shown for all basic components. Dimensions may be found for your particular system by deleting the component shown on the unit drawing and adding the dimension for the same item you have selected. Note: Motor dimensions may vary according to the manufacturer and should be confirmed by the Monarch Factory or your Distributor.
- When selecting Motor, choose the HP required or the next highest HP available.
- When selecting a Reservoir, consideration should be given to dissipating heat, separating air from the oil, and settling out contamination in the oil. The traditional “rule of thumb” is that the reservoir should be 2-3 times larger than the pump output per minute. There must always be a reserve of oil in the reservoir when all cylinders are fully extended. Contact the Monarch Factory or your Distributor for proper reservoir sizing for your application.
- All system wiring should be completed by a certified electrician according to local codes.

2.1 M-400 Series Power System Selection Guide

Circuit	Description	Model	Page
	Pump + Motor	M-4226 Mini	26
		M-4326	12
	Pump + Motor + Reservoir	M-4204	13
		M-4304	14
Operates Single Acting Cylinder			
	Pump + Motor + Reservoir + Manual Valve	M-4313	15
		M-4509	16
		M-4509-C	17
		M-4301	18
		M-4315	
	Pump + Motor + Reservoir + Solenoid Valve	M-4219	19
		M-458 Mini	20
		M-4319	21
		M-4519-C	22
		M-4303	23
Operates Double Acting Cylinder			
	Pump + Motor + Reservoir + Manual Valve	M-4310	29
	Pump + Motor + Reservoir + Solenoid Valve	M-4551-C	34
		M-4252	35
		M-4253	38
		M-4506	24
		M-4505	25
Operates 2 Double Acting Cylinder			
	Pump + Motor + Reservoir + Solenoid Valves	M-4328	41
		M-4328-P	42
		M-4528	42
Independent Operation of 2 Single Acting Cylinders or Master / Slave			
	Pump + Motor + Reservoir + Solenoid Valves	M-4266	39
		M-4257	40
Operates 1 Double Acting and 1 Single Acting Cylinder			
	Pump + Motor + Reservoir + Solenoid Valves	M-4593-C	39

2.2 M-400 Series Pump/Motor Performance Data

Pump Code	Displacement	RPM	GPM	Input HP Required at Pressure (PSI)					
	In^3 / Rev (Cm^3 / Rev)			500	1000	1500	2000	2500	3000
12637-150 (72) *	0.032	1725	0.24	0.20	0.30	0.35	0.50	0.55	0.75
	(0.524)	3450	0.48	0.40	0.60	0.70	1.00	1.10	1.50
12637-270 (62) *	0.057	1725	0.42	0.20	0.35	0.45	0.60	0.70	0.90
	(0.934)	3450	0.85	0.40	0.70	0.90	1.20	1.40	1.80
12172-150 (42)	0.077	1725	0.58	0.25	0.45	0.60	0.80	1.00	1.15
	(1.26)	3450	1.15	0.50	0.90	1.20	1.60	2.00	2.30
12172-200 (43)	0.099	1725	0.74	0.35	0.55	0.80	1.05	1.30	1.50
	(1.66)	3450	1.48	0.70	1.10	1.60	2.10	2.60	3.00
12172-250 (03)	0.125	1725	0.93	0.45	0.75	1.10	1.40	1.70	2.15
	(2.13)	3450	1.87	0.90	1.50	2.20	2.80	3.40**	3.95**
12172-270 (51)	0.137	1725	1.02	0.50	0.80	1.15	1.50	2.00	2.25
	(2.31)	3450	2.05	1.00	1.60	2.30	3.00	3.60**	
12172-330 (55)	0.168	1800	1.31		1.04	1.49	1.94	2.39	2.84
	(2.76)	3600	1.31		2.09	2.99	3.89	4.79	5.69
12172-380 (05)	0.193	1725	1.44	0.60	1.10	1.50	2.00	2.50	3.00
	(3.23)	3450	2.88	1.20	2.20	3.00	3.90**		
12172-510 (07)	0.251	1725	1.85	1.00	1.65	2.50	3.00	3.75**	
	(4.11)	3450	3.70	2.00	3.30**				

** = Intermittent Service Only. Contact the Monarch Factory or your Distributor for operating limits. The above pumps tested using Mobil DTE 24 at 100°F 165 SUS, 95 Viscosity. Note: kW = HP x 0.746

* = Denotes i-Pump

Recommended Operating Conditions for M-400 Series Pumps:

Oil Temperature Range: 10°F to 170°F (-25°C to 77°C)

Operating Temperature: 50°F to 130°F (10°C to 54°C)

Oil Viscosity:
- Optimum 100 to 350 SUS (Cst = .22 x SUS - 135/SUS)
- Minimum 100 SUS at Operating
- Maximum Start Up 4000 SUS

Recommended Filtration:
- 10 micron nominal or better

Recommended Fluid for indoor use:
- Mobil DTE 24 or equal

Recommended Fluid for outdoor use:
- Mobil DTE 13 or equal

Recommended Fluid for outdoor use:
- ATF Dexron II or equal

Contact factory for use with non-petroleum based fluids and availability of special seals.

STANDARD PUMP FEATURES:

- Fixed Displacement, External Tooth, Powdered Metal Gears
- Hardcoat Processed Internal Pump Surfaces Extend Service Life
- Extremely Tolerant of Fluid Contaminants and Resistant to Galling Caused by Low Viscosity Start-up
- Wide Temperature and Viscosity Operation
- Cost Effective
- 100% Tested for Volumetric Efficiency and Pressure
- Over Five Million Power Units Sold

2.3 M-400 Series Motor Information

Part Number	HP	RPM	Voltage	Phase	Frame	Enclosure
08740	1/2	1725	115/230/60	1	56C	TEFC
08742	1/2	3450	115/230/60	1	56C	TEFC
08741	1/2	1725	230/460/60	3	56C	TEFC
08743	1	1725	115/230/60	1	56C	TEFC
08744	1	1725	230/460/60	3	56C	TEFC
08745	1	3450	115/230/60	1	56C	TEFC
08746	1	3450	230/460/60	3	56C	TEFC
08747	1 1/2	1725	115/230/60	1	56C	TEFC
08748	1 1/2	1725	230/460/60	3	56C	TEFC
08749	1 1/2	3450	115/230/60	1	56C	TEFC
08750	1 1/2	3450	230/460/60	3	56C	TEFC
08177-B	2 2.8	3450	208/230/60	1	56C	TENV 15 MIN DUTY @ 2.0 HP 5 MIN DUTY @ 2.8 HP
08754	2	1725	115/230/60	1	56C	TEFC
08753	2	1725	230/460/60	3	56C	TEFC
08751	2	3450	115/230/60	1	56C	TEFC
08752	2	3450	230/460/60	3	56C	TEFC
08760	3	3450	115/230/60	1	56C	TEFC
08761	3	3450	230/460/60	3	56C	TEFC

Monarch Supplied 56C Motors have the standard length NEMA shaft shortened by 1-3/16”. All other frame size motors and all special ordered units are supplied with NEMA standard length drive shafts when possible. The above motors may be specified with standard NEMA 56C length drive shafts.

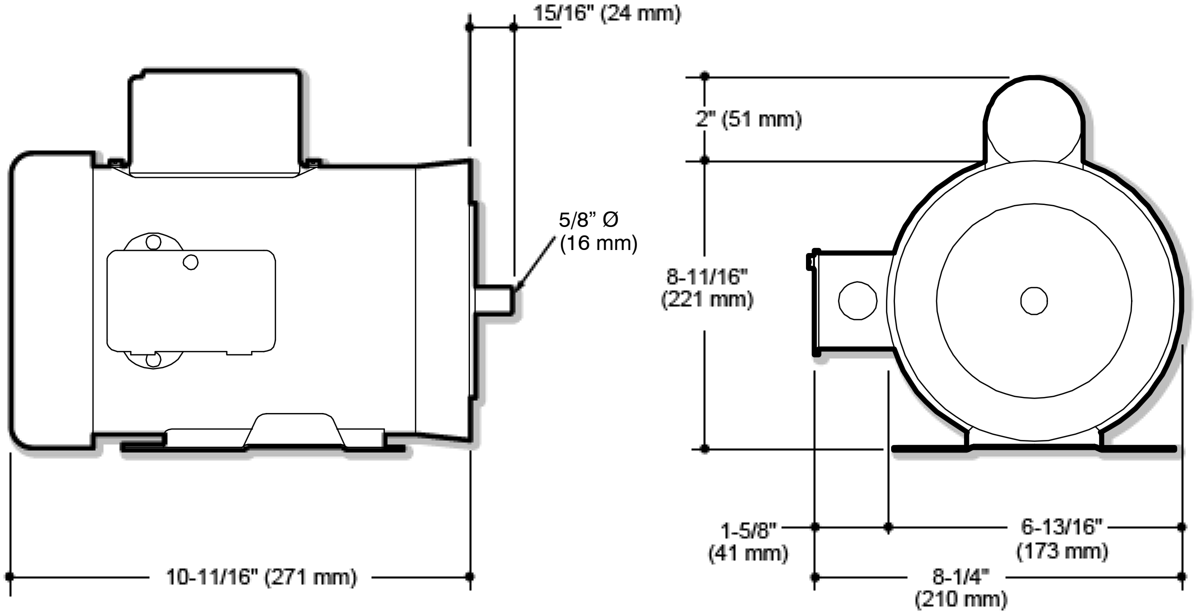
Special Motors commonly available for use with M-4300 units include:

- Explosion Proof
- Dual Frequency (50/60 Hz)
- Intermittent Duty - Custom Designed
- Washdown Duty
- 575V AC
- Open Drip Proof
- Totally Enclosed Non-Ventilated
- Custom Designed Motors for Special Applications

2.4 Dimensional Information for Standard M-400 Motors With Flexible Couplings

Motor Number 08751 is a 2 HP, 3450 RPM, 115/230 V AC, 60 Hz, 1 Phase, NEMA 56C TEFC and is shown as a general reference. Dimensions will vary according to motor output and manufacturer. Contact the Monarch Factory for more information.

Monarch standard adapter 01605 requires the NEMA motor shaft be shortened by 1-3/16”. Adapter 01615 should be specified when a standard NEMA motor shaft is required.



SIDE VIEW

END VIEW

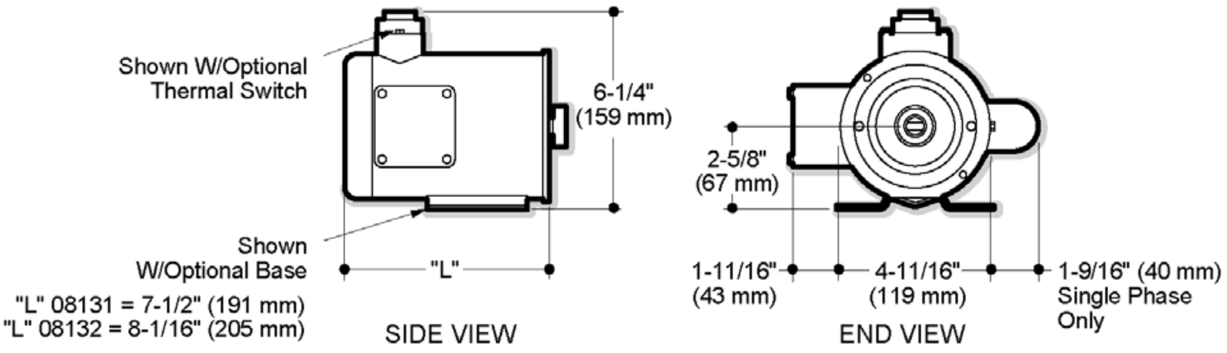
2.4.1 Close Coupled Motors For M-400 Units

The following direct drive (partial) motors are supplied with an adapter for mounting the pump base directly to the motor. The 01605 and/or 01615 extended pump/motor adapter and flexible coupling is not required. The close coupled motors may be used on Models: M-4301, M-4304, M-4315, M-4319, M-4326, M-4328 and M-4328-P

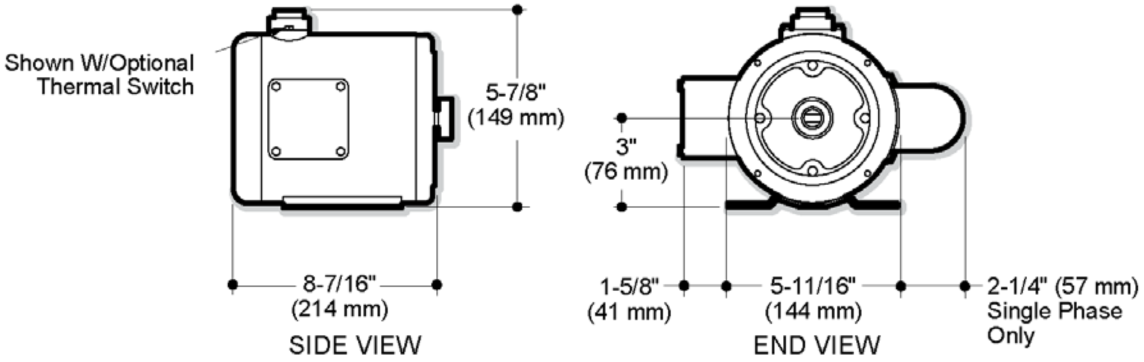
Part Number	HP	Duty	RPM	Voltage	Phase	Frame	Enclosure
08131	1/2	15 MINUTE	1725	115/230	1	42	TENV
08132	3/4	3 MINUTE	1725	115/230	1	42	TENV
08160	1	15 MINUTE	3450	115/230	1	48	TENV
08157	1	15 MINUTE	3450	230/460	3	48	TENV
08156	1	15 MINUTE	3450	575	3	48	TENV
18502-001	2.5	5 MINUTE	3450	208/230	1	56	TENV

For motors not found in this catalog, please contact factory.

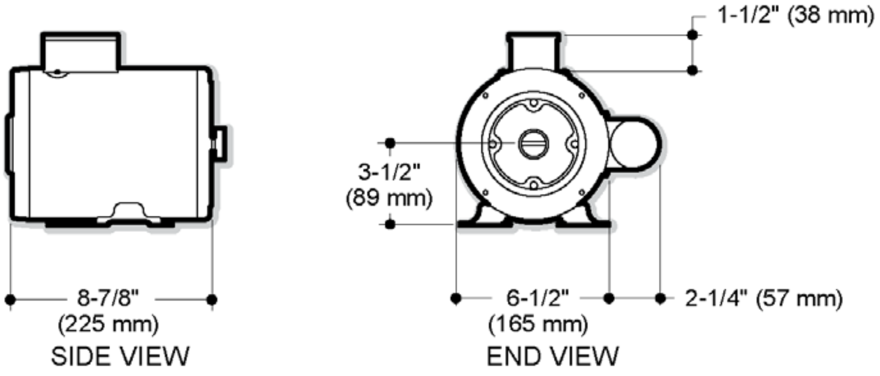
Dimensional Information for Close Coupled Motors



42 FRAME MOTOR DIMENSIONS



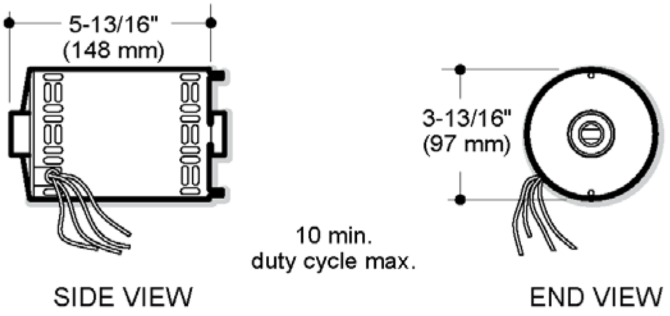
48 FRAME MOTOR DIMENSIONS



56 FRAME MOTOR AND ADAPTER

2.4.2 Close Coupled Motor for Monarch M-4200 Mini Units

The 08149 110 V AC, PSC 1 Phase, 60 Hz Motor is standard on all Mini Units. The motor includes a thermal overload with automatic reset. A capacitor is required. The 03862 60 iF 330V AC Capacitor is available as optional equipment. Note: Other Voltages, Enclosures, and Capacitors are available.



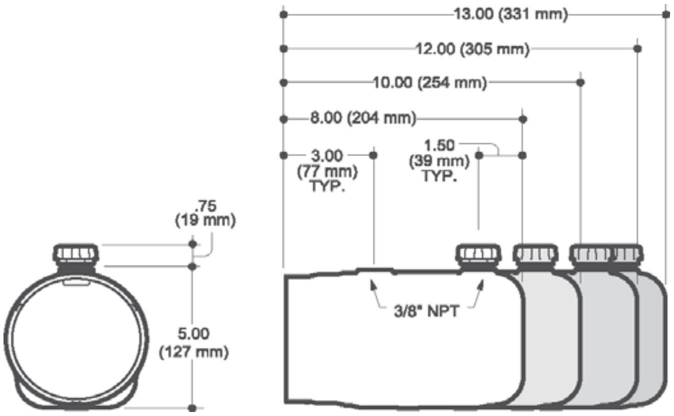
MINI AC MOTOR

Pump Code	Displacement	RPM	GPM	Input HP Required at Pressure (PSI)					
	In^3 / Rev (Cm^3 / Rev)			500	1000	1500	2000	2500	3000
12637-100 (70)	0.021 (0.34)	1800	0.16	7.6	7.7	8.0	8.4	8.9	9.5
12637-120 (71)	0.025 (0.41)	1800	0.20	7.6	7.8	8.2	8.8	9.5	9.5
12637-150 (72)	0.032 (0.524)	1800	0.25	7.7	7.8	8.6	9.5	9.5	9.5
12637-270 (62)	0.057 (0.934)	1800	0.44	7.7	8.7	9.5	9.5		
12172-150 (42)	0.077 (1.26)	1800	0.60	9.1	9.5				

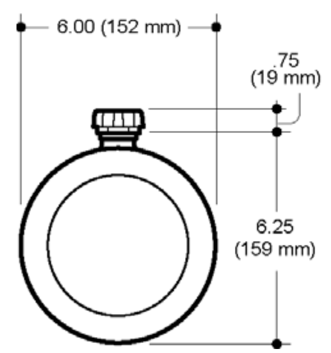
2.5 Reservoirs for M-400 Units

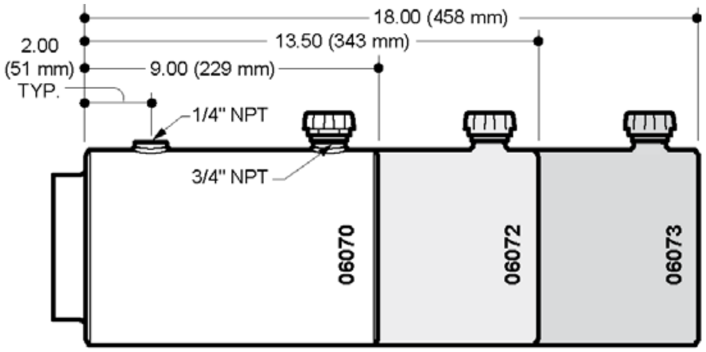
Horizontal			Length in / (mm)
Part Number	Useable Capacity		
	Cubic inch (in^3)	Liter (L)	
06102	79	1.3	8.00 (203.20)
06103	106	1.75	10.00 (254.00)
06104	134	2.20	12.00 (304.80)
06105	148	2.40	13.00 (330.20)

Vertical			Length in / (mm)
Part Number	Useable Capacity		
	Cubic inch (in^3)	Liter (L)	
04616	55	0.90	8.00 (203.20)
04617	90	1.50	10.00 (254.00)
04618	125	2.05	12.00 (304.80)
04619	140	2.30	13.00 (330.20)

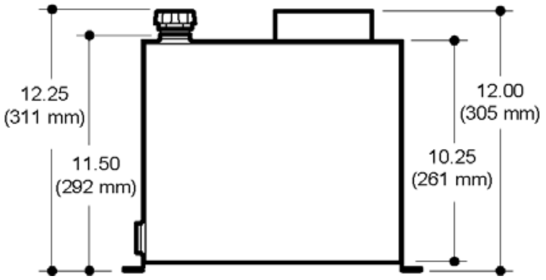


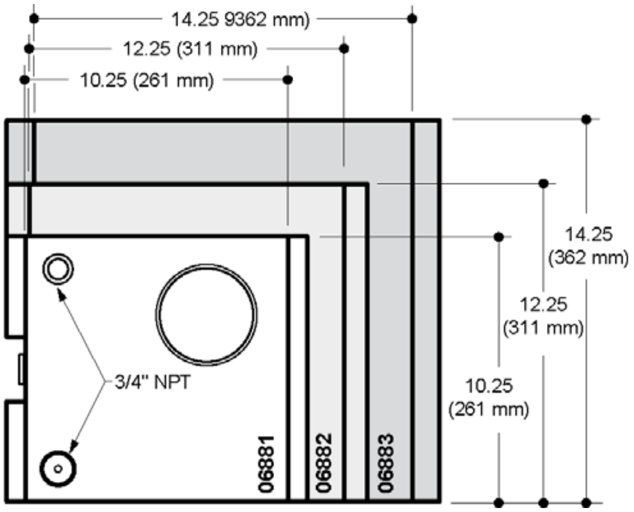
Part Number	Useable Capacity				Length in / (mm)
	Horizontal		Vertical		
	Cubic inch (in^3)	Liter (L)	Cubic inch (in^3)	Liter (L)	
06070	190	3.10	168	2.75	9.00 (229)
06072	292	4.80	285	4.70	13.50 (343)
06073	394	6.45	405	6.65	18.00 (458)





Vertical			Length in / (mm)
Part Number	Useable Capacity		
	Cubic inch (in^3)	Liter (L)	
06881	693	11.35	10” Sq. x 10”H
06882	1155	18.90	12” Sq. x 10”H
06883	1386	22.70	14” Sq. x 10”H

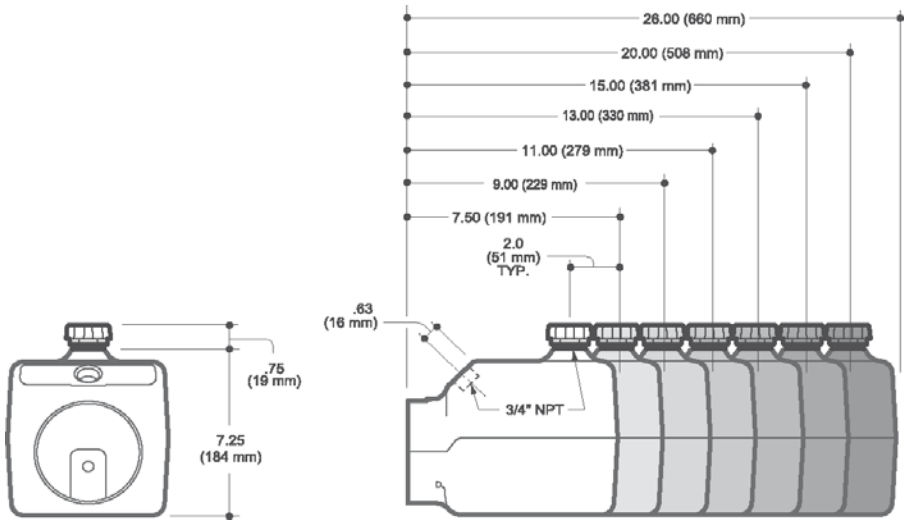




For reservoirs not found in this catalog, please contact factory..

Horizontal			Length in / (mm)
Part Number	Useable Capacity		
	Cubic inch (in^3)	Liter (L)	
14164	157.14	2.58	7.50 (190.50)
14165	203.21	3.33	9.00 (228.60)
14166	264.64	4.34	11.00 (279.40)
14167	326.07	5.34	13.00 (330.20)
14168	387.50	6.35	15.00 (381.00)
14169	541.08	8.87	20.00 (508.00)
14170	725.37	11.89	26.00 (660.40)

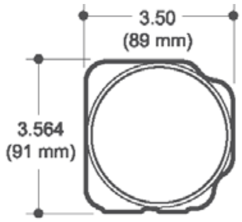
Vertical			Length in / (mm)
Part Number	Useable Capacity		
	Cubic inch (in^3)	Liter (L)	
14183	85.43	1.40	7.50 (190.50)
14184	149.51	2.45	9.00 (228.60)
14185	234.94	3.85	11.00 (279.40)
14186	320.37	5.25	13.00 (330.20)
14187	404.81	6.63	15.00 (381.00)
14188	619.39	10.15	20.00 (508.00)
14189	875.69	14.35	26.00 (660.40)

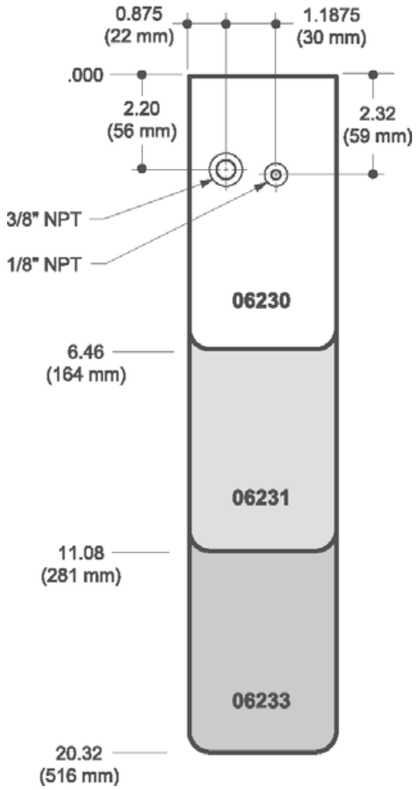


For reservoirs not found in this catalog, please contact factory.

2.6 Reservoirs for Mini Units

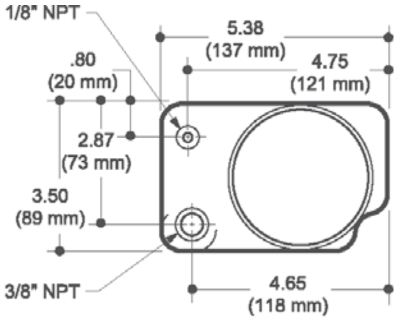
Part Number	Horizontal		Vertical		Length in / (mm)
	Useable Capacity				
	Cubic inch (in^3)	Liter (L)	Cubic inch (in^3)	Liter (L)	
06230	31	0.50	27	0.45	6.46 (164.08)
06231	61	1.00	73	1.21	11.08 (281.43)
06233	122	2.00	168	2.72	20.32 (516.13)

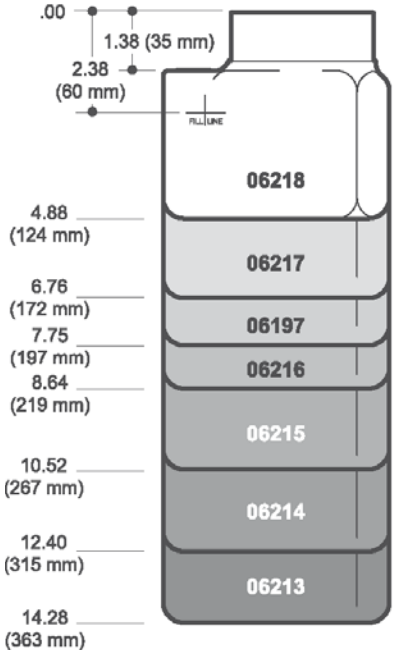




For reservoirs not found in this catalog, please contact factory.

Part Number	Horizontal		Vertical		Length in / (mm)
	Useable Capacity				
	Cubic inch (in^3)	Liter (L)	Cubic inch (in^3)	Liter (L)	
06218	31	0.50	39	0.64	4.88 (123.95)
06217	61	1.00	63	1.03	6.76 (171.70)
06197	77	1.26	76	1.24	7.75 (196.85)
06216	92	1.50	87	1.43	8.64 (219.46)
06215	122	2.00	111	1.82	10.52 (267.21)
06214	152	2.50	135	2.21	12.40 (314.96)
06213	183	3.00	159	2.61	14.28 (362.71)



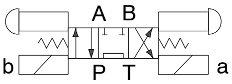
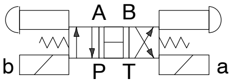
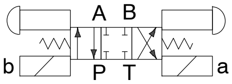
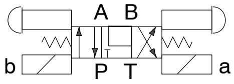
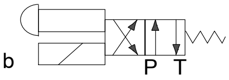
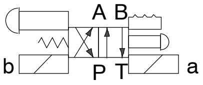
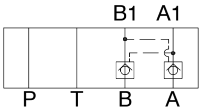
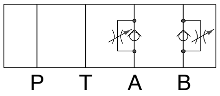
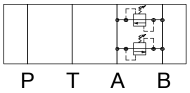
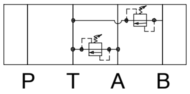


* Reservoir should not be used in a horizontal application without first consulting engineering (Special supports may be required).

2.7 Valves for M-400 Series Units

2.7.1 NPFA DO3 Directional and Auxiliary Control Valves.

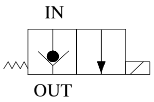
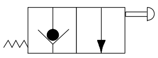
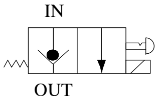
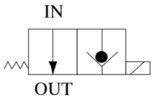
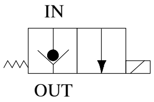
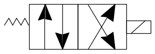
Solenoid directional and auxiliary controls are typically added to the M-4505, M-428, and M-429. Please refer to the Bucher Hydraulics Directional Control Valve brochure for additional information and selection.

Part Number	Schematic	Description
00970		4-Way/3-Position. Solenoid Operated. Tandem Center. 110 V AC
00967		4-Way/3-Position. Solenoid Operated. Open Center. 110 V AC
00968		4-Way/3-Position. Solenoid Operated. Closed Center. 110 V AC
00969		4-Way/3-Position, P Blocked. A and B to T. "Motor Spool". 110 V AC
01041		4-Way/2-Position. P to A. Spring Offset. 110 V AC
00692		4-Way/2-Position. P to A. Spring Offset. 110 V AC
00468		Dual Pilot Operated Check. A and B Port.
00469		Flow Control. Dual Meter Out. A and B Port.
00443		Cross Port Relief. A and B Ports. Adjustable.
00474		Dual Relief. A and B Ports to T. Adjustable.

Consult your local Monarch distributor or the factory about special requirements for explosion proof, shockless (soft shift) and other function and spool configurations not shown here. 12 and 24 VDC, 24 VAC and other voltages are available. Functional symbols related to solenoid identity "A" or "B" according to NFPA/ANSI standards, i.e., energizing solenoid "A" gives flow P to A, solenoid "B" gives flow P to B (As Applicable).

2.7.2 Cartridge Valves

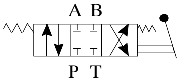
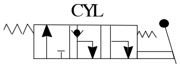
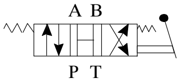
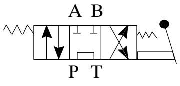
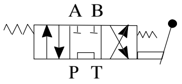
Solenoid operated cartridge valves are used in the M-403, M-419, and M-452 units.

Part Number	Schematic	Description
00986		2-Way/2-Position Normally Closed. Modified Cavity #8. 110 V AC Grounded Coil.
07144		2-Way/2-Position Normally Closed. Modified Cavity #8. Manual Operation. Pull to Open. Spring Closed.
00708		2-Way/2-Position Normally Closed. Modified. Cavity #8. Manual Overide. 110 V AC. Conduit Connector.
00987		2-Way/2-Position Normally Open. Modified Cavity #8. 110 V AC. Conduit Connector.
00585		2-Way/2-Position Normally Closed. Modified Cavity #8. 220 V AC. DIN 43650 Connection.
07145		4-Way/2-Position. Common Cavity #8. 110 V AC. Conduit Connector.

Consult Factory about many additional valve voltages, coil terminations and other options.

2.7.3 Manual Valves

Manually Operated Directional Control Valves are used on Models M-4301 and M-4310.

Part Number	Schematic	Description
00948		4-Way/3-Position. Closed Center. Manually Operated.
00800		3-Way/3-Position. Cylinder Port Checked.
00949		4-Way/3-Position. Open Center. Manually Operated.
00806		4-Way/3-Position. Tandem Center. Manually Operated.
00957		4-Way/3-Position. Tandem Center. NFPA DO3.

2.8 M-400 Series Accessories

Part Number	Description
01436	Sight Level/Temperature Gauge.
01516	Reservoir Breather, Flush Mount, .375” NPT. Cross Scored.
03171	Reservoir Breather, .375” NPT.
01143	Reservoir Breather, .750” NPT.
01670	Sight Glass. 3/4” NPT.
03219	Pressure Gauge, Liquid Filled. 1/4” NPT. 0-500 PSI.
01434	Pressure Gauge, Liquid Filled. 1/4” NPT. 0-3000 PSI.
01790	Pressure Gauge, Liquid Filled. 1/4” NPT. 0-5000 PSI.
00570	Gauge Shutoff. 1/4” NPT.
00904	Flow Control, Adjustable. 1/4” NPT. - 0-7 GPM
03642	Float Switch, Electrical N.O or N.C.
01875	Filter Only, Return Line. 15 GPM. 10 Micron Nominal, includes filterhead.
04369	Filter, Return Line. 5 GPM. 10 Micron Nominal, includes filterhead.
01425	Filler/Breather, Chrome Plated. Basket Strainer.

Other Available Options and Accessories Include:

- Air Motors
- Heat Exchangers
- Temperature Switches
- Pressure Switches
- Motor Controls
- Multi-Function Valve Controls - Monoblock and Sectional

Consult Factory about many additional valve voltages, coil terminations and other options.

2.9 Monarch Hand Pumps

Standard - Standard Displacement (0.50 In3/Stroke) High Pressure - Low Displacement (0.25 In3/Stroke) High Pressure/ Heavy Duty - Standard Displacement (0.50 In3/Stroke)

Note: It is recommended that pins and piston be periodically lubricated to prolong hand pump life.

2.10 Standard Hand Pumps

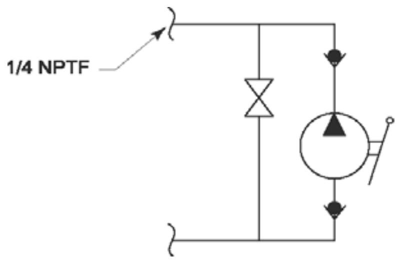
Description

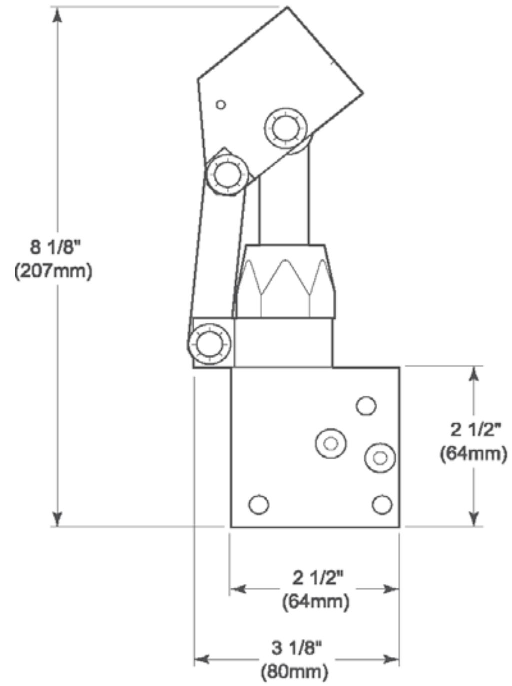
- 0.50 In3/Stroke (8.20 Cm3/Stroke)
- Single Acting
- 2000 PSI (138 Bar)
- Outlet Port: 1/4” NPTF
- Ideal For Emergency Back-Up Application in Case of Primary Pump Failure
- Horizontal or Vertical Mounting
- Designed for Mounting Directly to Monarch Power Units
- Handle May Positioned in any Direction
- Release Valve (Use Handle for Actuating)
- Supplied with Painted Steel ”Comfort Grip” Handle
- All Exposed Materials are Aluminum or Plated Steel for Corrosion Resistance

Popular Options

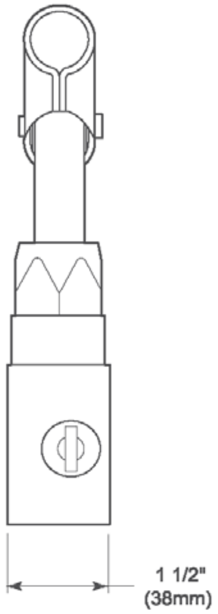
- Remote Mounting
- Ports. Other Styles Available
- Relief Valve
- Integral Reservoir

Schematic





SIDE VIEW



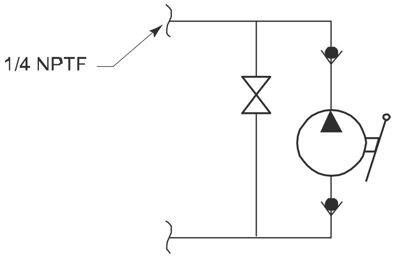
END VIEW

2.11 High Pressure - Low Displacement Hand Pump

Description

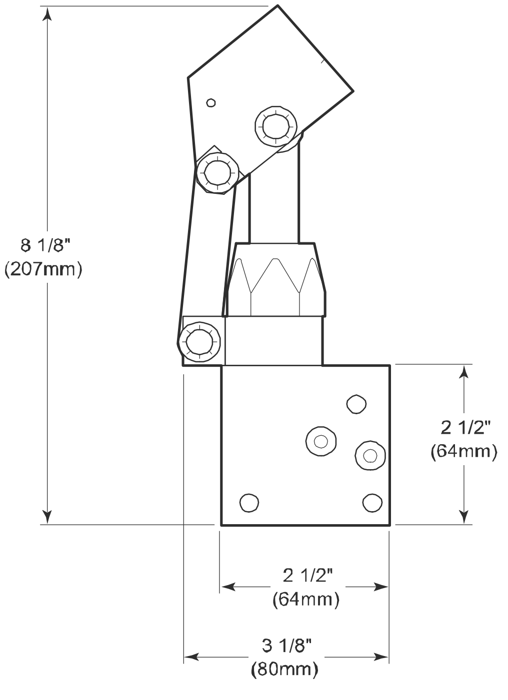
- 0.25 In^3/Stroke (4.10 Cm3/Stroke)
- Single Acting
- 3500 PSI (240 Bar)
- Outlet Port: 1/4” NPTF
- Ideal For Emergency Back-Up Application in Case of Primary Pump Failure
- Horizontal or Vertical Mounting
- Designed for Mounting Directly to Monarch Power Units
- Handle May Positioned in any Direction
- Release Valve (Use Handle for Actuating)
- Supplied with Painted Steel ”Comfort Grip” Handle
- All Exposed Materials are Aluminum or Plated Steel for Corrosion Resistance

Schematic

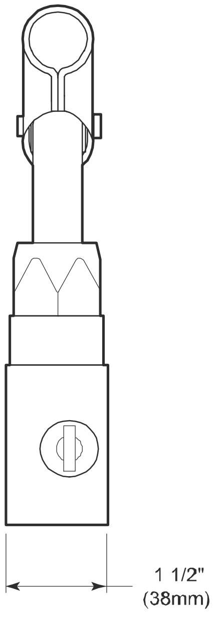


Popular Options

- Remote Mounting
- Ports. Other Styles Available
- Relief Valve



SIDE VIEW



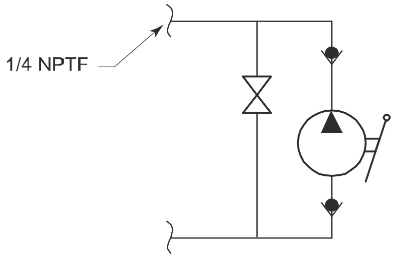
END VIEW

2.12 High Pressure - Heavy Duty Hand Pump

Description

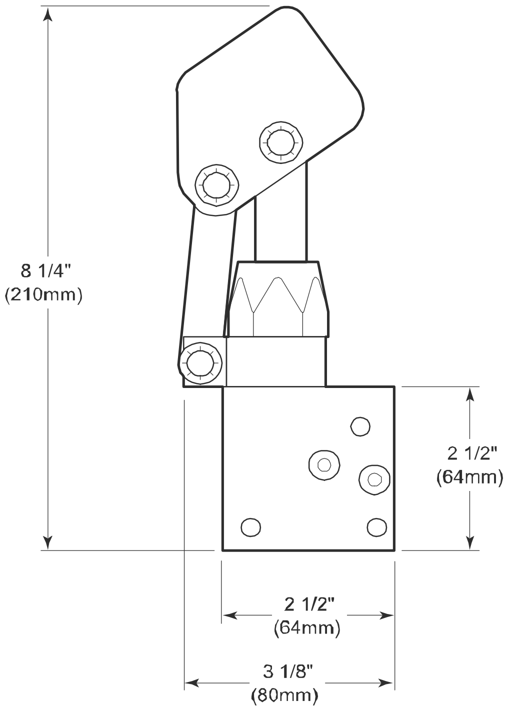
- 0.50 In3/Stroke (8.20 Cm3/Stroke)
- Single Acting
- 4000 PSI (275 Bar)
- Outlet Port: 1/4” NPTF
- Heavy Duty Plated Steel Tension Link and Extruded Aluminum Top and Bottom Brackets
- Ideal For Emergency Back-Up Application in Case of Primary Pump Failure
- Horizontal or Vertical Mounting
- Designed for Mounting Directly to Monarch Power Units
- Handle May Positioned in any Direction
- Release Valve (Use Handle for Actuating)
- Supplied with Painted Steel ”Comfort Grip” Handle
- All Exposed Materials are Aluminum or Plated Steel for Corrosion Resistance

Schematic

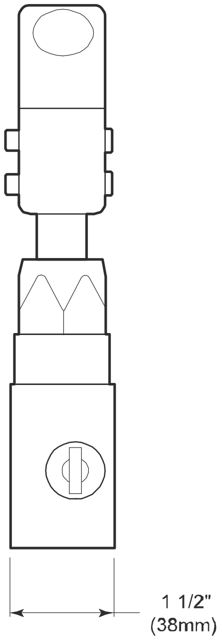


Popular Options

- Remote Mounting
- 1/4” NPTF Ports. Other Styles Available
- Relief Valve

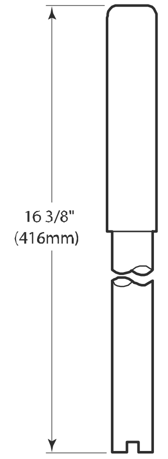


SIDE VIEW

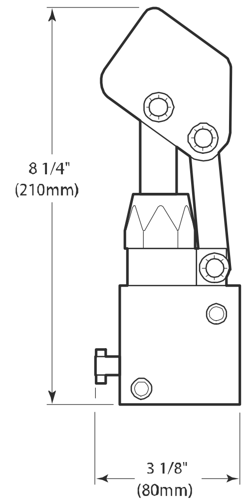


END VIEW

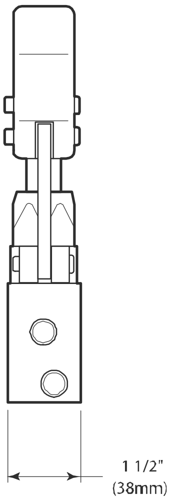
2.13 Heavy Duty Remote Hand Pump



HANDLE



SIDE VIEW

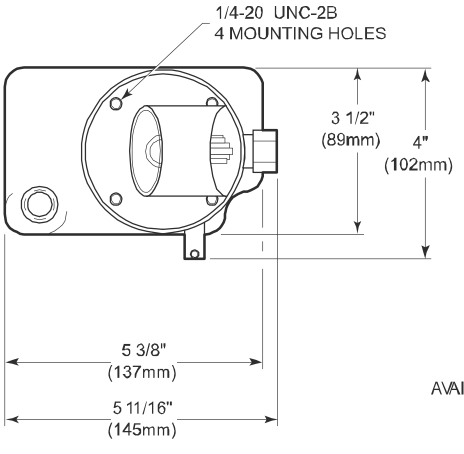


END VIEW

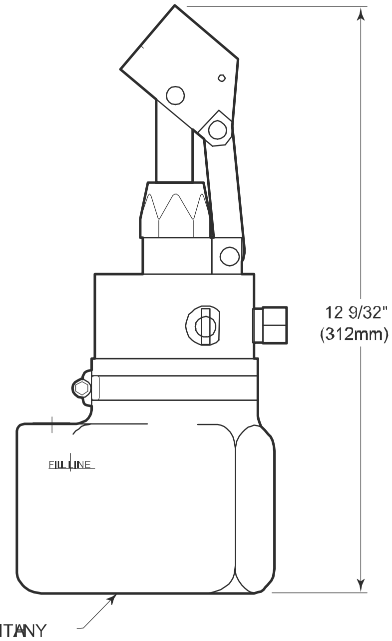
2.14 Model H-100 Series Hand Pumps With Reservoirs

Hand Pump with Relief Valve and Reservoir

- 12139 Standard Duty Hand Pump with Relief Valve
- 12140 Heavy Duty Hand Pump with Relief Valve



TOP VIEW



SIDE VIEW

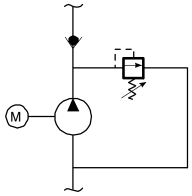
3 Monarch A.C. Hydraulic Power Systems

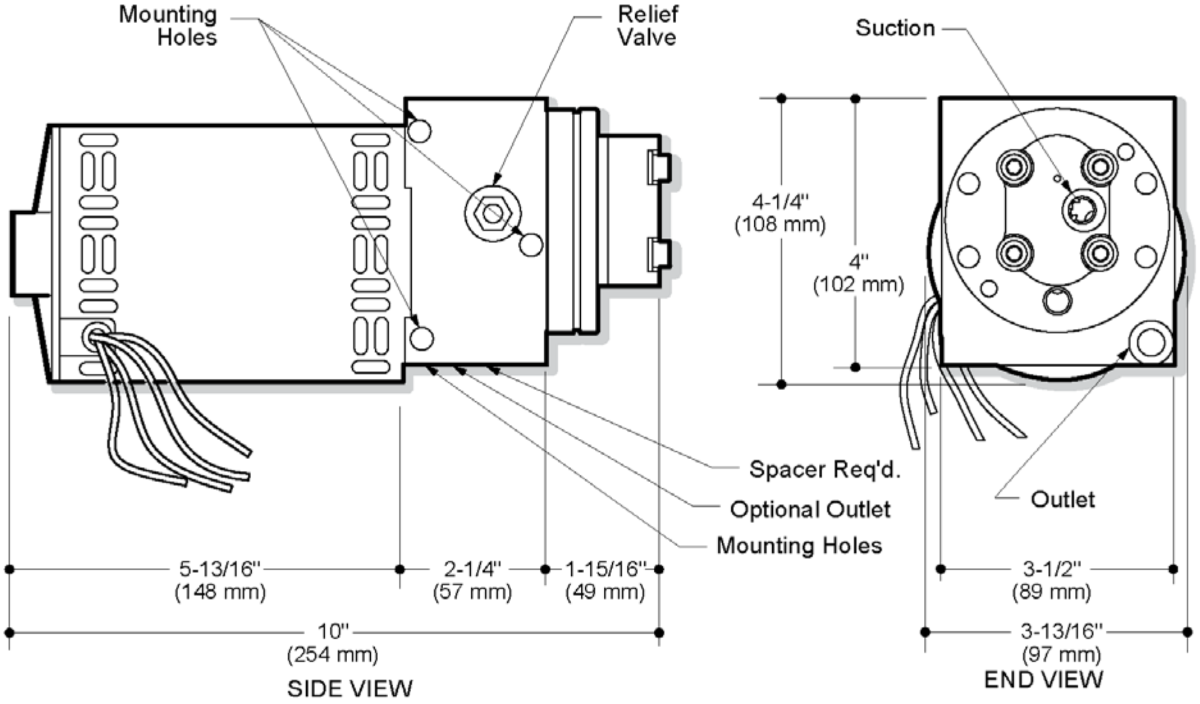
3.1 Model M-4226 Mini System (Formerly M-455)

Description

- Pump Motor Unit
- Check Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Suction
- 7/16-20 SAE Outlet Port

Schematic





How to Order Your M-4226 Mini System

Comprehensive information may be found on the page referenced below each selection category.

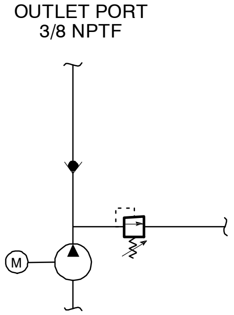
Pump	Motor	Voltage	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 9		Ref. Page 21

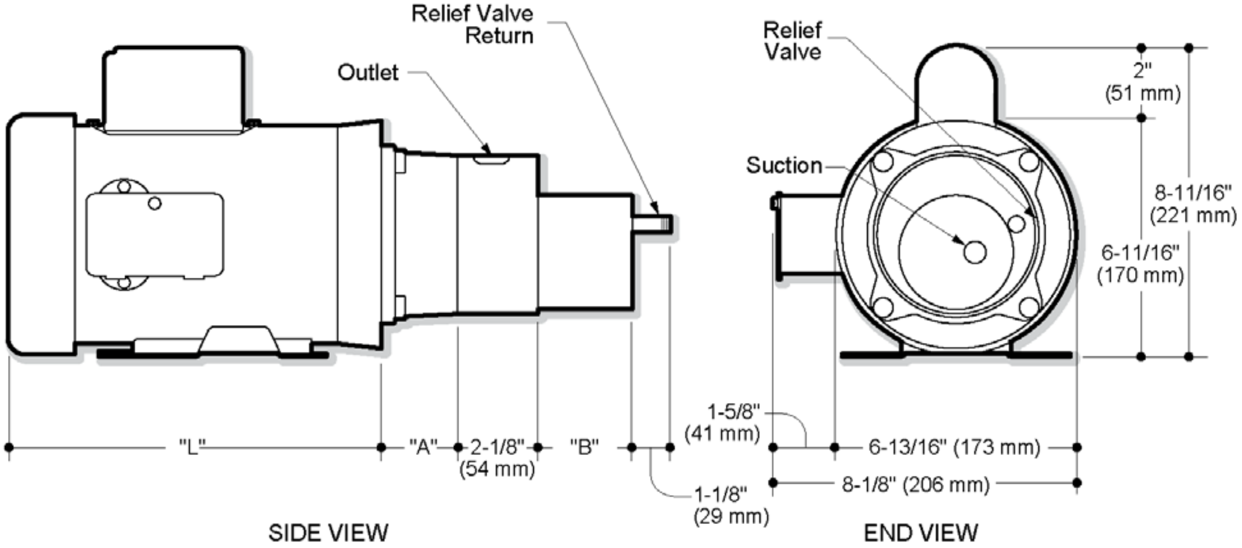
3.2 Model M-4326 (Formerly M-426)

Description

- Pump Motor Unit
- Check Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Suction
- .375 Inch NPT Outlet
- .125 Inch NPT Relief Valve Return Port

Schematic





”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
”B” pump dimensions vary depending on pump used
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4326 Power System

Comprehensive information may be found on the page referenced below each selection category.

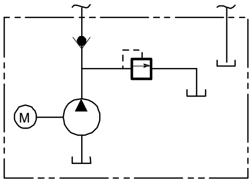
Pump	Motor	Close-Coupled	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13		Ref. Page 21

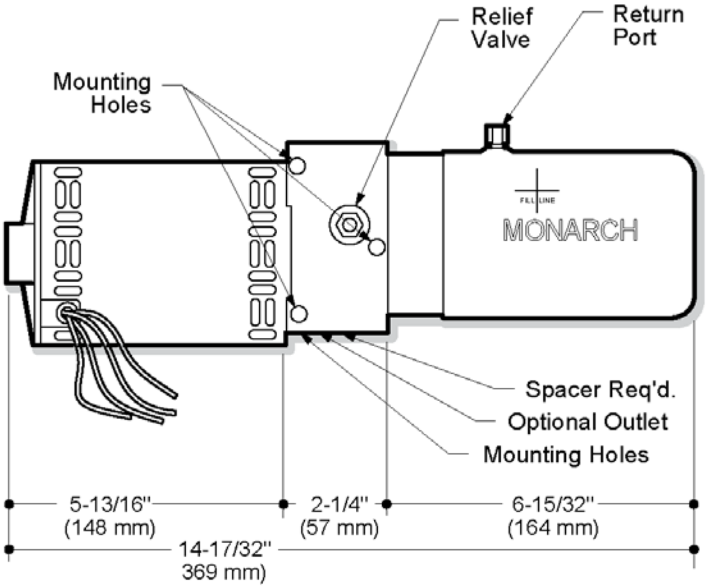
3.3 Model M-4204 Mini System (Formerly M-454)

Description

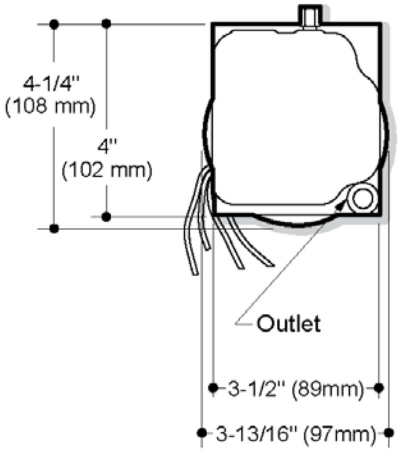
- Pump / Motor / Reservoir / Unit
- Externally Adjustable Relief Valve
- 7/16-20 SAE O-Ring Outlet Port, 3/8” NPT Return
- Horizontal Mounting Standard
- Vertical Mounting / Motor Up

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4204 Mini System

Comprehensive information may be found on the page referenced below each selection category.

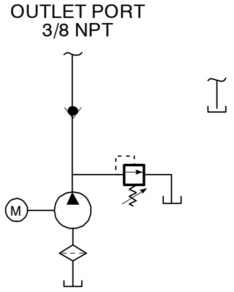
Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

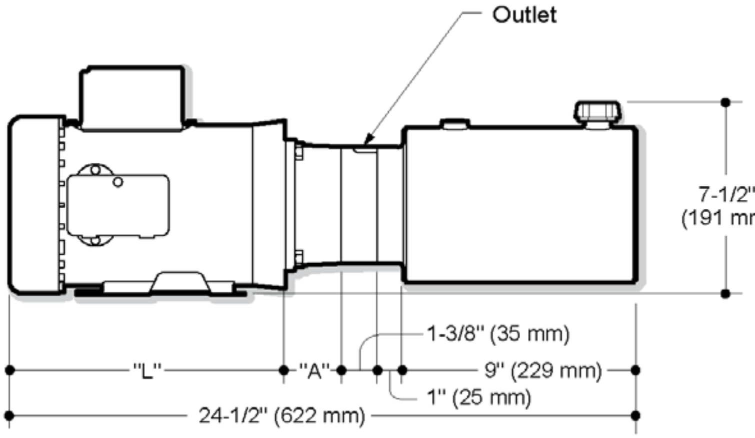
3.4 Model M-4304 (Formerly M-404)

Description

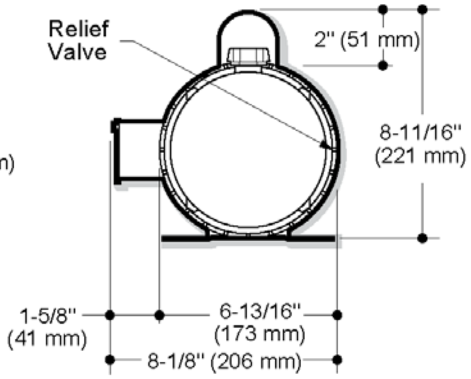
- Pump / Motor / Reservoir / Unit
- Check Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Outlet and Return
- Horizontal Mounting Standard
- Vertical Mounting / Motor Up

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4304 Power System

Comprehensive information may be found on the page referenced below each selection category.

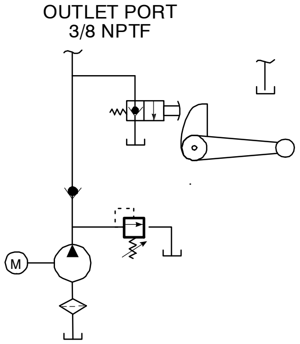
Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

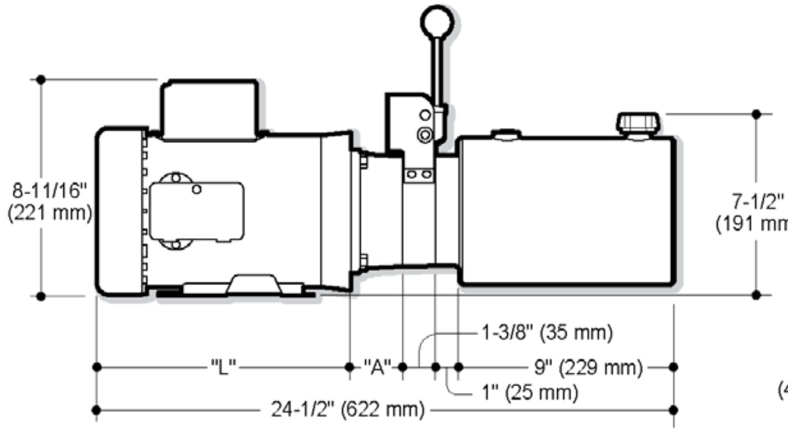
3.5 Model M-4313 (Formerly M-413)

Description

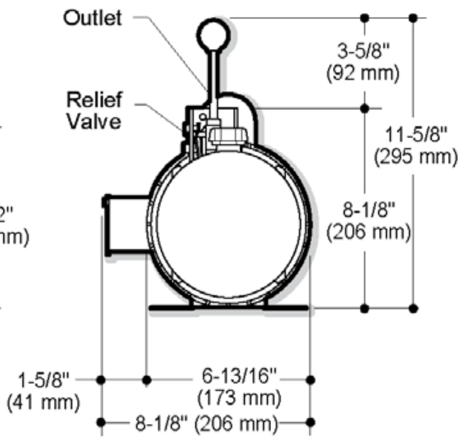
- Pump / Motor / Reservoir / Unit
- Manually Operated 2-Way/2-Position Normally Closed Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Outlet and Return
- Horizontal Mounting Standard
- Vertical Mounting / Motor Up

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4313 Power System

Comprehensive information may be found on the page referenced below each selection category.

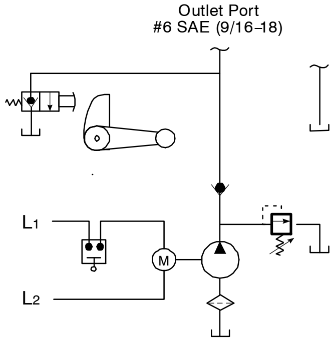
Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page 21

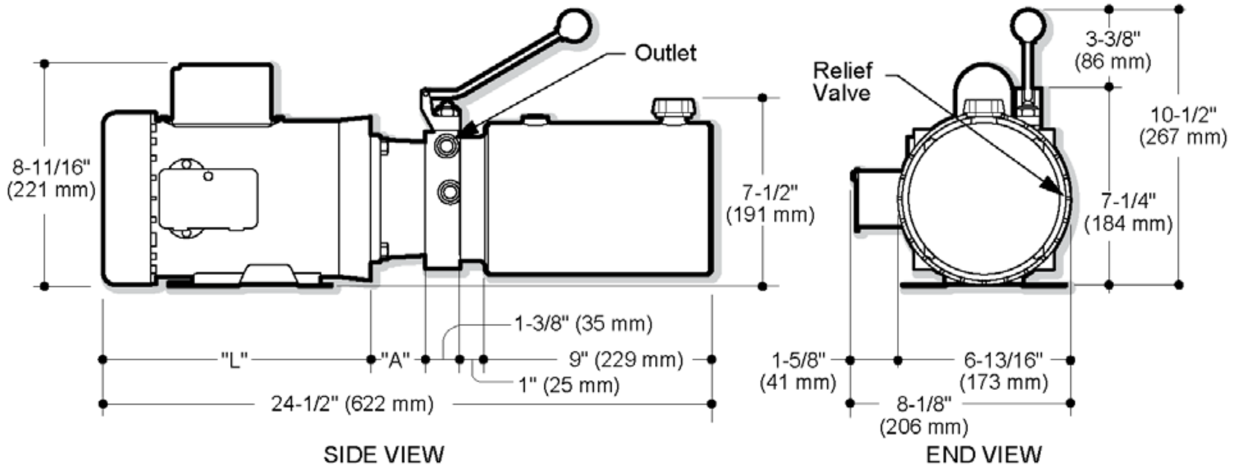
3.6 Model M-4509

Description

- Pump / Motor / Reservoir / Valve Unit
- 3-Way Manually Operated Valve
- Externally Adjustable Relief Valve
- .#6 SAE
- Vertical Mounting Standard (Motor Up)
- Snap Action Push Button Start Switch in Motor
- Kill Switch in Motor (Optional)
- Cord and Plug from Motor (Optional)

Schematic





”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4509 Power System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page 21

3.7 Model M-4509-C

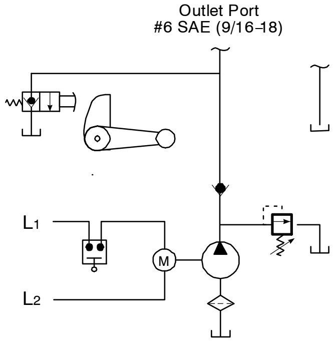
Description

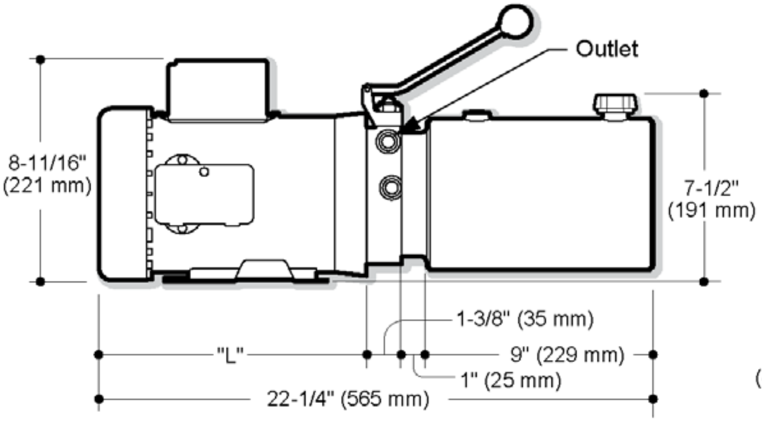
- Pump / Motor / Reservoir / Valve Unit
- Check Valve
- Externally Adjustable Relief Valve
- Manually Operated Lowering Valve
- Pressure Compensated Flow Control
- #6 SAE Outlet
- Vertical Mounting Standard, Motor Up

Popular Features

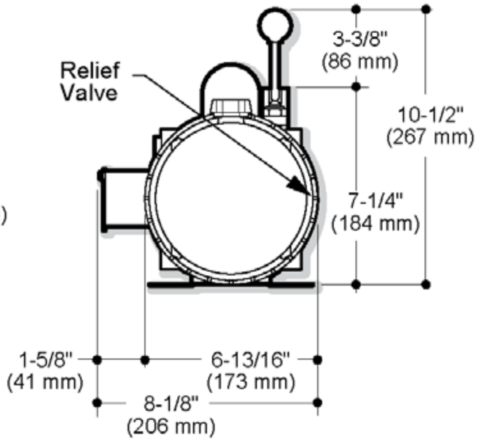
- Horizontal Mounting

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4509-C Power System

Comprehensive information may be found on the page referenced below each selection category.

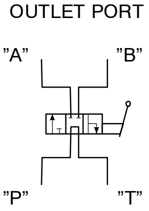
Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page 21

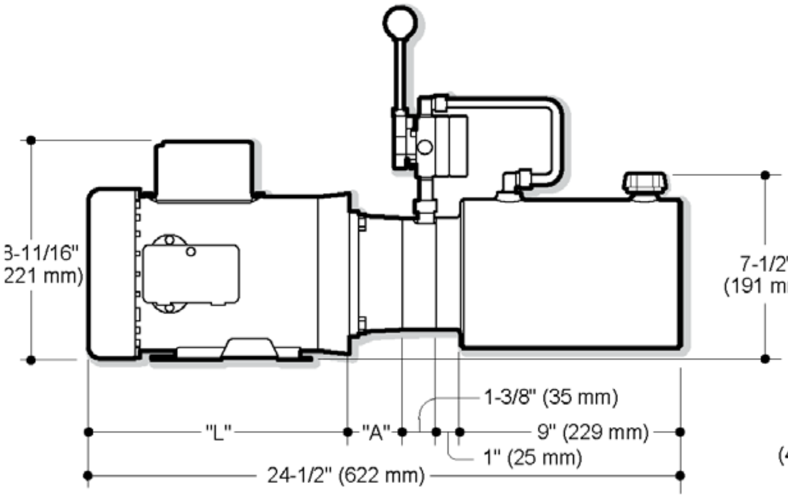
3.8 Model M-4301 (Formerly M-401)

Description

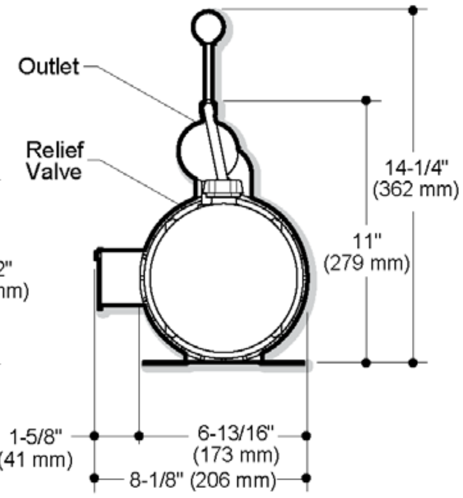
- Pump / Motor / Reservoir / Unit
- 3-Way Manually Operated Valve
- Externally Adjustable Relief Valve
- .250 Inch NPT Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4301 Power System

Comprehensive information may be found on the page referenced below each selection category.

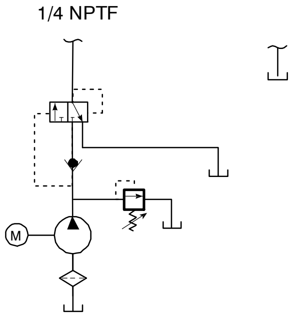
Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

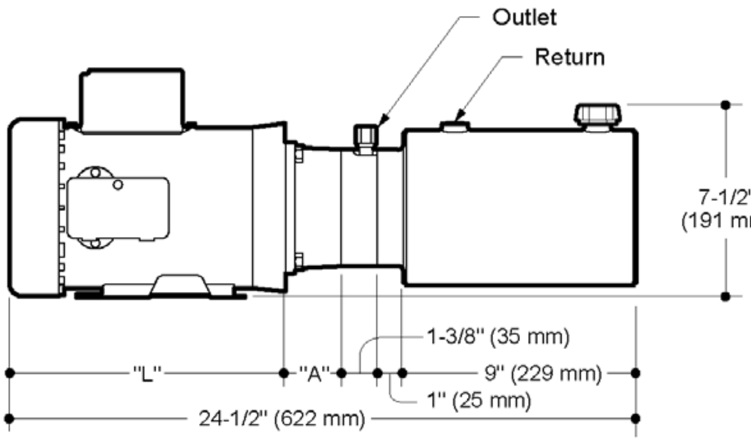
3.9 Model M-4315 (Formerly M-415)

Description

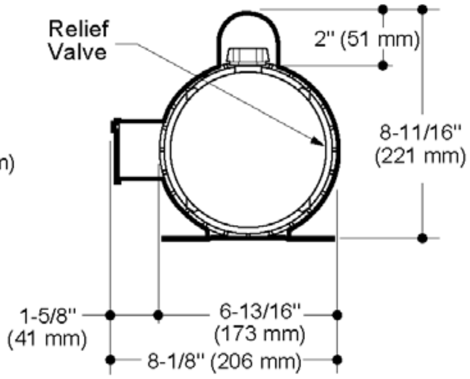
- Pump / Motor / Reservoir / Unit
- Integral Shuttle Valve
- Externally Adjustable Relief Valve
- .250 Inch NPT Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4315 Power System

Comprehensive information may be found on the page referenced below each selection category.

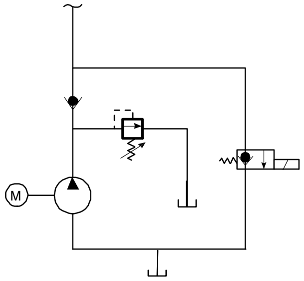
Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

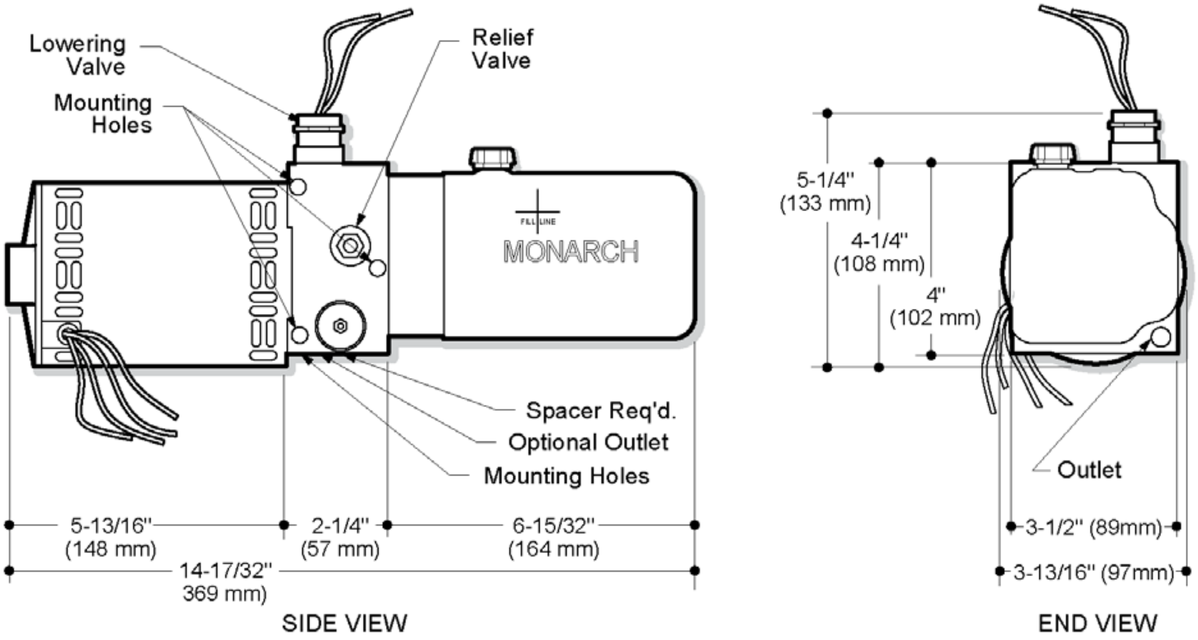
3.10 Model M-4219 (Formerly M-459)

Description

- Pump / Motor / Reservoir / Unit
- Check Valve
- Externally Adjustable Relief Valve
- 2-Way/2-Position Normally Closed Solenoid Operated Lowering Valve
- Outlet Port Options:
  Check Valve Port 7/16-20 SAE O-Ring or
  Face Port: 7/16-20 SAE O-Ring
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





How to Order Your M-4219 Power System

Comprehensive information may be found on the page referenced below each selection category.

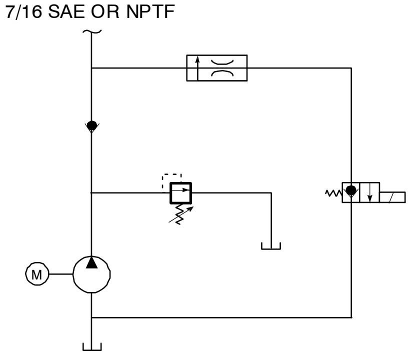
Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

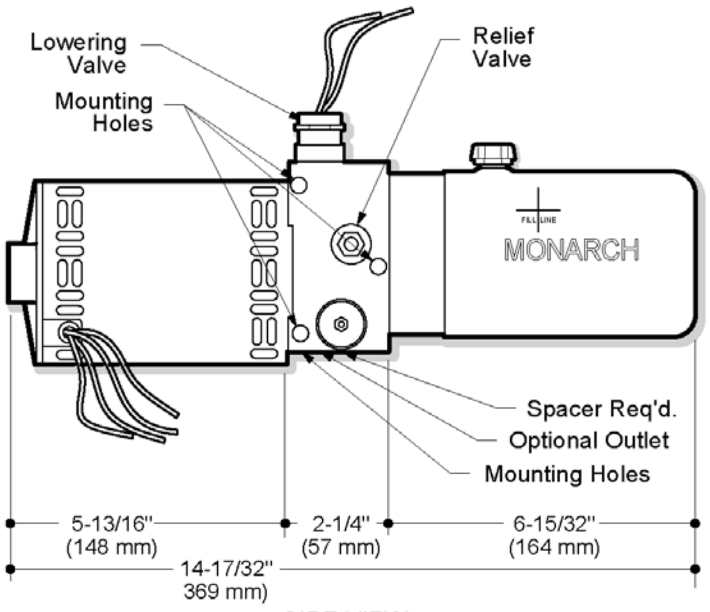
3.11 Model M-4219 w/PCFC

Description

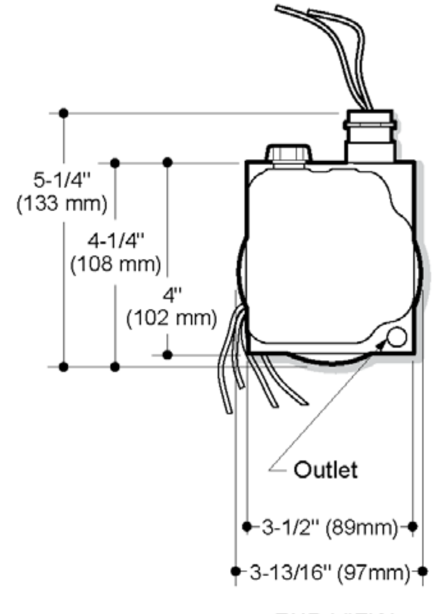
- Pump / Motor / Reservoir / Unit
- Check Valve
- Externally Adjustable Relief Valve
- 2-Way/2-Position Normally Closed Solenoid Operated Lowering Valve
- Cartridge Style Pressure Compensated Lowering Valve
- Outlet Port **Options:**
  Check Valve Port 7/16-20 SAE O-Ring or
  Face Port: 7/16-20 SAE O-Ring
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4219 w/PCFC Power System

Comprehensive information may be found on the page referenced below each selection category.

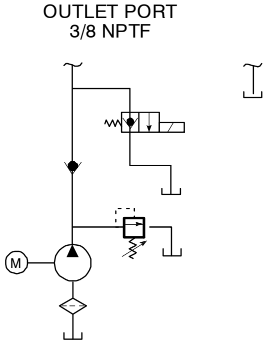
Pump	Motor	Capacitor	Reservoir	Mounting Posi-tion	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

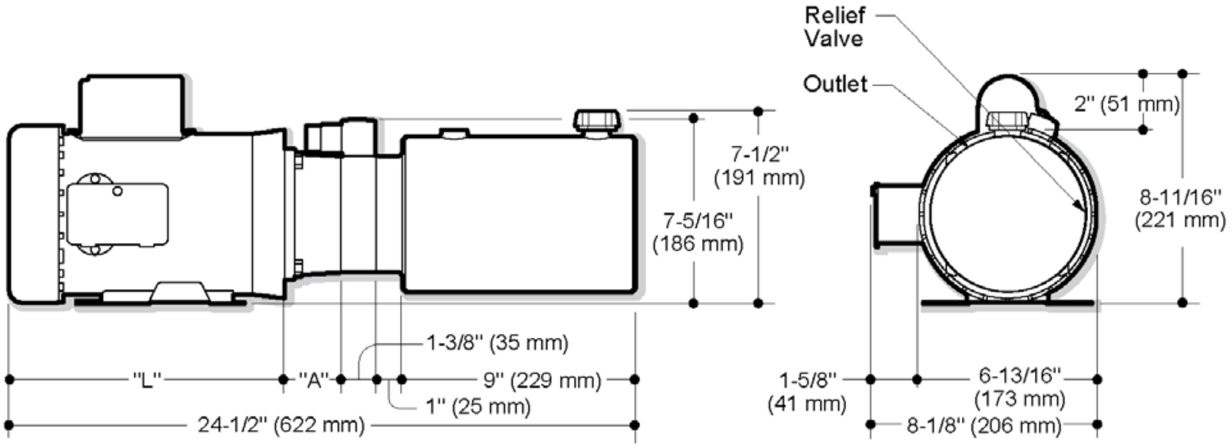
3.12 Model M-4319 (Formerly M-419)

Description

- Pump/Motor/Reservoir/Valve Unit
- Solenoid Operated 2-Way/2-Position Normally Closed Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4319 Power System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

3.13 Model M-4519-C

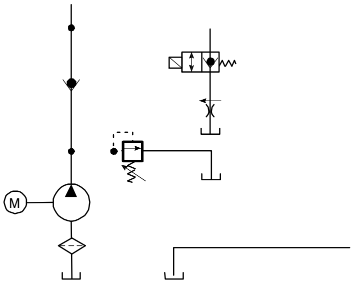
Description

- Pump/Motor/Reservoir/Valve Unit
- Check Valve
- Externally Adjustable Relief Valve
- 2 Way/2 Position Normally Closed Cartridge Valve
- #6 SAE Outlet
- Horizontal Mounting Standard

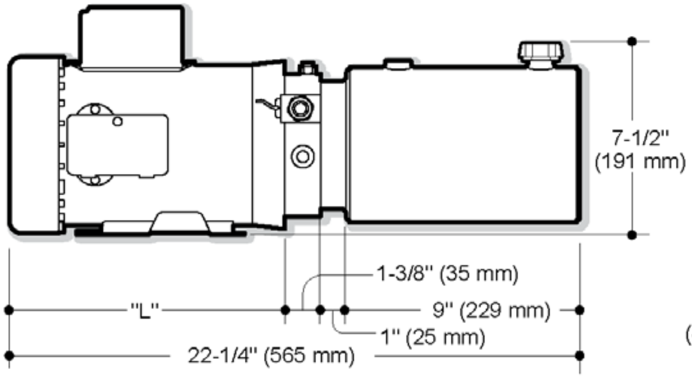
Popular Features

- Vertical Mounting / Motor Up
- Pressure Compensated Cartridge Style On Lowering Circuit
- Manual Override

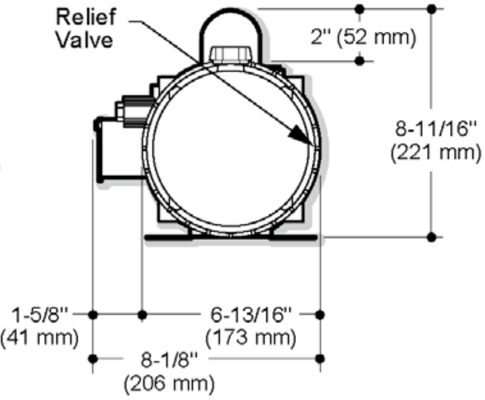
Schematic



HYDRAULIC SCHEMATIC



SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4519-C Power System

Comprehensive information may be found on the page referenced below each selection category.

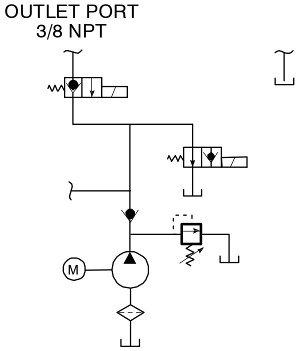
Pump	Adapter	Motor	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 11	Ref. Page 10	Ref. Page 13		Ref. Page 21

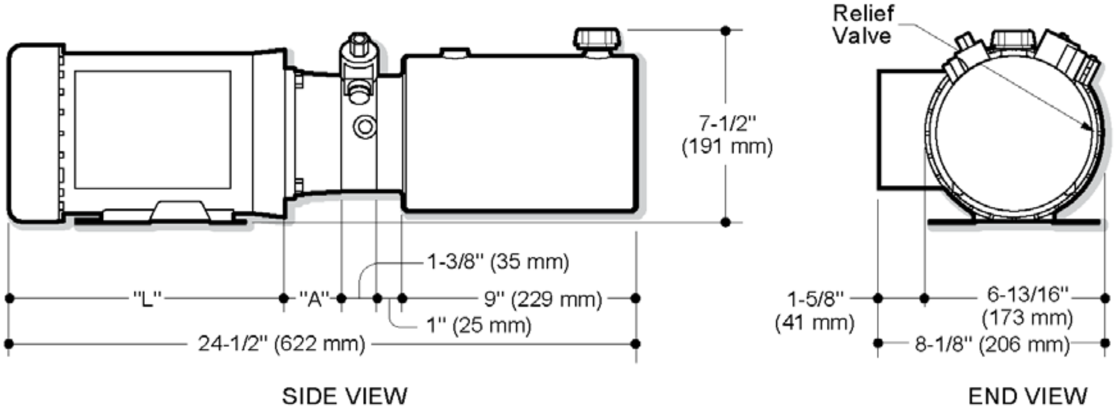
3.14 Model M-4303 (Formerly M-403)

Description

- Pump/Motor/Reservoir/Valve Unit
- Solenoid Operated 2-Way/2-Position Normally Closed Valve and Solenoid Operated 2-Way/2-Position Normally Open Valve
- Externally Adjustable Relief Valve
- .375 Inch NPT Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4303 Power System

Comprehensive information may be found on the page referenced below each selection category.

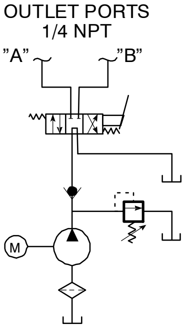
Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page 21

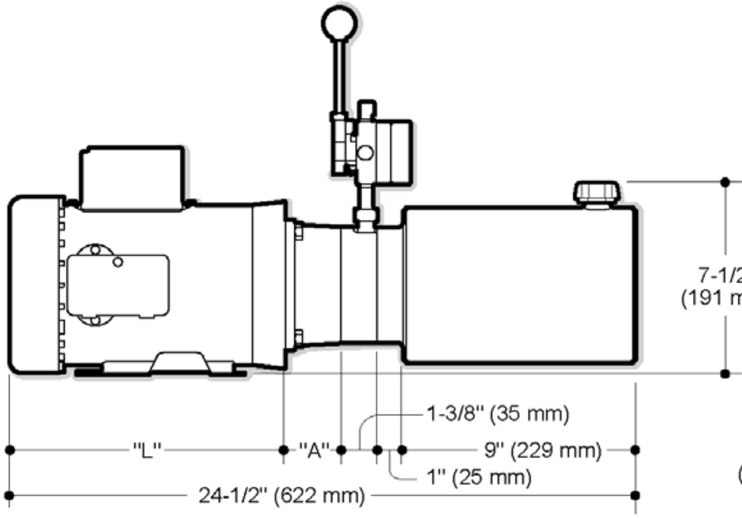
3.15 Model M-4310 (Formerly M-410)

Description

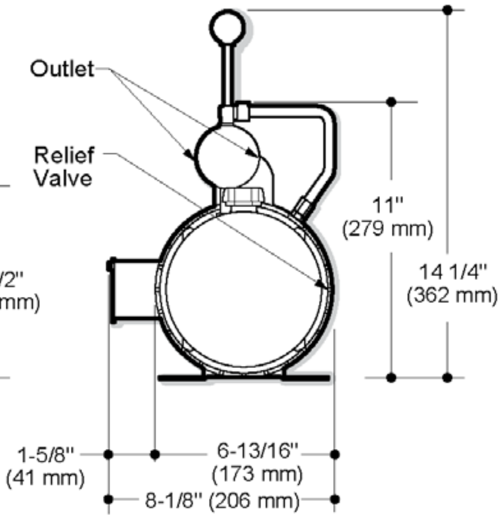
- Pump/Motor/Reservoir/Valve Unit
- 4-Way Manually Operated Valve
- Externally Adjustable Relief Valve
- .250 Inch NPT Outlets
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4310 Power System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Valves	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page19	Ref. Page 21

3.16 Model M-4551-C

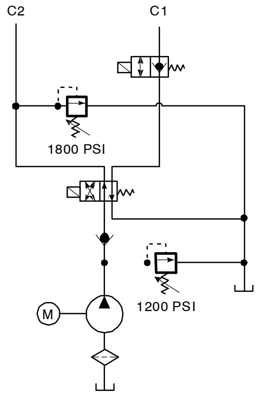
Description

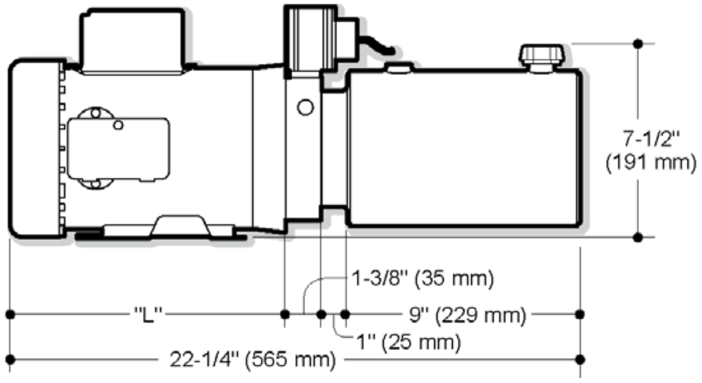
- Pump/Motor/Reservoir/Valve Unit
- Check Valve
- Externally Adjustable Relief Valve
- (1) 4 Way/2 Position and (1) 2 Way/2 Position Normally Closed Solenoid Cartridge Valve Located in the Base
- C1 Port Positively Checked
- Externally Adjustable Relief Valve in C2 Port
- #6 SAE Outlets
- Horizontal Mounting Standard

Popular Features

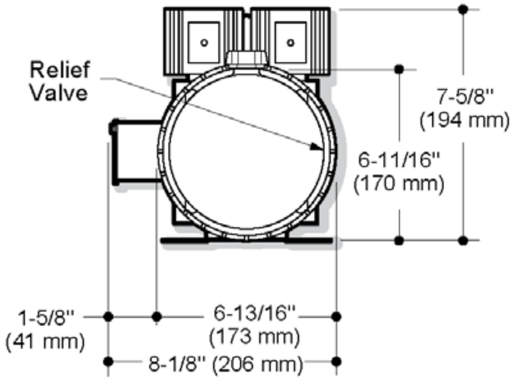
- Pressure Compensated Cartridge Style Flow Control
- Vertical Mounting, Motor Up

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4551-C Power System

Comprehensive information may be found on the page referenced below each selection category.

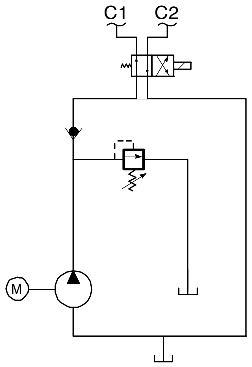
Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

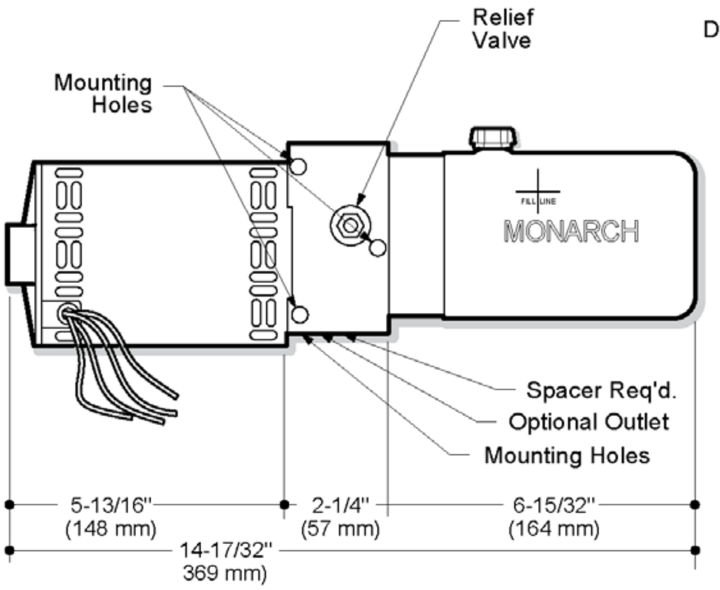
3.17 Model M-4252 (Formerly M-452)

Description

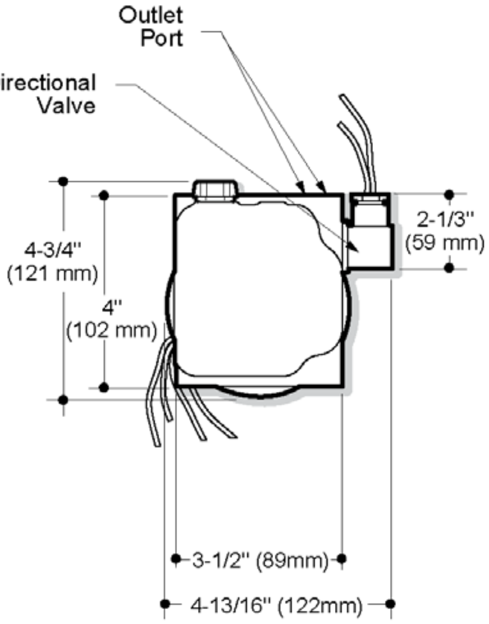
- Pump / Motor / Reservoir / Unit
- Check Valve
- 4-Way/2-Position Solenoid Cartridge Valve Mounts Directly to Unit
- 7/16-20 SAE O-Ring Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4252 Mini System

Comprehensive information may be found on the page referenced below each selection category.

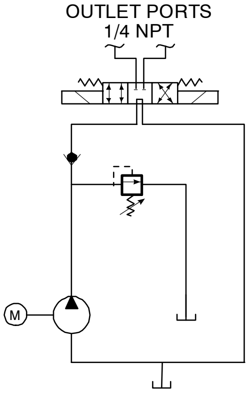
Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

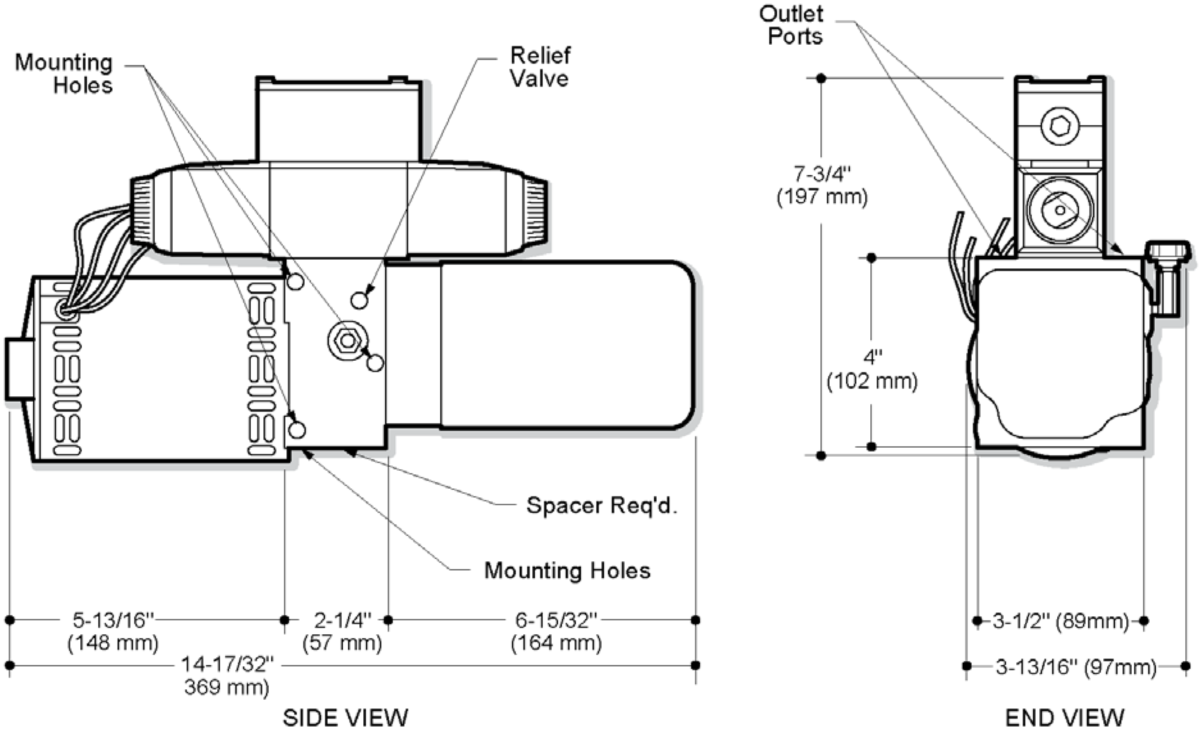
3.18 Model M-4253 (Formerly M-453)

Description

- Pump / Motor / Reservoir / Unit
- 4-Way/3-Position DO3 Solenoid Valve
- 7/16-20 SAE O-Ring Outlet
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





How to Order Your M-4253 Mini System

Comprehensive information may be found on the page referenced below each selection category.

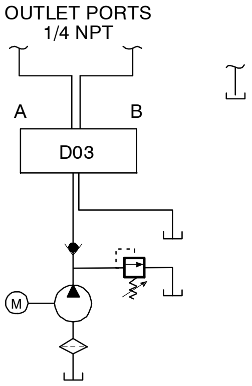
Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

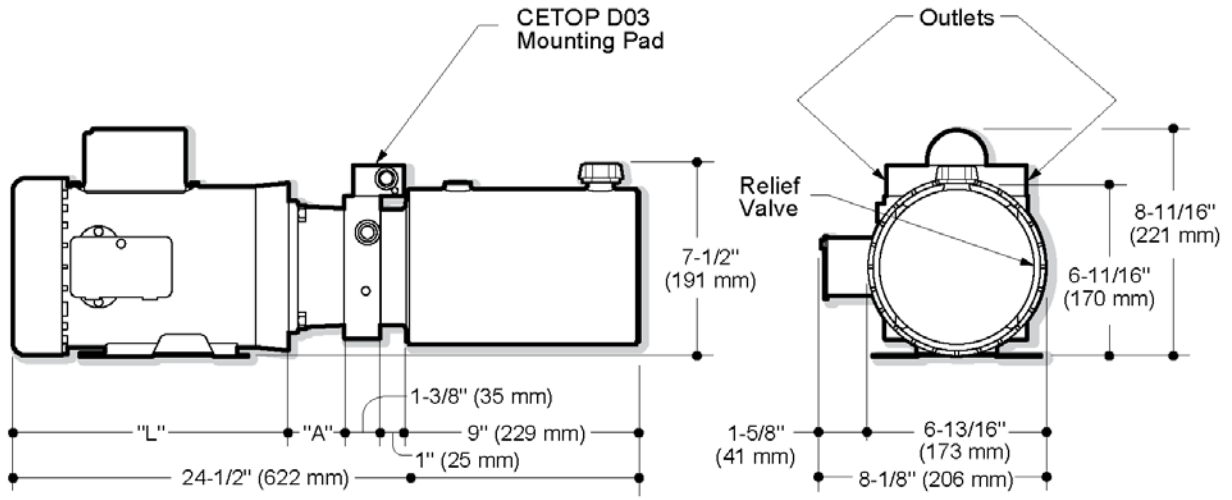
3.19 Model M-4506 (Replaces M-406)

Description

- Pump / Motor / Reservoir / Unit
- NPFA DO3 Valve Mounting Surface
- Externally Adjustable Relief Valve
- .250 Inch NPT Outlets
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW

END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4506 Power System

Comprehensive information may be found on the page referenced below each selection category.

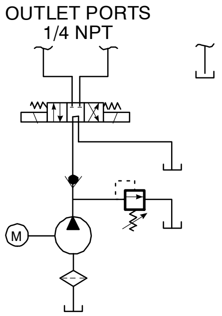
Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Valves	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page19	Ref. Page 21

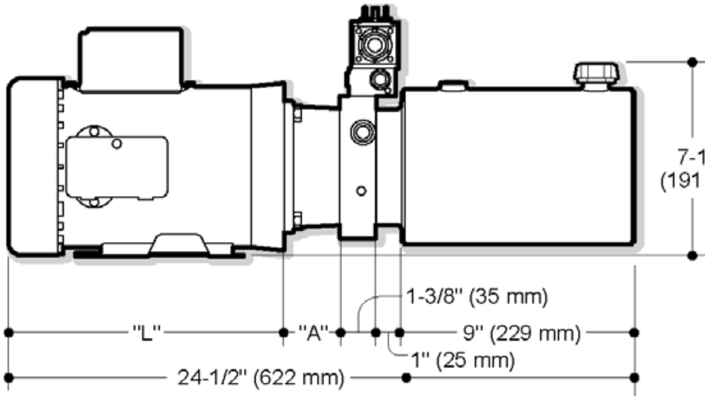
3.20 Model M-4505 (Replaces M-405)

Description

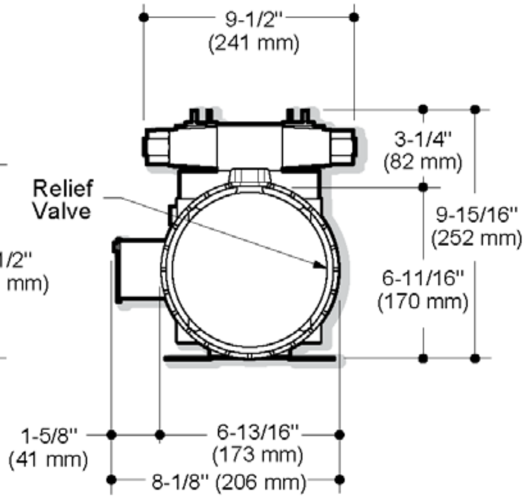
- Pump / Motor / Reservoir / Unit
- Externally Adjustable Relief Valve
- 4-Way/3-Position Solenoid Operated DO3 Valve. Standard Tandem Center Shown. Other Spool Types Available.
- .250 Inch NPT Outlets
- Horizontal Mounting Standard
- Vertical Mounting (Motor Up) Optional

Schematic





SIDE VIEW



END VIEW

”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4505 Power System

Comprehensive information may be found on the page referenced below each selection category.

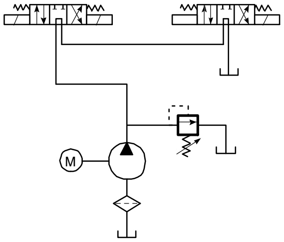
Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Valves	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page19	Ref. Page 21

3.21 Model M-4328 (Formerly M-428)

Description

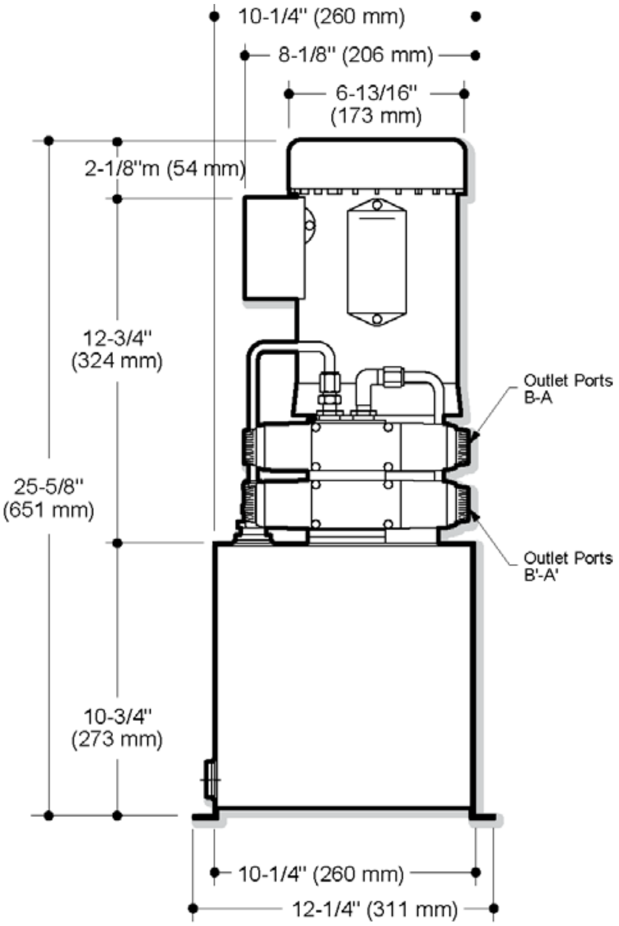
- Pump/Motor/Reservoir/Valve Unit
- Externally Adjustable Relief Valve
- Two 4-Way/3-Position Solenoid Operated Tandem Center DO3 Valves in One Two Station Manifold for Series Operation
- Maximum Relief Valve Setting 1400 PSI
- ..375 Inch NPT Outlets
- Vertical Mounting

Schematic



Popular Features

- Unit Less D03 Valves



How to Order Your M-4328 Power System

Comprehensive information may be found on the page referenced below each selection category.

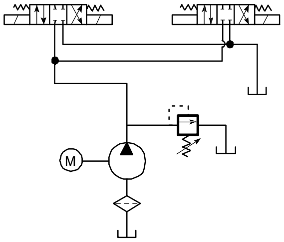
Pump	Motor	Close-Coupled	Reservoir (Length)	Mounting Position	Valves	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page 13		Ref. Page19	Ref. Page 21

3.22 Model M-4328-P (Formerly M-428-P)

Description

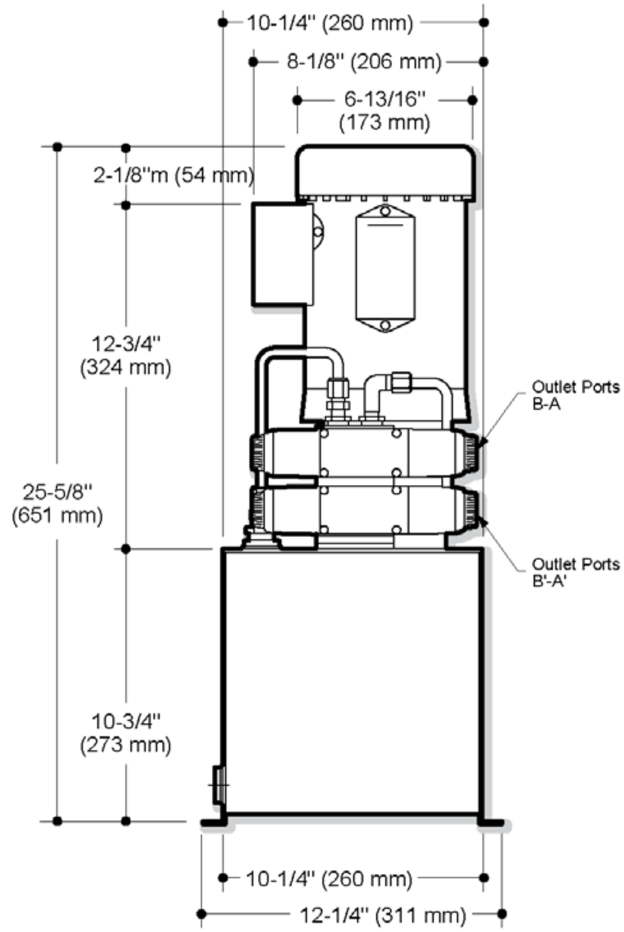
- Pump/Motor/Reservoir/Valve Unit
- Externally Adjustable Relief Valve
- Two 4-Way/3-Position Solenoid Operated Tandem Center DO3 Valves in One Two Station Manifold for **Parallel** Operation
- ..375 Inch NPT Outlets
- Vertical Mounting

Schematic



Popular Features

- Unit Built with unloading valve
- Unit Less D03 Valves



How to Order Your M-4328-P Power System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Close-Coupled	Reservoir (Length)	Mounting Position	Valves	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page 13		Ref. Page19	Ref. Page 21

3.23 Model M-4528

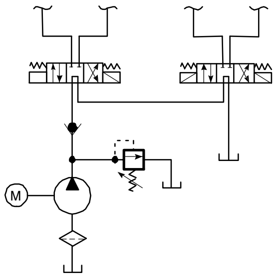
Description

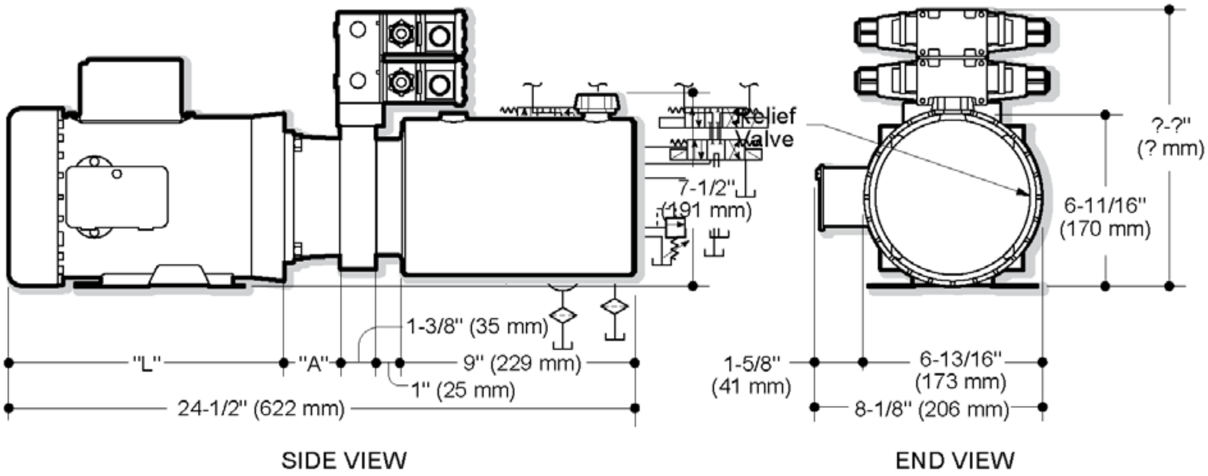
- Pump/Motor/Reservoir/Valve Unit
- Check Valve in ”P” Port
- Externally Adjustable Relief Valve
- (2) D03 Double Solenoid Valves
- #6 SAE Outlets
- 250 Inch NPT Outlets

Popular Features

- Vertical Mounting, Motor Up
- Large Selection of D03/CETOP Valves and Accessories
- Parallel Circuit Available

Schematic





”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
”A” dimension for standard 01605 adapter is 2-5/32” (55 mm)
”A” dimension for optional 01615 adapter is 3-11/32” (85 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4528 Power System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Adapter	Close-Coupled	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13	Ref. Page 13		Ref. Page 21

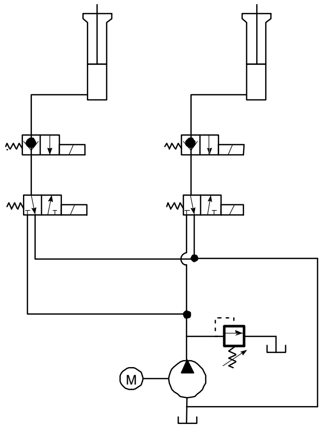
3.24 Model M-4266 (Formerly M-466)

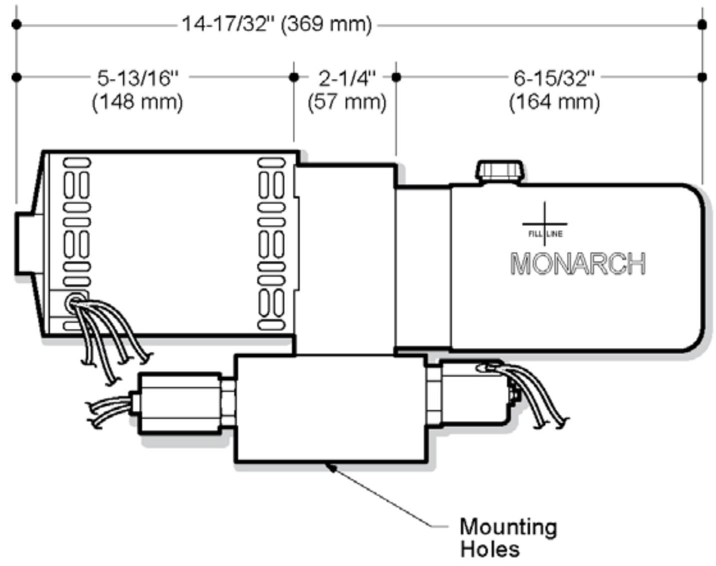
Description

- Pump/Motor/Reservoir/Valve Unit
- Cartridge Valve Block Manifolded Directly to Power Unit
- Controls 2 Single Acting Cylinders Independently
- .125 Inch NPT Outlets
- Horizontal Mounting Standard
- Vertical Mounting / Motor Up

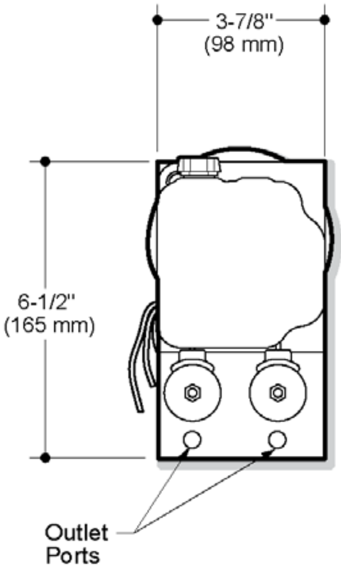
NOTE: Consult factory regarding return flow limitations.

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4266 Mini System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

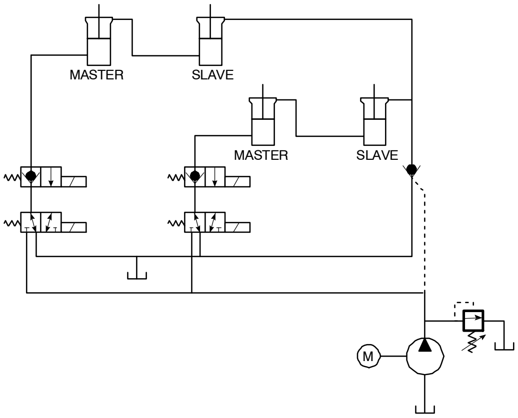
3.25 Model M-4257 (Formerly M-457)

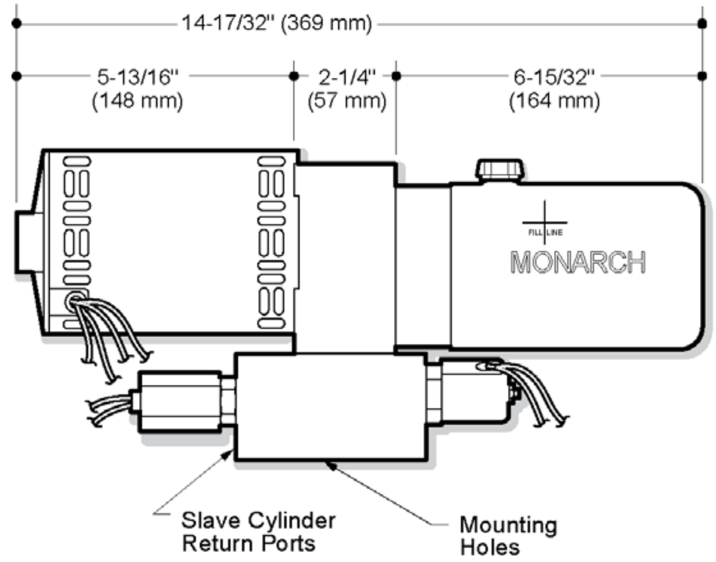
Description

- Pump/Motor/Reservoir/Valve Unit
- Independent Operation of Two Single Acting Master/ Slave Cylinder Circuits
- Cartridge Valve Block Manifolded Directly to Power Unit
- .125 Inch NPT Outlets
- Horizontal Mounting Standard
- Vertical Mounting / Motor Up

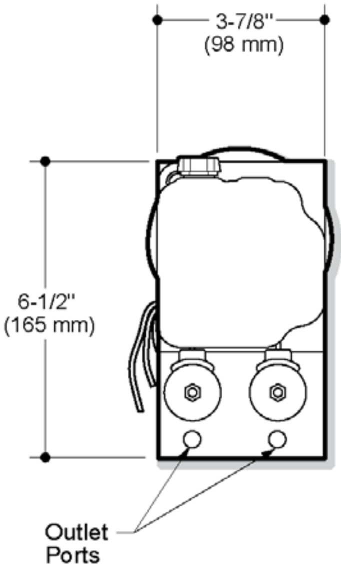
NOTE: Consult factory regarding return flow limitations.

Schematic





SIDE VIEW



END VIEW

How to Order Your M-4257 Mini System

Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Capacitor	Reservoir	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 13	Ref. Page17		Ref. Page 21

3.26 Model M-4593-C

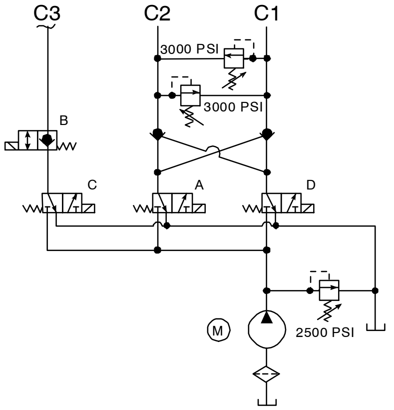
Description

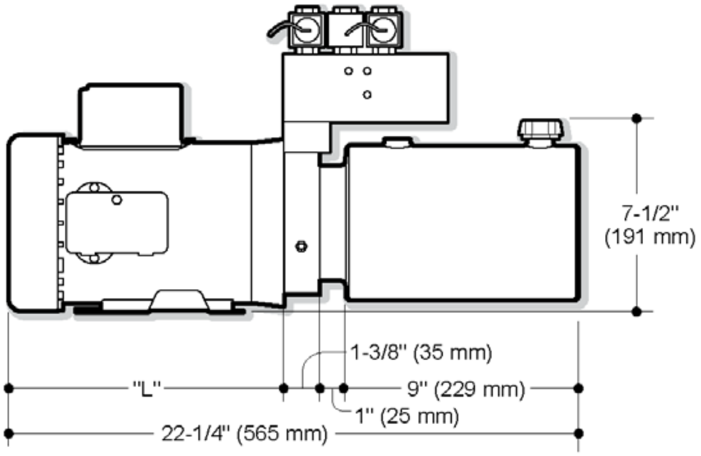
- Pump/Motor/Reservoir/Valve Unit
- Externally Adjustable Relief Valve
- Solenoid Cartridge Valves, Pilot Operated
- Check Valves, and Adustable Cross-Over Relief System Mounted in a Compact Manifold
- Horizontal Mounting Standard

Popular Features

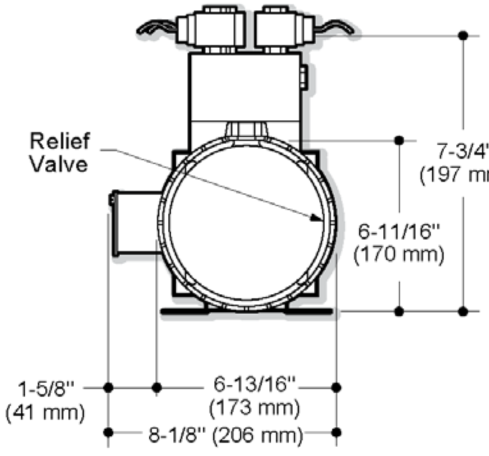
- Vertical Mounting, Motor Up

Schematic





SIDE VIEW



END VIEW

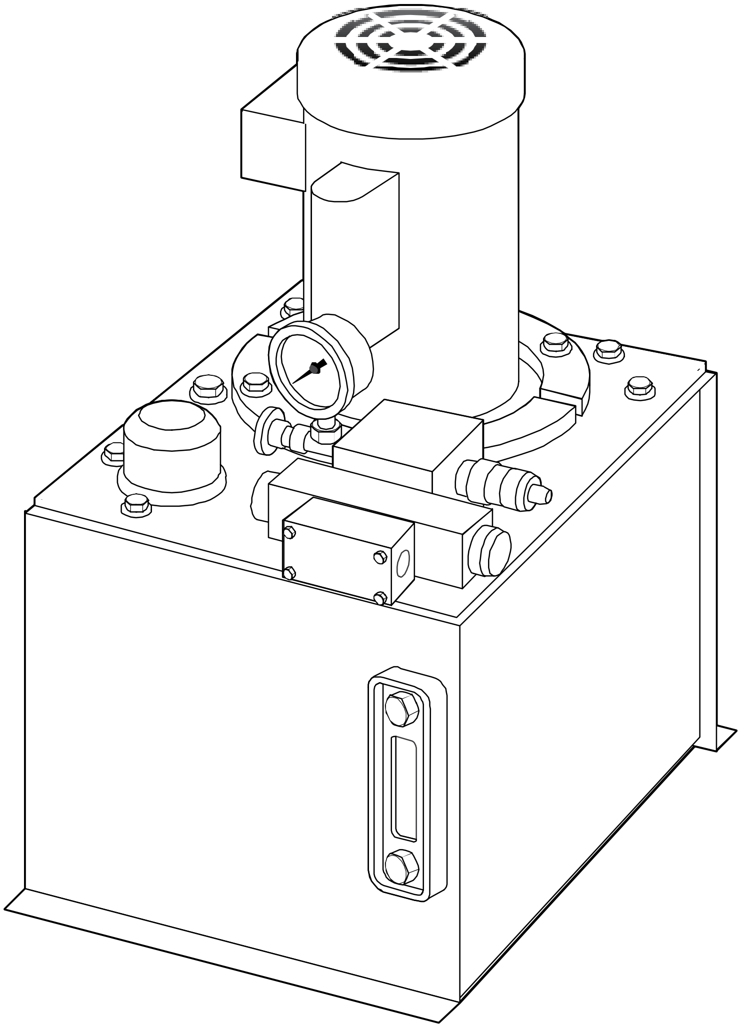
”L” dimension shown for 08751 motor is 10-11/16” (271 mm)
Dimensions will vary according to motor output and manufacturer

How to Order Your M-4593-C Mini System

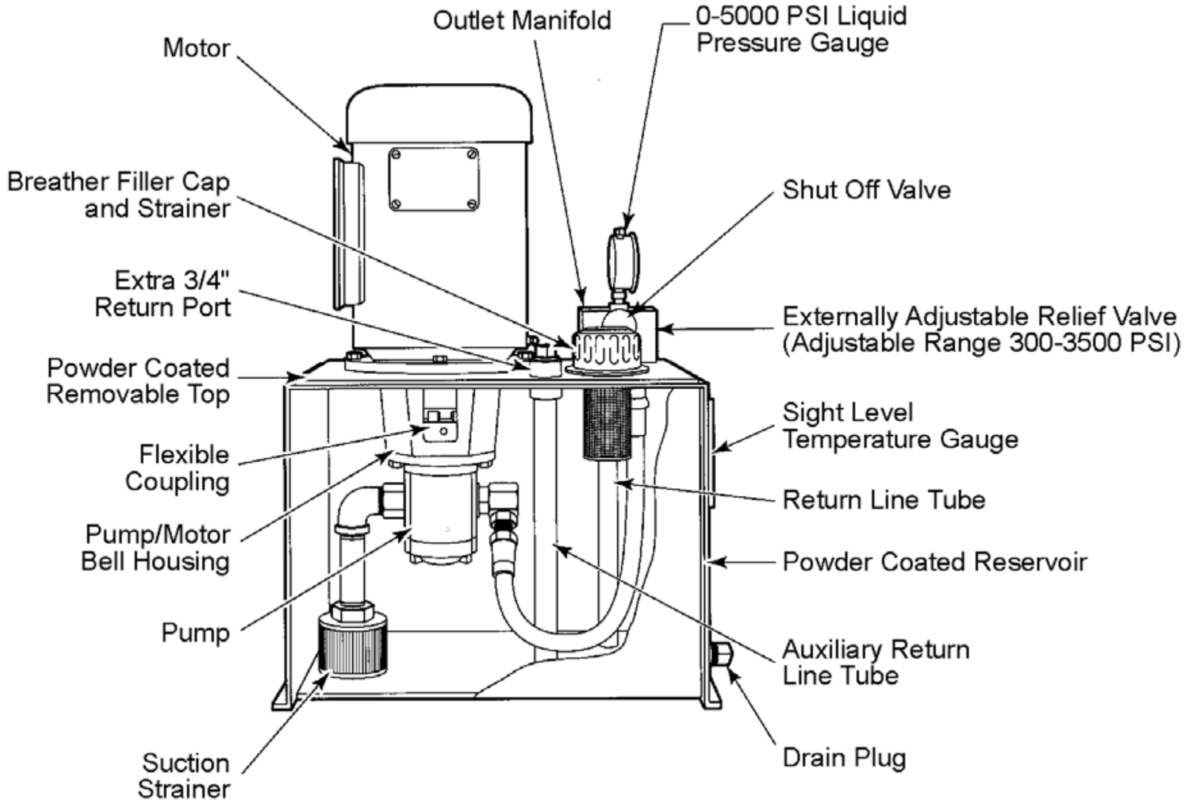
Comprehensive information may be found on the page referenced below each selection category.

Pump	Motor	Adapter	Reservoir (Length)	Mounting Position	Accessories
Ref. Page 9	Ref. Page 10	Ref. Page 11	Ref. Page 13		Ref. Page 21

4 MT & T Series Industrial Power Units



4.1 Standard System Side View w/cutaway



Options:

- Water/Oil Heat Exchangers
- Air/Oil Heat Exchangers
- Wide Range of Pressure Gauges
- Heaters
- Viton Seals
- NPT Ports
- Return Filter, 10 Micron Nominal
- A Wide Selection of D03 and D05 Directional
- Control Valves
- Pressure Switches
- Float Switches

- Custom Systems
- Synthetic Fluids - Consult Factory
- Subplate Mounted D03 and D05 Stack Valves
- Cross Port Relief
- Pressure Reducing
  - Single and Double Flow Control
  - Directional and Pilot Operated Check
  - Sequence
  - Counter Balance Relief

Recommended Operating Conditions for T Power Units

Oil Temperature Range:		10°F - 170°F
Recommended Operating Temperature:		50°F - 130°F
Oil Viscosity:	Optimum:	100 - 350 SUS
	Minimum:	100 SUS
	Maximum Start Up:	3500 SUS
Recommend Filtration:		25 Micron nominal or less

4.2 MT & T Series Pump Performance Data

4.2.1 MT Series

Pump Code	IN^3/REV	RPM	GPM	500 HP	1000 HP	1500 HP	2000 HP	2500 HP	3000 HP
12637-150 (72)	0.032	1800 3600	0.25 0.50	0.20 0.40	0.30 0.60	0.35 0.70	0.50 1.00	0.55 1.10	0.75 1.50
12637-270 (62)	0.57	1800 3600	0.45 0.90	0.20 0.40	0.35 0.70	0.56 0.90	0.60 1.20	0.70 1.40	0.90 1.80
12172-150 (42)	0.77	1800 3600	0.60 1.20	0.25 0.50	0.45 0.90	0.60 1.20	0.80 1.60	1.00 2.00	1.15 2.30
12172-200 (43)	0.099	1800 3600	0.80 1.60	0.35 0.70	0.55 1.10	0.80 1.60	1.05 2.10	1.30 2.60	1.50 3.00
12172-250 (03)	0.125	1800 3600	1.00 2.00	0.45 0.90	0.75 1.50	1.10 2.20	1.40 2.80	1.70	2.15
12172-270 (51)	0.137	1800 3600	1.10 2.20	0.50 1.00	0.80 1.60	1.15 2.30	1.50 3.00	2.00	2.25
12172-380 (05)	0.193	1800 3600	1.50 3.00	0.60 1.20	1.10 2.20	1.50 3.00	2.00	2.50	3.00

4.2.2 T Series

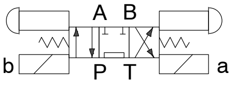
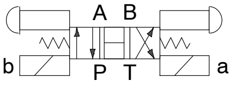
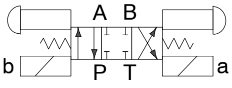
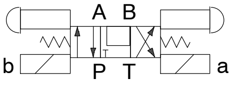
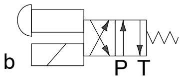
Pump Code	IN^3/REV	RPM	GPM	500 HP	1000 HP	1500 HP	2000 HP	2500 HP	3000 HP
02913	0.27	1800	2.10	0.85	2.00	2.30	3.00	3.90	4.80
02908	0.37	1800	2.90	1.10	2.10	3.10	4.15	5.15	6.25
02902	0.50	1800	3.90	1.50	2.80	4.00	5.30	6.60	8.10
02909	0.68	1800	5.30	1.90	3.71	5.56	7.42	9.28	11.13
02904	0.84	1800	6.55	2.40	4.60	6.65	8.65	10.65	12.85
02910	0.97	1800	7.60	2.70	5.32	7.90	10.50	13.20	16.00
02911	1.15	1800	9.00	3.15	6.30	9.45	12.62	15.80	18.90
02912	1.37	1800	10.7	3.80	7.50	11.20	14.90	18.70	
02907	1.58	1800	12.3	4.30	8.60	12.90	17.20		
2948/2949*	0.960	1800	3.5 to 7.5 GPM. See Below.						

* Pump supplied standard with adjustable maximum displacement stop which can be set between 3.0 GPM and 7.5 GPM. Maximum speed pump 2000 RPM.

* When selecting motor, choose the HP required or the next HP available.

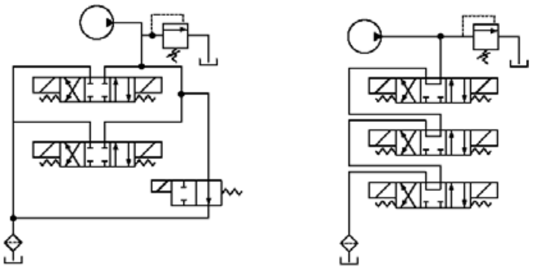
* Contact the factory for operating T Series pumps at speeds above 1800 RPM.

4.3 Standard D03 and D05 Directional Control Valves

Schematic	Pump Code
	4-Way/3-Position. Solenoid Operated. Tandem Center.
	4-Way/3-Position. Solenoid Operated. Open Center.
	4-Way/3-Position. Solenoid Operated. Closed Center.
	4-Way/3-Position, P Blocked. A and B to T. "Motor Spool".
	4-Way/2-Position. P to A. Spring Offset

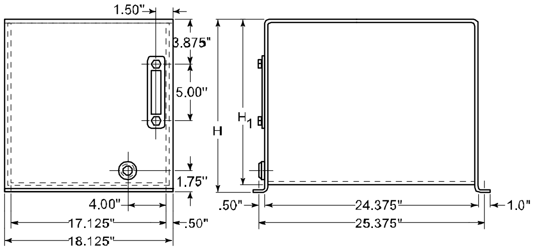
Manifolds are available from stock in Parallel and Series configurations. These manifolds may be combined in multiples of 2 and 3 to form multi-station valve banks.

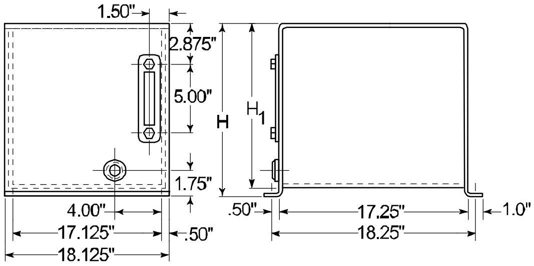
Example:



PARALLEL 2 STATION SERIES 3* STATION

* Back pressure in tank line must not exceed 1000 PSI in Series configuration with D05 valves or 1500 PSI with D03 valves.

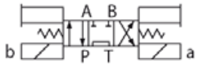
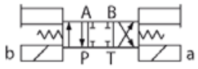
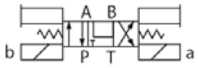
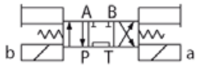
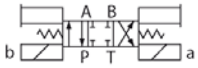
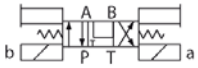
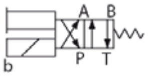




DIM. in Inches	Reservoir Capacity Total/Usable in Gallons		
	20/12	30/21.8	40/29
H	$16^{3/4}$	$22^{1/4}$	34
H_1	16	$21^{1/2}$	$33^{1/4}$

DIM. in Inches	Reservoir Capacity Total/Usable in Gallons		
	8.5/4.4	10.1/5.2	15.2/9.8
H	$12^{3/4}$	$14^{1/4}$	19
H_1	12	$13^{1/2}$	$18^{1/4}$

Series	Pump	Reservoir	Heat Exchanger	Motor					Valve Manifold
		TOTAL CAPACITY GALLONS	(SEE SELECTION CHART ON REVERSE PAGE)	(ALL STANDARD MOTORS TEFC)					
					HP	RPM	VOLTAGE	PHASE	
MT 0.25-4.0 GPM	**MT-400**	**08** T-8*	**1** AIR/OIL TYPE	**01**	1/2	1800	115/230	1	**01** P&T 3/4-16 SAE Ports
	17 P72	**10** T-10*	- MOUNTS ON	**02**	1/2	1800	230/460	3	- Aux Gauge Port
	14 P62	**15** T-15	MOTOR FAN	**03**	1/2	3600	115/230	1	- Relief Valve cavity
	01 P42	**20** T-20*	COVER	**04**	1	1800	115/230	1	- Use as subplate for
	--- **02** P43	**30** T-30	**2** WATER TYPE	**05**	1	1800	230/460	3	multi-station manifolds
	03 P03	**40** T-40	- MOUNTS ON	**06**	1	3600	115/230	1	**02** D03 Single Station
	04 P51	**01** WITHOUT	TANK	**08**	1	3600	230/460	3	- 3/4-16 SAE Ports
	05 P05	RESERVOIR	**3** AIR/OIL With Filter	**09**	1 1/2	1800	115/230	1	- Aux Gauge Port
		- DOES NOT	**4** WATER/OIL	**10**	1 1/2	1800	230/460	3	- Relief Valve cavity
		INCLUDE	With Filter	**11**	1 1/2	3600	115/230	1	**03** D05 Single Station
T 2.10-12.3 GPM	**T-400**	SUCTION LINE,	**0** Without Cooler	**12**	1 1/2	3600	230/460	3	- 3/4-16 SAE Ports
	08 02913	RETURN LINE	**7 SPECIAL**	**30**	2	1800	115/230	1	- Aux Gauge Port
	09 02908	OR SUCTION		**13**	2	1800	230/460	3	- Relief Valve cavity
	16 02902	STRAINER.		**14**	2	3600	115/230	1	
	10 02909	**07 SPECIAL**		**15**	2	3600	230/460	3	**NFPA D03 Interface**
	18 02904			**16**	3	1800	230/460	3	
	11 02910	*Do not specify for		**32**	3	1800	230/460	3	**04** 2 Station Parallel*
	12 02911	piston pump		**17**	3	3600	230/460	3	**34** D03 2 Station Parallel & Unloading Valve
	13 02912	applications.		**29**	3	3600	115/230	1	**05** 3 Station Parallel*
	06 02907			**34**	5	1800	208/230	1	**35** D03 3 Station Parallel & Unloading Valve
	21 2948			**18**	5	1800	230/460	3	**06** 4 Station Parallel*
	22 2949			**19**	7 1/2	1800	230/460	3	**36** D03 4 Station Parallel & Unloading Valve
	23 2948 (3-5 HP)*			**20**	10	1800	230/460	3	**08** 5 Station Parallel*
	24 2948 (7.5-15 HP)*			**21**	15	1800	230/460	3	**38** D03 5 Station Parallel & Unloading Valve
	25 2949 (3-5 HP)**								**09** 2 Station Series
	26 2949 (7.5-15 HP)**			Without motor but with **MONARCH** supplied hardware.					**10** 3 Station Series
	07 SPECIAL								**11** 4 Station Series
									69 Power Up, Gravity Down with Check
	*2948 Variable Displacement Pump furnished with factory preset, adjustable **remote** Pressure Compensating Valve. Specify Compensator setting.			**96** 182C Frame					
				97 56C Frame					**NFPA D05 Interface**
				98 182TC-184TC					
				99 213TC-215TC					**13** 2 Station Parallel**
				07 SPECIAL					**43** D05 2 Station Parallel & Unloading Valve
	**2949 Variable Displacement Pump furnished with factory preset Pressure Compensator. Specify Compensator setting.								**14** 3 Station Parallel**
									44 D05 3 Station Parallel & Unloading Valve
									15 4 Station Parallel**
									45 D05 4 Station Parallel & Unloading Valve
									16 5 Station Parallel**
	NOTE: T-400 Pumps available with Viton seals - Consult factory for use with synthetic fluids.								**46** D05 5 Station Parallel & Unloading Valve
									17 2 Station Series
									18 3 Station Series
									19 4 Station Series
									07 SPECIAL
									NOTE: If ordering a multi-station D03 manifold, valve manifold 01 will be included for use as a subplate.
									If ordering a multi-station D05 manifold, valve manifold 01 and a transition plate will be included for use as a subplate.
									*D03 - If an unloading valve is required, substitute a 3 for the 0 in the option code. **D05 - If an unloading valve is required, substitute a 4 for the 1 in the option code.

Relief Valve	Directional Control Valves	Coil Voltage and Electrical Connection	Filter	Economy Options
1 Relief Valve, 300-3500 PSI* Externally Adjustable, Pilot Operated. **2** 100-300 PSI **3** 100-2000 PSI **4** 550-5000 PSI **0** Without Relief Valve **7** **SPECIAL** *Specify Setting	**NOTE:** Valves for multi-station manifolds should be listed sequentially starting from the base. (OTHERS ARE AVAILABLE) **DO3** **01**  **02**  **03**  **04**  **05**  **D05** **08**  **09**  **10**  **11**  **12**  **00** WITHOUT VALVE **07** **SPECIAL** Specialty valves are available such as pressure reducing, sequence, pilot operated check, meter in, meter out, etc. Please consult the factory or your distributor.	(CHOOSE ONE FROM (EACH GROUP) **GROUP 1** **1** 120V/50-60 HZ **2** 240V/50-60 HZ **3** 24V/50-60 HZ **4** 12V D.C. **5** 24V D.C. **GROUP 2** **6** STANDARD LEAD **8** HIRSCHMANN **9** BRAD HARRISON **00** WITHOUT **07** **SPECIAL** **NOTE:** Not all of the above electrical connection types are available from certain valve manufacturers. Consult factory.	(PETROLEUM BASED FLUIDS ONLY) **1** RETURN - SPIN ON TYPE - 10 MICRON NOMINAL **2** RETURN - SPIN ON TYPE - 10 MICRON NOMINAL - INDICATING GAGE **3** RETURN - SPIN ON TYPE - FLEXIBLE TUBING **4** RETURN - SPIN ON TYPE - FLEXIBLE TUBING - GAUGE **0** WITHOUT FILTER **7** SPECIAL *Consult factory for use with synthetic fluids.	**0** 0-5000 PSI Gauge & Shut-Off Valve (Standard) **1** Delete Pressure Gauge **2** 0-3000 PSI Gauge **3** 0-2000 PSI Gauge **4** 0-1500 PSI Gauge **5** 0-1000 PSI Gauge **6** 0-600 PSI Gauge **7** **SPECIAL**

4.4 Limited 1 Year Warranty

Bucher Hydraulics, Inc. (“Bucher”) makes the following warranty to any party who purchases this Bucher Hydraulics, Inc. product directly from Bucher Hydraulics, Inc. with the intention of either reselling this Bucher Hydraulics, Inc. product or incorporating it into or attaching it to some other product (“the purchaser”).

Bucher Hydraulics, Inc. warrants to the purchaser that this product is free from any substantial defects in materials and workmanship. If this product proves to be defective in materials or workmanship during the period of this warranty, Bucher Hydraulics, Inc. will repair or replace, at it’s option, the defective product free of charge (except for transportation charges as provided below). The period of this warranty is the (1) year period beginning from the date of shipment of this Bucher Hydraulics, Inc. product by Bucher Hydraulics, Inc. to the purchaser.

To obtain warranty service, the purchaser must call Bucher Hydraulics, Inc. to have a return goods authorization number assigned to them. The purchaser should then send the product claimed to be defective within the warranty period, transportation prepaid, to: Bucher Hydraulics, Inc., 1363 Michigan Street N.E., Grand Rapids, MI. 49503, USA. Bucher Hydraulics, Inc. will then repair or replace, at it’s option, items which it finds to have been defective. Bucher Hydraulics, Inc. will return such repaired or replacement items to the sender free of charge. Items claimed by the purchaser, but not found by Bucher Hydraulics, Inc., to be defective will be returned to the purchaser by a reasonably expeditious means at the purchaser’s expense. This expense may include labor charges incurred from inspecting the unit.

This warranty does not extend to any failure of this Bucher Hydraulics, Inc. product to perform as warranted hereinabove which is caused by misuse, abuse or material alteration of this product, or any negligence in connection with the installation, service, or use of this product by any person other than Bucher Hydraulics, Inc.

Bucher Hydraulics, Inc. hereby expressly disclaims any liability for consequential damages to property other than this Bucher Hydraulics, Inc. product to perform as warranted hereinabove.

Note: Supersedes all former warranties written or implied.

info.mi@bucherhydraulics.com **www.bucherhydraulics.com**

Classification: 450

Instruction **Manual**

ROYTRONIC EXCEL™ Series AD

Electronic Metering Pumps

For file reference, please record the following data:

Model No: ___________________________________

Serial No: ___________________________________

Installation Date: ______________________________

Installation Location: ___________________________

When ordering replacement parts for your LMI Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

⚠ ***Carefully read and understand all precautions before installing or servicing any metering pump.*** ⚠

LMI
MILTON ROY

201 Ivyland Rd.
Ivyland, PA 18974
TEL: (215) 293-0401
FAX: (215) 293-0445
www.lmipumps.com

Lit# 2024.C 10/2011

LMI
MILTON ROY

ROYTRONIC EXCEL™ Series AD

Model AD | 2 | 5 | 1 | - | 8 | 3 | 8 | S | I

Model Code Configuration

Drive

Control Code

AD2 - Dual Manual Control – Digital:
Stroke frequency and length manually adjustable with digital LCD display, low level indication (remote input). Display configurable to indicate calculated pump flow.

AD8 - Pulse/Analog Input w/ Dual Manual Control – Digital:
Pulse or 4-20 mA signal input controls frequency, digital LCD display, manual stroke length control, frequency manually adjustable when in local control, pulse multiply/divide functions, 24 V output for remote device. Includes dual low level float switch input. Display configurable to indicate calculated pump flow.

AD9 - Pulse/Analog Input w/Dual Manual Control & Enhanced Controls – Digital:
Advanced Features - Pulse or 4/20 mA signal input controls frequency, Digital graphical display, manual stroke length control, Frequency manually adjustable when in local control, Pulse multiply/divide functions, 24 V output for remote device, dual low level float switch input, Remote on/off signal input. Outputs include: 4-20 mA, pulse, & Alarm. Remote internal/external mode input.

Output / Size Code

See Most Recent Price List for Flow and Pressure Ratings

Voltage Code

1 – 110-120V US Plug
2 – 220-240V US Plug
3 – 220-240V DIN Plug
5 – 220-240V UK Plug
6 – 220-240V Aust/NZ Plug
7 – 220-240V Swiss Plug
8 – 110-120V No Plug

Liquid End

Liquid End Code

6 – High Viscosity Head
7 – Molded Head, Single Ball Check Valves
8 – Molded Head, Double Ball Check Valves
9 – Machined Head, Double Ball Check Valves

Liquifram™ Size Code

1 – 0.2 in^2
2 – 0.4 in^2
3 – 0.8 in^2
4 – 1.6 in^2

Material Code

See Most Recent Price List for Material Options

Head/Valve Code

S – FastPrime™ Head + 4FV
N – FastPrime™ Head
H – AutoPrime™ Head + 4FV
A – AutoPrime™ Head
V – High Viscosity Head
P – High Viscosity w/Ported Head

Connection Code

I – Inch Tubing
M – Metric Tubing
P – 1⁄2” NPT - 1⁄2” BSP Pipe (SS 1/4” NPT)
U – Black, UV Resistant Tubing

***Note:** Not all configurations are available. Please see your local distributor or price list for available options.

Contents

1.0 PRECAUTIONS

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to MSDS precautions from your solution supplier.

Water Pre-Prime

All LMI pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, o-rings, balls and Liquifram™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)

Liquid Compatibility

CAUTION: The evaluation performed by UL was tested with water only. LMI pumps are tested to NSF 50 for use on muriatic acid (40%) and sodium hypochlorite (12.5%). The pumps are certified to NSF 61 with: sodium hypochlorite (12.5%), sulfuric acid (98.5%), sodium hydroxide (50%), and hydrochloric acid (30%). Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. Always refer to the solution supplier and the **LMI Chemical Resistance Chart** for compatibility of your specific LMI metering pump. Contact your local LMI distributor for further information.

Tubing Connections

Inlet and outlet tubing or pipe sizes must not be reduced. Outlet tubing size must not be increased. Make certain that all tubing is SECURELY ATTACHED to fittings prior to start-up (see Section 3.3, Tubing Connections). ALWAYS use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded and secure to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

Vinyl Tubing

Your carton may contain a roll of clear vinyl tubing; this is only for connection to the return line of the FastPrime™ Head and must not be used as discharge tubing.

Fittings and Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting is snug may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

Most LMI pumps have straight screw machine threads on the head and fittings and are sealed by the O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve, the stainless steel liquid end connections, except for the head's discharge port, or if piping is directly connected to the pipe threads of the suction or discharge fittings.**

Plumbing

Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI is not responsible for improper installations.

Back Pressure/Anti-Syphon Valve

If you are pumping downhill or into low or no system pressure, a back pressure/anti-syphon device such as LMI's Four-Function Valve should be installed to prevent overpumping or syphoning. Contact your LMI distributor for furthur information.

Electrical Connections

WARNING: To reduce the risk of electrical shock, the metering pump must be plugged into a properly grounded grounding-type receptacle with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. **Do not use adapters!** All wiring must conform to local electrical codes. If the supply cord is damaged, it must be replaced by the manufacturer, stocking distributor, or authorized repair center in order to avoid a hazard.

Fuse (all models) and Battery (AD9 only)

Caution, Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire. The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.

Flooding

WARNING: Install this pump in a location where flooding cannot occur.

Ground Fault Circuit Interrupter

WARNING: To reduce the risk of electric shock, install only on a circuit protected by a Ground Fault Circuit Interrupter (GFCI).

Line Depressurization

To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI's Four-Function Valve (4-FV) is one way to include this feature.

Over Pressure Protection

To ensure safe operation of the pump it is recommended that some type of safety/pressure-relief valve be installed to protect the piping and other system components from failing due to excessive pressure.

Chemical Concentration

There is a potential for elevated chemical concentration during periods of no flow, for example, during backwash in the system. Steps, such as turning the pump off, should be taken during operation or installation to prevent this.

See your distributor about other external control options to help mitigate this risk.

Retightening Components

Plastic materials will typically exhibit creep characteristics when under pressure over a period of time and to insure a proper fit it may be necessary to retighten the head bolts periodically. To insure proper operation, we recommend tightening the bolts to 25 inch-pounds after the first week of operation and on a monthly basis thereafter.

Flow Display

The default flow value as shown on the pump display is accurate at maximum pressure and 100% stroke length. If your operating conditions differ from this, then calibration is necessary in order to display an accurate measure of the flow.

2.0 Introduction

LMI is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

2.1 Specifications

	AD2XY (where X is any number; where Y is 1, or 8)	**AD2XY (where X is any number; where Y is 2,3,4,5,6,7, or 9)**	**AD8XY, or AD9XY (where X is any number; where Y is any number)**
Operating Temperature	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C	14 to 113°F –10 to 45°C
Voltage	110 to 120 V	220 to 240 V	95 to 240 V
Frequency	50 to 60 Hz	50 to 60 Hz	50 to 60 Hz
Max. Current	2.0 A	1.0 A	1.4 A
Wattage	25 W	22 W	20 W

	AD2	**AD8**	**AD9**
Battery	N/A	N/A	Panasonic BR1225 or Renata CR1225 or Energizer/Eveready CR1220
Fuse	Bel Fuse 5HT1.25-R Time-lag, 5mm x 20mm	Bel Fuse 5HT 2-R Time-lag, 5mm x 20mm	Bel Fuse 5H 2-R Time-lag, 5mm x 20mm

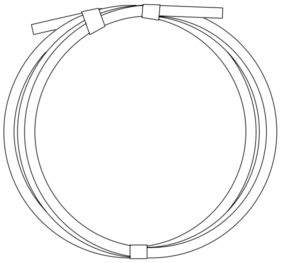
***The battery and fuse are internal, factory serviceable parts, and must be replaced by the factory or a qualified distributor with parts of the same type and rating.**

2.2 Unpacking Check List

Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.

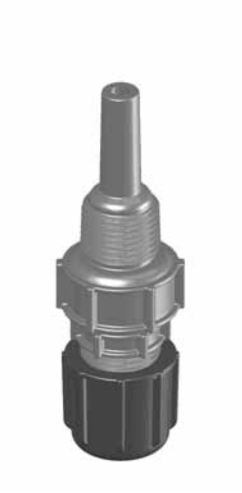
Metering Pump

Foot Valve



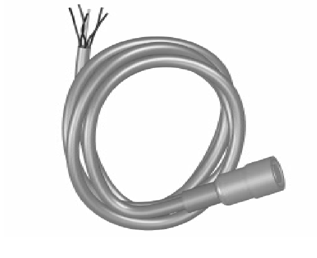
Tubing (0 to 3 Rolls)

Ceramic Foot Valve Weight



Injection Check Valve

Four-Function Valve (Optional)



External Control Cable (0, 1, or 2 Cables)

Tube Connection Hardware

3.0 Installation

3.1 Pump Location and Installation

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be operated in ambient temperatures above 113°F (45°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

This pump is cord connected and not intended for permanent mounting to a building. However, temporary mounting to stabilize the pump during operation may be necessary as long as tools are not required for the installation or removal of the pump.

3.2 Pump Mounting

The pump can be mounted in one of two ways:

A. FLOODED SUCTION (ideal installation); or

B. SUCTION LIFT - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water or viscosity of less than 100 cSt (centistokes). For denser or more viscous solutions, consult distributor.

Note that suction conditions can affect the performance of the pump. This effect is more pronounced with lower pressure pumps. Consult your distributor for additional information.

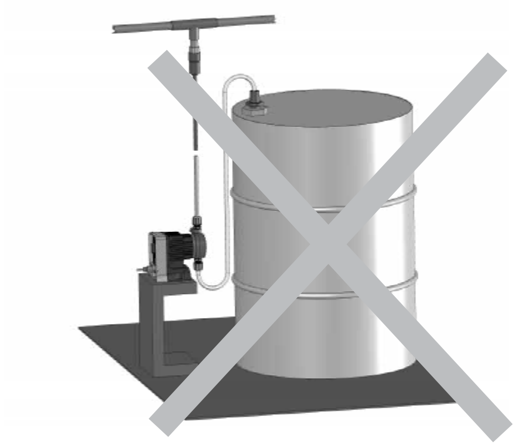
Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

3.2.1 Flooded Suction

For flooded suction the pump is mounted at the base of the storage tank. This installation is the most trouble-free, and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced. A foot valve is not necessary in a flooded suction installation.

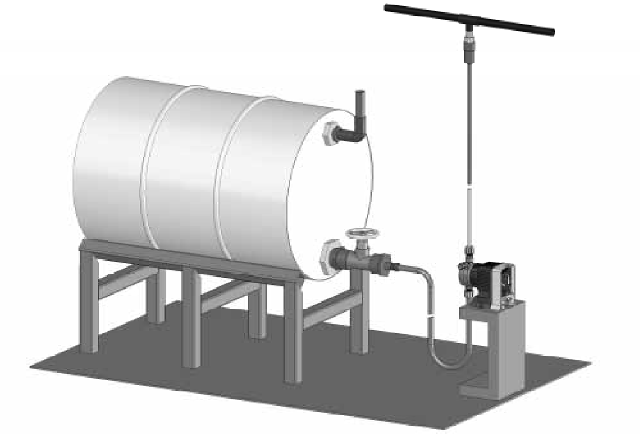
When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning.

Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT

Avoid this type of false flooded suction.



CORRECT

3.2.2 Suction Lift - Wall Bracket Mount

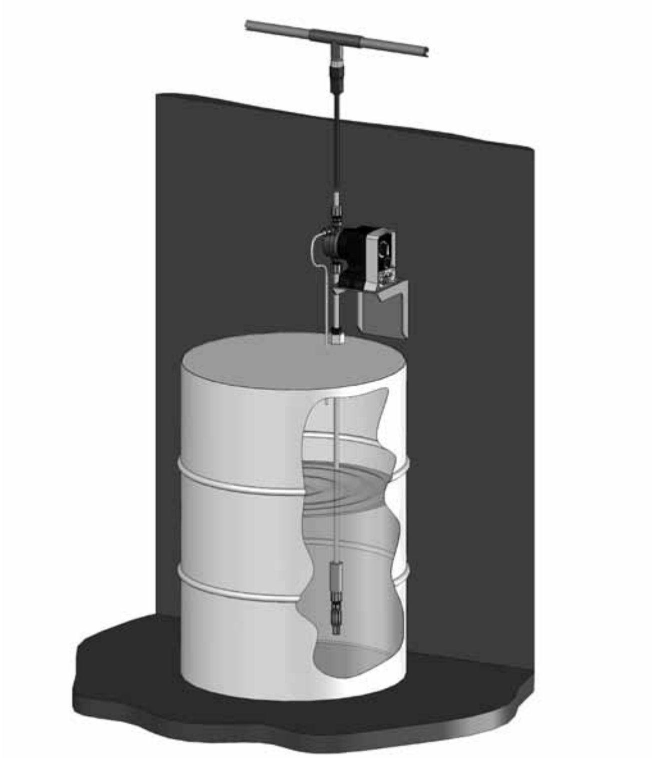
The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.

3.2.3 Suction Lift - Tank Mount

The pump may be mounted on a LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350).

3.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m).



3.3 Tubing Connections

1. Insert tubing through Coupling Nut—Tubing should enter the smaller end of the Coupling Nut first, orienting the larger opening of the Coupling Nut toward the tubing end.

2a. For 1/4” OD tubing: Position the Female Ferrule so that 1/4” to 3/8” (5-10 mm) of tubing protrudes from the Female Ferrule. Orient the raised collar of the Ferrule toward the Coupling Nut (reference FIGURE 1).

2b. For 3/8” or 1/2” OD tubing: Position a Female Ferrule about one inch (25 mm) from end of tubing. Orient the raised collar of the Female Ferrule toward the Coupling Nut. Then, insert the Male Ferrule onto the end of the tube, pushing the tube into the bottom of the groove in the Male Ferrule. Then slide the Female Ferrule down the tubing and with your fingers, press tightly into the Male Ferrule (reference FIGURE 2).

3. Firmly hand tighten the Coupling Nut onto the fitting. Note: Tightening with pliers may cause the Ferrules to break.

A. USE ONLY LMI TUBING—ALWAYS use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings.

B. *DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.* The pressure created by the pump can rupture vinyl tubing.

C. Before installation, all tubing must be cut with a clean square end.

D. Valve and head connections from the factory are capped or plugged to retain pre-prime water. Remove and discard these caps or plugs before connecting tubing.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

DO NOT REUSE FERRULES—USE ONLY NEW FERRULES.

Replacement Ferrules, and Coupling Nuts are available as the following kit numbers:
¼” Tube – 77382
⅜” Tube – 77383
½” Tube – 77384
3 x 6 mm Tube – 77378
6 x 8 mm Tube – 77379
9 x 12 mm Tube – 77380
One kit is needed for each end of the tube.

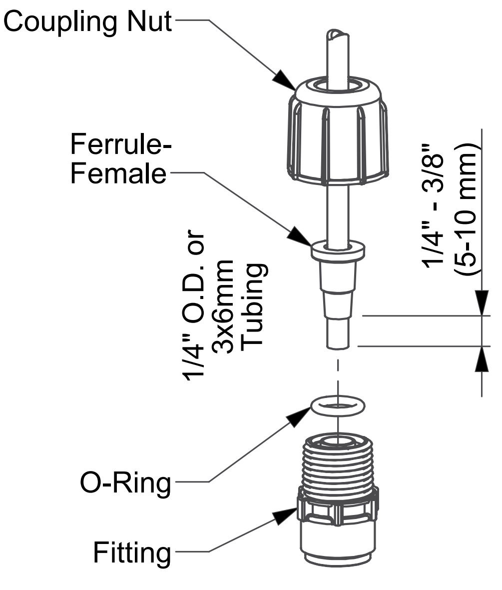


FIGURE 1

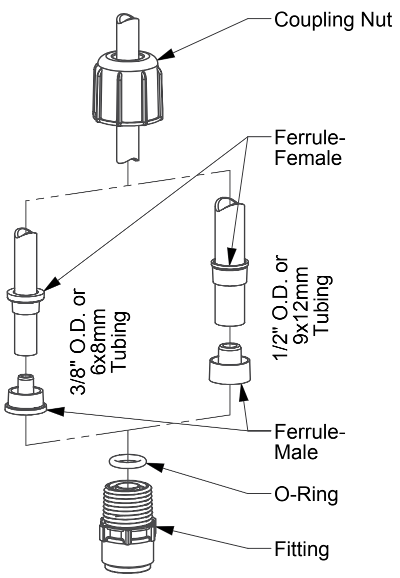
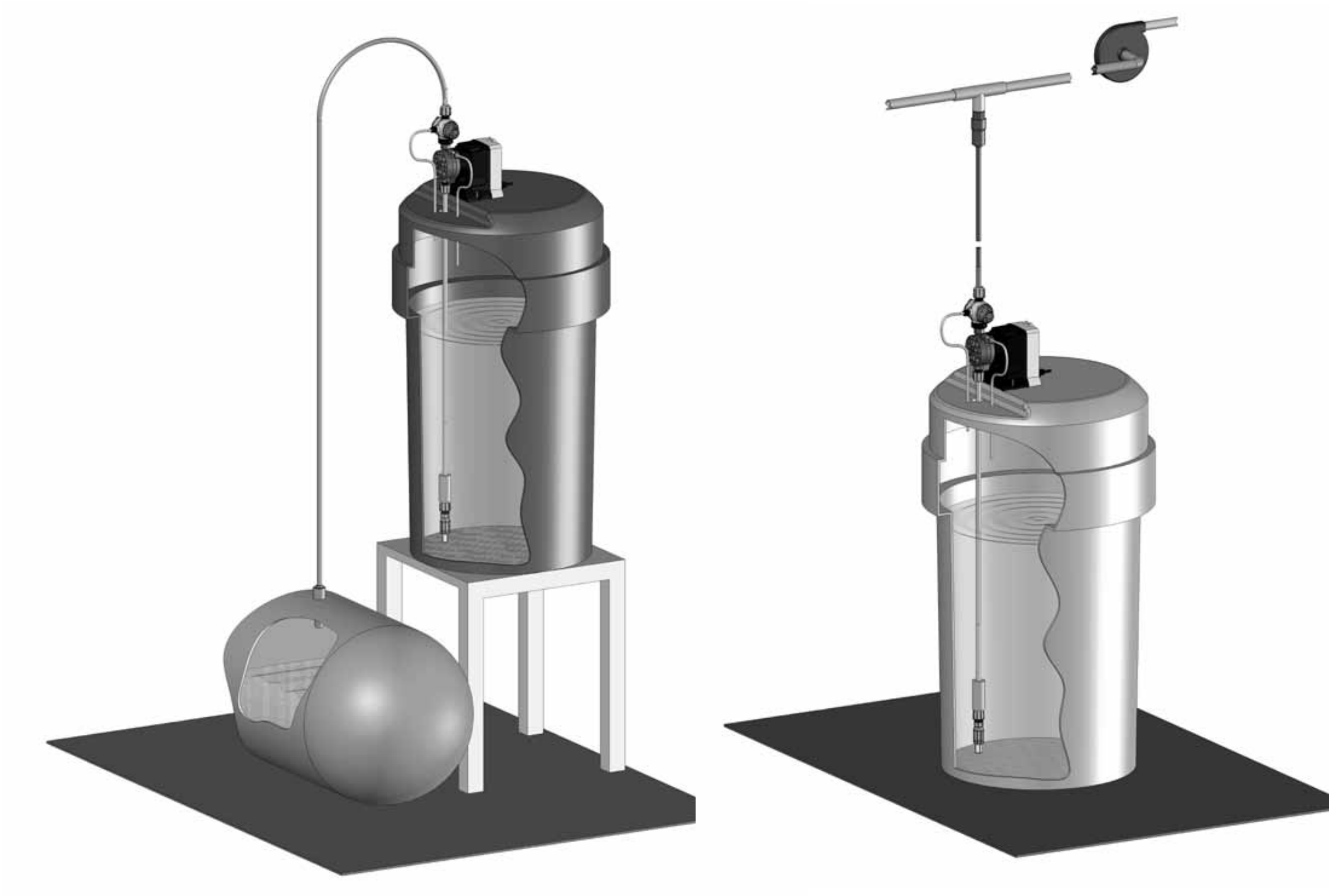


FIGURE 2

3.4 Four-Function Valves (4-FV)

Your pump may be equipped with a 4-FV, or standard discharge valve. If your pump is not equipped with a four-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor. The features of a 4-FV are listed below.

1. **Pressure Relief:** If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.
2. **Line Depressurization:** Opening the relief knob provides line drain back to the supply tank.
3. **Anti-Syphon:** Prevents syphoning when pumping solution downhill or into a vacuum.
4. **Back Pressure:** Supplies approximately 20 psi back pressure to prevent overpumping when little or no system back pressure is present.

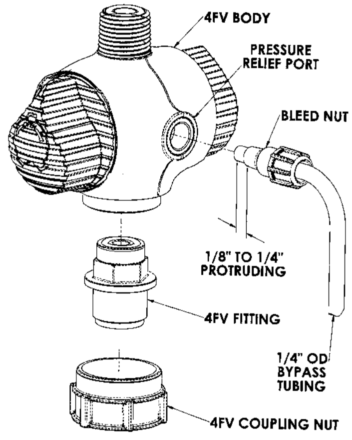


4-FV prevents syphoning when pumping downhill into low or no pressure.

4-FV prevents syphoning when pumping into a vacuum such as the suction side of a recirculating pump.

Typical Installations Requiring the Anti-Syphon Feature of a Four-Function Valve

3.5 Four-Function Valve Installation



Four-Function Valve Tubing Connection

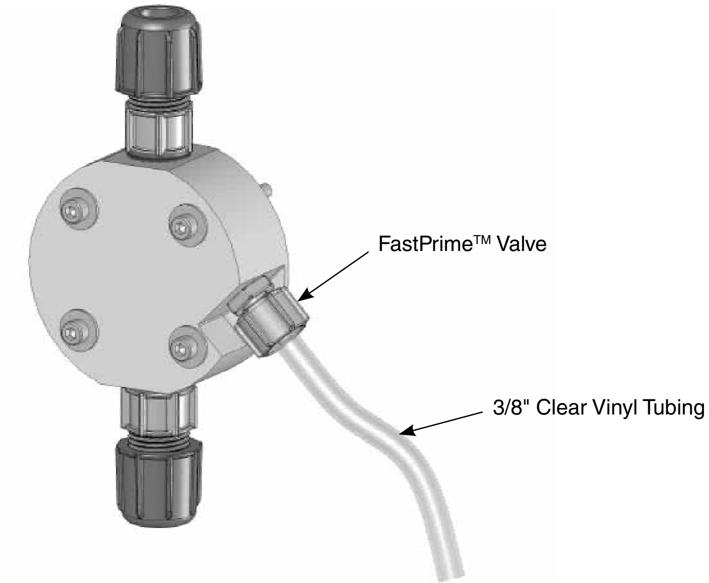
To install a 4-FV, the 4-FV Fitting and Coupling Nut should be assembled with the appropriate cartridges into the discharge port of the pump. Use a 13/16" or 20 mm socket to tighten fitting. Tightening to 50 inch-pounds is recommended. Do not over tighten.

To assemble the Four-Function Valve Body, insert the large opening on the Four-Function Valve Body into the 4-FV Coupling Nut and hand tighten. You can position the valve to have the Bleed Nut pressure relief port in any convenient location by tightening the 4-FV Coupling Nut with the Bleed Nut positioned 90º CCW from desired location, then holding the 4-FV Coupling Nut stationery while turning the 4-FV Valve Body the final 90º to desired position. Next, insert the ¼" tubing through the Bleed Nut. Ensure that about ¼" (6 mm) of tubing is protruding through the tip of the Bleed Nut. Firmly hand tighten the Bleed Nut in the hole on the side of the 4-FV. This tubing should be routed back to the supply tank. To ensure proper function of the priming function, the end of this tubing should not be submerged in the solution.

This return line tubing must be secured to ensure pumped solution will safely return to supply tank.

3.6 *FastPrime™*

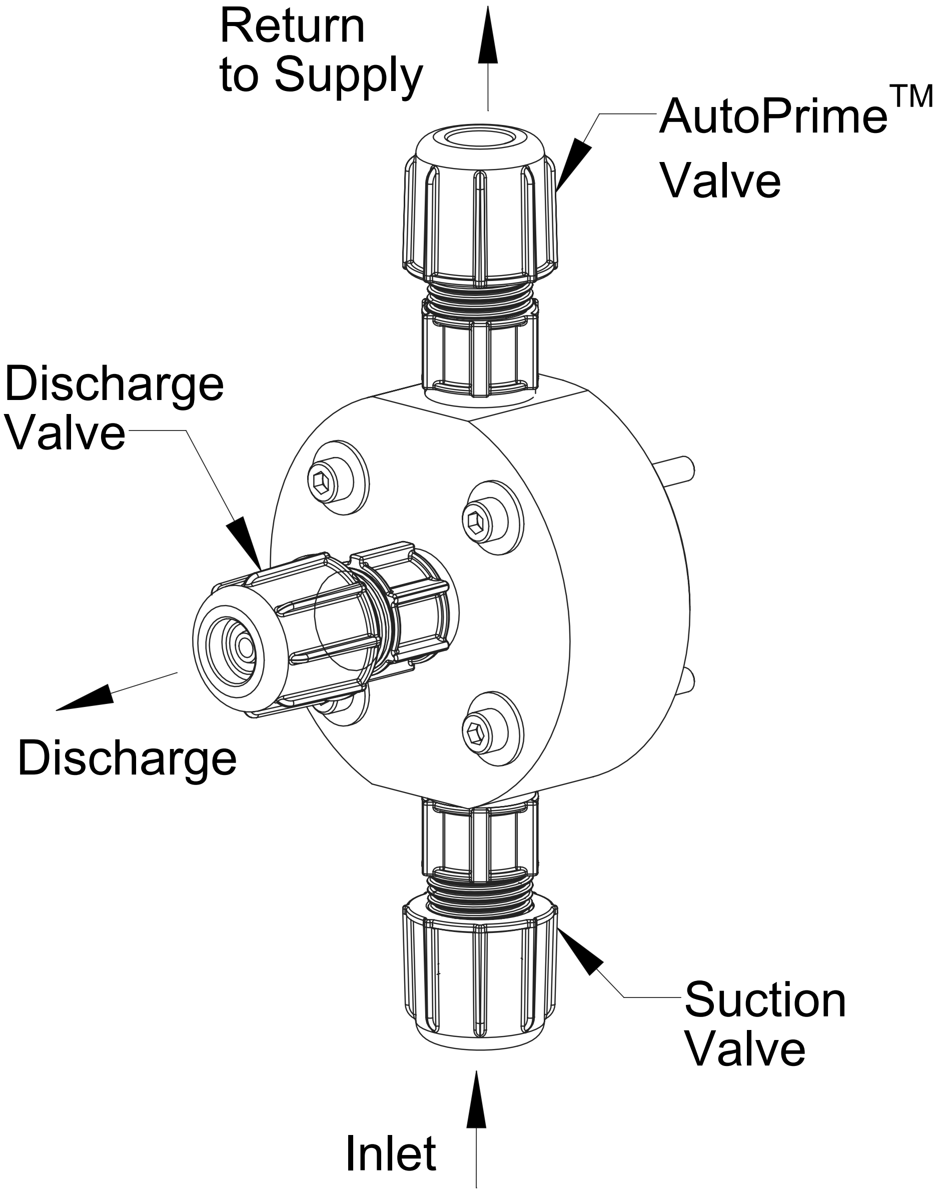
The FastPrime™ Head is equipped with a valve that allows for opening the head to atmospheric pressure. When installing a pump equipped with a FastPrime™ Head connect the 3/8" outer diameter clear vinyl tubing provided with the pump to the barbed nozzle. Route the vinyl return line back to the solution tank. This tubing must not be submerged in the solution.



FastPrime™ Head

3.7 AutoPrime™

Pumps installed with the AutoPrime™ Liquid End are equipped with a valve that allows for constant removal of vapors and gasses inherent with effervescent chemicals such as Sodium Hypochlorite and Hydrogen Peroxide. The valve keeps the pump primed automatically. When installing a pump equipped with an AutoPrime™ Liquid End, connect the 1/2" OD Polyethylene tubing to the top vertical fitting, and route this line back to the supply tank. To ensure priming, this tubing should not be submerged in the solution. The horizontal fitting is the discharge, and the bottom vertical fitting is the suction.



AutoPrime™ Liquid End Example

3.8 Foot Valve/Suction Tubing Installation

The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

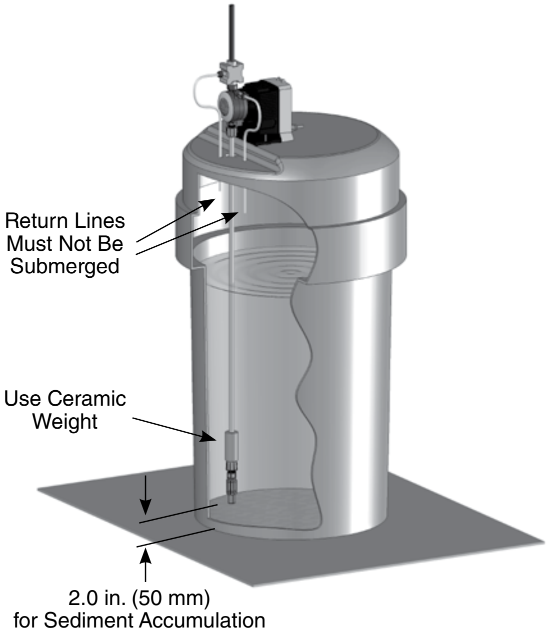
The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

The ceramic weight, when installed, helps position the foot valve in a vertical position.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 3.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 3.3).

Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

Foot Valve
Tilted Sideways WILL NOT PRIME
INCORRECT



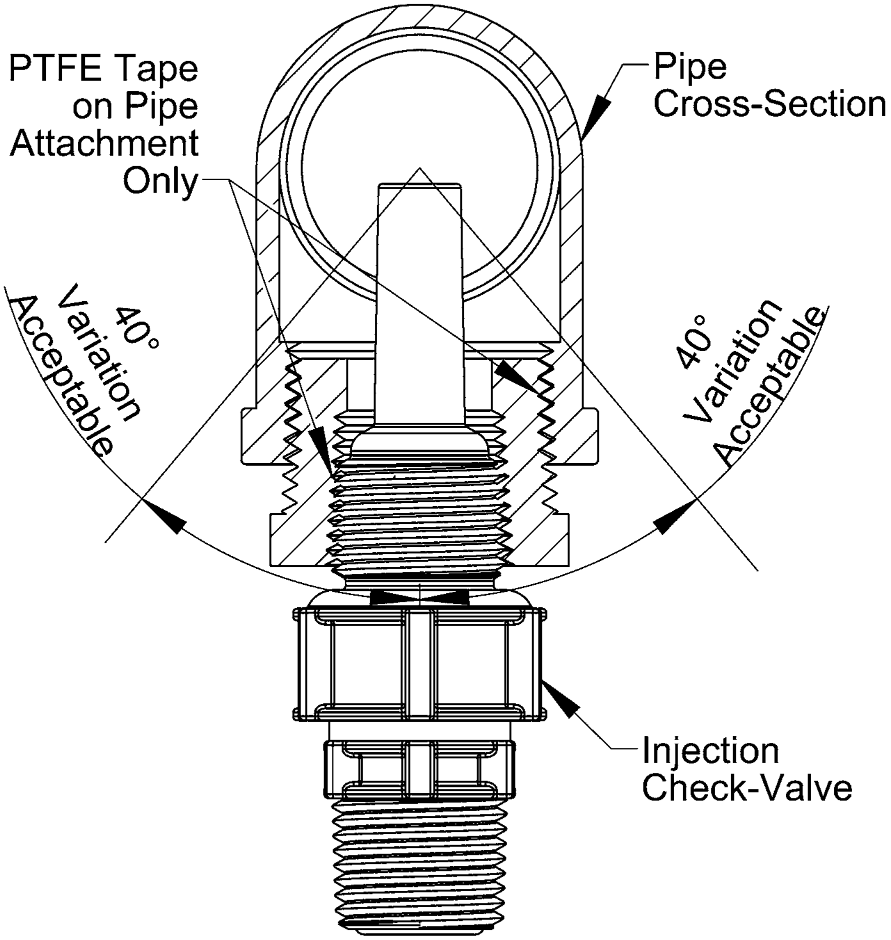
Foot Valve Must
Remain Vertical
CORRECT

3.9 Injection Check Valve and Discharge Tubing Installation

The Injection Check Valve prevents backflow from a treated line. Install the injection check valve at the location where chemical is being injected into the system. Any size female NPT fitting or pipe tee with a reducing bushing to 1/2" female NPT will accept the injection check valve. PTFE tape should only be used on threads that are connected with pipes.

When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations left and right within 80° are acceptable (see illustration).

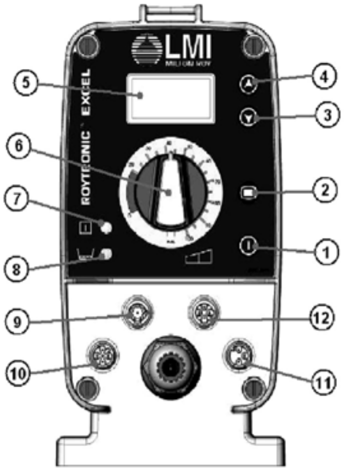
After cutting an appropriate length of tubing, connect tubing to the injection check valve then back to the discharge side of the pump head. Make sure it does not crimp or come into contact with hot or sharp surfaces (see Tubing Connections, Section 3.3).



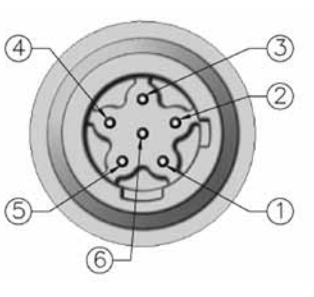
Typical Injection Check Valve Installation

4.0 Operation

4.1 Output Adjustment Controls



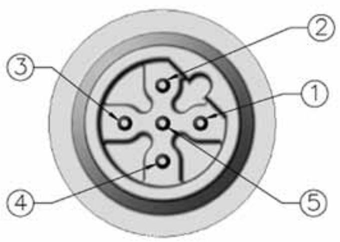
1. ⏻Power Button: This button allows convenient starting and stopping of the pump.
2. ▣Mode Selection Button: For pumps with external control capability (AD8, AD9) this button switches pump operation between internal and external modes. When operating in internal mode the Pulse Indicator Light will flash green while pumping. When operating in external mode the Pulse Indicator Light will flash yellow while pumping.
3. ▼Down Button: This button reduces the stroke speed of the pump. It will reduce the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly reduce the stroke speed. When a speed of 1 stroke per minute (SPM) is reached the speed can be further reduced by pressing this button again to enter stroke per hour settings.
4. ▲Up Button: This button increases the stroke speed of the pump. It will increase the stroke speed by 1 each time it is pressed. If this button is held down, it will rapidly increase the stroke speed. When a speed of 59 strokes per hour (SPH) is reached the speed can be further increased by pressing this button again to enter stroke per minute settings.
5. LCD Display: This display will show the stroke speed of the pump. Pumps with theoretical (AD2, AD8, AD9) or actual (AD9 **when combined with a flow meter**) flow will display the flow here.
6. Stroke Adjustment Knob: This knob provides adjustment of the stroke length. Turning this knob clockwise ↻ increases the stroke length, which results in a higher amount of chemical displaced per stroke. It is recommended that the stroke range stay between 20% and 100%.
7. Pulse Indicator Light: This light will flash green when pumping in internal mode and will flash yellow when pumping in external mode. The light is on between strokes and off during the actual stroke.
8. Low-Level Indicator Light: For units with Single-Level Float Sensors this light will turn red when the Low-Level Sensor registers empty. This will turn the pump off. For units compatible with Dual-Level Sensors (AD8, AD9) the light will turn yellow when a low level is registered, and red when an empty level is registered. The pump will turn off when it registers an empty level.
9. Output, Alarm, & Remote Mode Connector (6-Pin): This connector is used for the special functions associated with the AD9 controls. For the AD9 this connector is associated with the 4-20ma out, Alarm Out, and Internal/External remote modes.
    1. Alarm Out (Red/White) – Programmed as either an Alarm Output or Internal/External mode indicator. As an Alarm Output, pins 1 and 2 will give a closure (solid state) triggered by: empty tank indication, input pulse error, exceed batch error, or flow switch activation. For remote mode indication it is open for internal mode and closed for external.
    2. Alarm Return (Red) – Return side for the above pin 1 Alarm Out.
    3. Remote Internal/External Mode (AD9) (Green) – This pin is programmed as Internal/External remote mode control for an AD9. If programmed as the Internal/External control, a closure will put the AD9 into external mode.



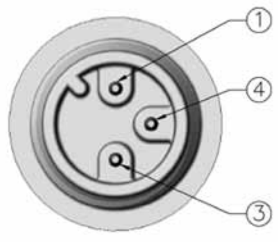
   4. Pulse Out (AD9) (Red/Yellow) – On the AD9 this pin gives a100ms pulse output for each pump stroke.
   5. 4-20mA Out (AD9) (Red/Black) – On the AD9 this pin is the positive 4-20ma output. This output will show you 4ma when the pump is idle, 20ma at max stroke speed.
   6. Ground/Return Connection (Red/Blue)– Common Ground

10. <u>External Control Connector (5-Pin)</u>: This connector is for the connection of various options and accessories that can be used to externality control the pump. The pin functions (and the wire color for the standard LMI external control cable) are as follows:

   1. Remote On/Off Signal (Brown)
   2. Ground/Return Connection (White)
   3. External Pulse Signal (Blue)
   4. 24V 75 mA* Power Supply (Black)
   5. 4-20mA Input Signal (Green/Yellow)



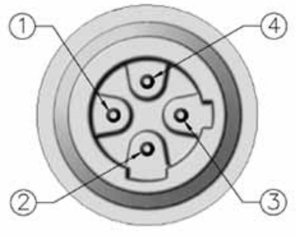
11. <u>Low-Level Connector (3-Pin)</u>: This connector is for the connection of a Low-Level Sensor (49246) or a Dual-Level Sensor (49249). The Tank Empty input connections are always active for all models in all functional modes. The Tank Low input connections are always active for models equipped with dual level functionality (AD8, AD9). If the fluid level drops below the top float on a Dual-Level Sensor, the Low-Level Indicator Light will turn yellow. If the fluid level drops below the float on a Low-Level Sensor, or the bottom float on a Dual-Level Sensor, the Low-Level Indicator Light will turn red, and the pump will stop. The pump is designed to recognize an open circuit as full and a closed circuit as low or empty. There is a five second delay between triggering the sensor, and the pump's reaction. This is intended to avoid triggering during refilling your supply tank. The pin functions are as follows:



   1. Tank Empty Signal
   3. Tank Low Signal
   4. Ground/Return Connection

12. <u>Flow Monitor/Meter Connector (4-Pin)</u>: This connector will be used with a Milton Roy flow meter or the Milton Roy Digpulse flow monitor (FM-ROY-9). The pin functions are as follows:

   1. Flow Meter In – A closure between this pin and ground registers a pulse for the flow meter/monitor.
   2. 24 Volt 75 mA* Supply – Supply voltage for a Milton Roy flow meter.
   3. Ground/Return Connection – Common ground
   4. Flow Meter Sense – The condition of this pin will set the pump into the Digipulse or Flow Meter mode. This will automatically occur with the Milton Roy device is connected. A connection to ground indicates the use of a flow meter, while an open circuit indicates a flow monitor.



*The total current output of the 5-pin and 4-pin connectors should not exceed 75 mA.

4.2 Start-up and Adjustment

- *The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.*
- *Pumps are shipped from the factory with water in the pump head to aid in priming.*

4.2.1 Start-Up/Priming for FastPrime™ Heads (LE-XXXNX)

If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Turn The FastPrime™ knob 1 to 2 turns counter-clockwise ↺.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the FastPrime™ valve. Once this happens, turn the knob clockwise ↻ until hand tight and **SHUT THE PUMP OFF.**
6. The pump is now primed.
7. Proceed to output adjustment, Section 4.3.

4.2.2 Start-Up/Priming for Pump Supplied with 4-FV (LE-XXXSX or LE-XXXHX)

If the pump does not self-prime, remove the 4-FV on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the Speed Adjustment Knob and the Stroke Adjustment Knob at 100%.
3. Open the relief side (black knob) of the 4-FV by turning to the stop (about 1/8 turn).
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the 4-FV. Once this happens, return the knob to the 12:00 position and **SHUT THE PUMP OFF.**
6. The pump is now primed.
7. Proceed to output adjustment, Section 4.3.

4.2.3 Start-Up/Priming for AutoPrime™ Heads (LE-XXXAX or LE-XXXHX)

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may prime the pump.

1. Plug in or switch on the pump.

2. While the pump is running, set the speed knob and the stroke knob at 100%.

3. The suction tubing should begin to fill with solution from the tank as the AutoPrime™ valve purges air from the pump head.

4. Once the solution begins to exit the pump head through both the discharge valve and the AutoPrime™ valve, **SHUT THE PUMP OFF**.

5. The pump is now primed.

6. Proceed to output adjustment, Section 4.3.

4.3 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

4.3.1 Total Pump Output

Calculate the **approximate** output of the pump as follows:

When converting between different units, remember these conversion factors:

1 Gallon = 3.785 Liters

1 Day = 1,440 Minutes

120 SPM = 7,200 SPH

PUMP OUTPUT = MAX PUMP OUTPUT x % SPEED x % STROKE

Example: AD251-938SI

Use Max Output (from dataplate on side of pump) = 1 GPH (1 gallon per hour).

If the pump is set at 60 strokes per minute (out of a possible 120 SPM) and 70% stroke length, the approximate pump out-put is:

$1.0 \times \frac{60}{120} \times 0.70 = 0.35$ GPH.

Multiply by 24 (hours in one day) to calculate in gallons per day.

It is important to note that this is only an approximate output and it does not account for tolerance variations in pump components or flow variations due to pressure sensitivity, or viscosity effects. Variations due to these effects can be significant, necessitating calibration for your pump.

4.3.2 Calibrating the Displayed Flow (AD2, AD8)

The Roytronic Excel Pumps are equipped to display a theoretical flow rate based upon the pump's stroke speed and stroke length. These calculations are based upon factory test conditions which may be significantly different from your application. It is necessary for the user to perform the following calibration procedure when the pump is connected to your system, and using the actual chemical. This one-point calibration procedure will greatly improve the accuracy of the pump's calculated flow. The closer the pump's stroke length is to the typical use stroke length, the more accurate the result. We recommend using the approximate settings determined in section 4.3.1 as a starting point for calibration.

1. Prepare a flow measuring device such as a graduated cylinder or a scale sensitive to a gram.
2. Ensure the pump is primed following the procedures in 4.2.
3. Put the pump into Internal Mode and use the Power Button ⏻ to turn the pump off.
4. Hold the Up Button ▲ and Down Button ▼ in at the same time for 8 seconds until 'CAL' is displayed on the LCD Display, then release the buttons. Note 'FLO' will be displayed first. Continue to press the buttons until 'CAL' is displayed.
5. Push the Power Button ⏻ and release until a "0" is displayed.
6. Note the reading on the calibration device. If using a graduated cylinder note the starting liquid level. If using a scale note the displayed weight, or reset the scale's display to zero.
7. Push the Power Button ⏻ and release to start the pump. Notice that the display will count the total number of strokes. (The screen will show SPH).
8. Allow the pump to run; the accuracy will improve with more strokes. Use the Power Button ⏻ to stop the pump. The number of strokes will be displayed up to 999 strokes. If you will be pacing the pump externally, note the number of strokes.
9. Press and release the Power Button ⏻ again. This will display the pump's estimated volume pumped in mL. (The screen will show ml/h).
10. Use the Up ▲ and Down ▼ Buttons to match the displayed volume to the measured volume. If using a graduated cylinder, the presence of the tubing will cause the measurement to be slightly higher than actual. The measurement should be adjusted using the formulas shown below. If using a scale, the number of grams can be divided by the specific gravity of your chemical to determine the number of mL pumped. If the pump will be controlled externally, the output volume per stroke can be determined by dividing the measured output by the number of strokes.
11. Once the displayed value has been adjusted, hold and release the Power Button ⏻ to return the pump to internal mode.

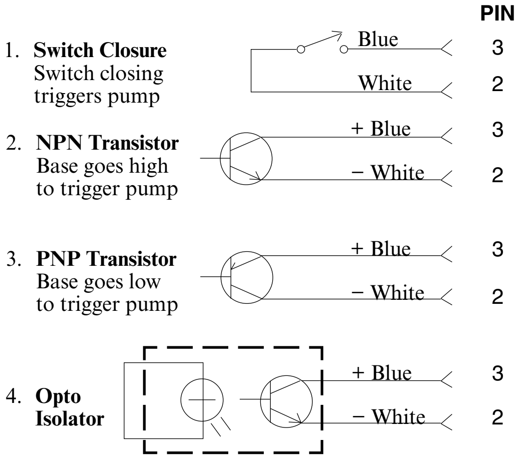
$$V_{actual} = V_{observed} * R \quad \textit{where} \quad R = 1 - \left(\frac{D_{tube}}{D_{column}}\right)^2$$

For accuracy, it is important that the water level does not drop below the top of the ceramic foot valve weight.

Note: If you will be using the pump at a different stroke length, or pressure, the pump should be recalibrated under those conditions using the procedure above to ensure accuracy.

4.4 Methods of Externally Triggering or Pacing AD8 and AD9 Pumps

Method of Triggering AD8 and AD9 Pumps through External Control Connector

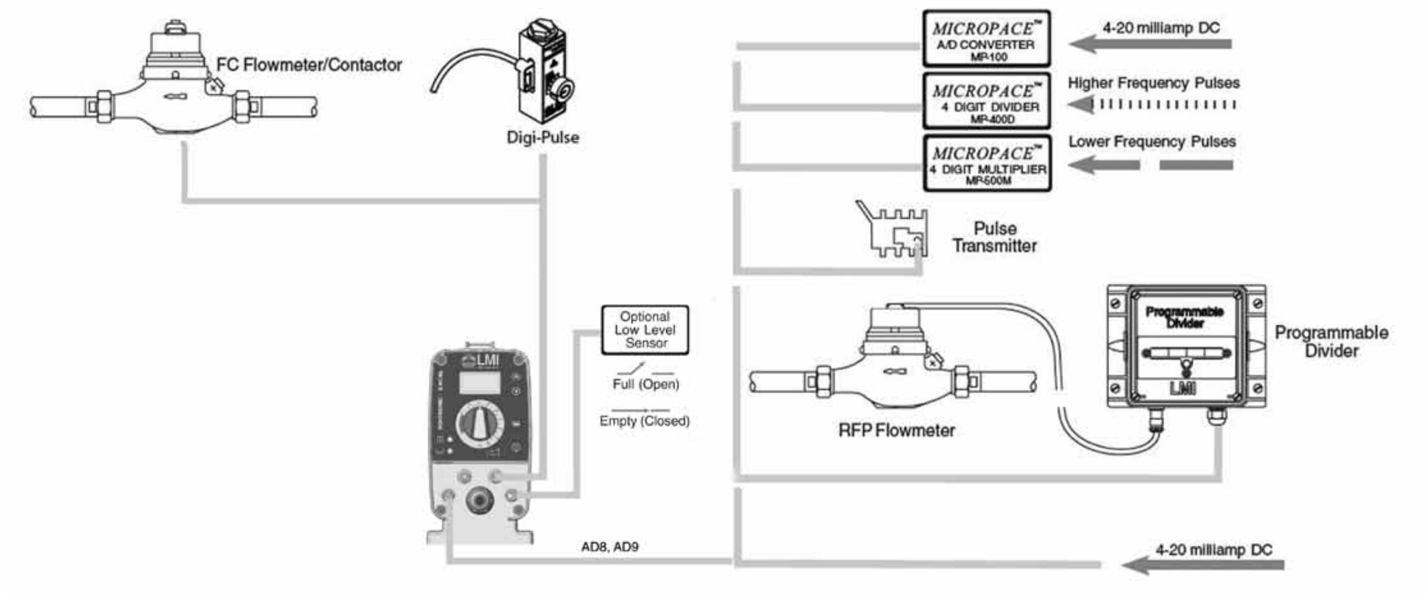


Switch or transistors must be capable of switching 24V DC at 15 milliamperes. Minimum time in low impedance state (ON) is 25 milliseconds. Minimum time in high impedance state (OFF) is 50 milliseconds.

The remote on/off input (using pins 1 and 2) is active in all modes. In the out-of-box configuration, the pump will run when contacts are open. The pump is monitoring these pins for a change in closure condition. Regardless of the pump being on or off, when the contacts close, then the pump will turn on. When the contacts open, the pump will turn off.

The Power Button overrides the remote on/off and can still be used to turn the pump on and off. If the contacts are closed when the on/off button is pressed, the pump will turn off. To restart the pump remotely, the contacts must be opened and then closed again.

These pumps have two operating modes: Local (Pulse Indicator Light flashes green) and Remote (Pulse Indicator Light flashes yellow). Pressing the Mode Selection Button switches between Local and Remote modes. The default configuration for operating mode is Local mode.



4.4.1 Control Modes

4.4.1.1 Local/Internal Mode

- When in Local mode Roytronic Excel pumps run at the speed indicated on the LCD Display.
- The stroking speed can be adjusted from the maximum speed of 120 strokes per minute (SPM) down to 1 stroke per hour (SPH).

4.4.1.2 Changing Displayed Flow Units (AD2, AD8)

1. When in Internal Mode use the Power Button to turn the pump off.
2. Hold the Up Button and Down Button in at the same time until ‘FLO’ is displayed on the LCD Display, then release the buttons.
3. Use the Up or Down Buttons to select the desired units of measure.
4. Press the Power Button and the pump will return to internal mode with the desired units displayed.

4.4.1.3 Remote Mode (for AD8)

In Remote mode the pump can be controlled in a variety of ways: pulse divide, pulse multiply, or analog milliamp input. To cycle through the available modes, start in external mode, then press and hold the Power Button and Mode Selection Button simultaneously for about five seconds.

4.4.1.3.1 Divide Mode (for AD8)

The pump is in Divide Mode when a division symbol (÷) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number of incoming pulses received before a stroke occurs. Once the Power Button is pushed to turn the pump on, the LCD Display will show the approximate stroke rate of the pump based on the incoming pulses.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter ‘m’. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

4.4.1.3.2 Multiply Mode (for AD8)

The pump is in Multiply Mode when a multiplication symbol (×) is shown on the left-hand side of the LCD Display. Use the Up Button and Down Button to select the number strokes that will occur for each incoming pulse. Once the Power Button is pushed to turn the pump on, the LCD Display will count down the number of strokes starting at the multiplier value each time a pulse input is recognized. The strokes will occur every half second until it has counted down to zero. The pump will then wait for the next pulse input.

If it is necessary to change the pulse duration required to recognize a pulse from the factory default of 60 ms, hold both the Up Button and Down Button until a number appears followed by the letter ‘m’. This number is the minimum required time in milliseconds needed to count as a pulse. Use the Up Button and Down Button to adjust this number as needed. If no button is pressed for about 4 seconds, the pump will save the value and return to the previous screen.

4.4.1.3.3 Analog Mode (for AD8)

The pump is in Analog Mode when ‘mA’ is shown on the left-hand side of the LCD Display.

Pressing the Up or Down Button will display ‘P1’ and the milliamp input that corresponds to zero strokes. The Up and Down Buttons can be used to adjust this value. Pressing the Power Button (or waiting for about 8 seconds) will display ‘P2’ and the milliamp input that corresponds to max stroke rate. Note that the maximum stroke rate will be either 120 strokes per minute or 59 strokes per hour. This depends on the stroke speed set in Internal Mode.

5.0 Spare Parts Replacement and Routine Maintenance

LMI metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the Liquifram™, cartridge valves, O-rings, and the injection check valve spring. LMI recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

5.1 Depressurizing the Discharge Line (for Pumps Equipped with a 4-FV Only)

ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

To reduce the risk of chemical splash during disassembly or maintenance, all installations should be equipped with line depressurization capability. Using LMI's Four-Function Valve (4-FV) is one way to include this feature.

Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your 4-FV and runs back to your solution drum or tank.

2. Turn the black knob on the 4-FV 1/8 turn to the stop. Turn and hold the yellow knob for a few seconds. The discharge line is now depressurized. Keep both valve knobs open until solution drains back down the discharge tubing into the solution tank or drum. Then release the yellow knob, and turn the black knob to its normal position.

5.2 Depressurizing the Discharge Line (for Single-Ball FastPrime™ Heads Only)

ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your FastPrime™ valve and runs back to your solution drum or tank.

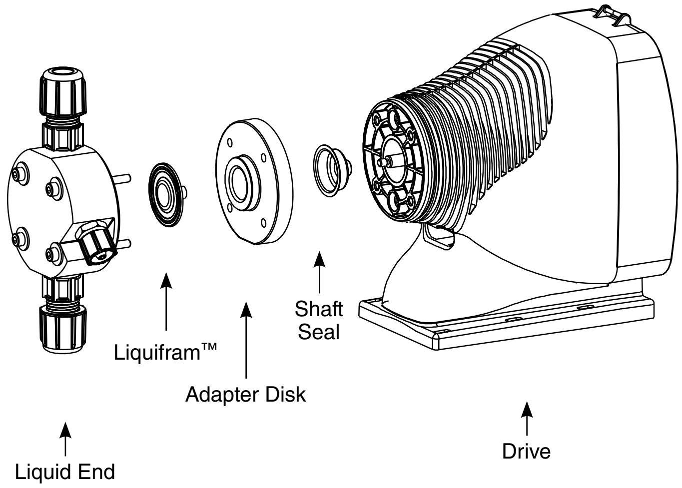
2. Turn the FastPrime™ knob one-and-a-half turns counter-clockwise ↺. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then turn the knob clockwise ↻ to tighten knob to closed position.

5.3 Liquifram™ (Diaphragm) Replacement

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

LMI metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the Liquifram™, cartridge valves, O-rings and the injection check valve spring. LMI recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the Liquifram™, the cartridge valves, or O-rings, the injection check valve spring should also be replaced (see next Section 5.4). A Spare Parts Kit or RPM Pro Pac™ kit containing these parts may be obtained from your local distributor.



Replacing the Liquifram™:

1. Carefully depressurize, drain, and disconnect the discharge line (see previous sections in this manual).
2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Immerse the head in water or other neutralizing solution.

3. Remove the four metric screws using an M4 Allen wrench and washers from the head.
4. Start the pump. While running, set the Stroke Adjustment Knob to 0% and then turn the pump off.
5. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise ↺. Discard old Liquifram™. Remove the Adapter Disk (located behind the Liquifram™) and ensure that the diameter of the raised section is the same as the diameter of the replacement Liquifram™.
6. Remove Adapter Disk and check condition of the Shaft Seal. Replace Shaft Seal if necessary.
7. Replace the Adapter Disk so that the drain hole of the disk is oriented downward, and the mounting holes line up with the mounting holes of the pump.

Be careful not to scratch the Fluorofilm™ face of the new Liquifram™.

8. Screw on the new Liquifram™ clockwise ↻ until turned all the way in. Start the pump and turn the stroke knob to 100%. Stop the pump.
9. Remount the pump head using the four (4) screws and washers. Tighten in a criss-cross pattern. Torque screws to 25 inch-pounds. After one week of operation, recheck the screws and tighten if necessary.

5.4 Cartridge Valve and O-ring Replacement

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

1. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in this manual).

2. Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, carefully disconnect the suction and discharge tubing using protective clothing, gloves and face shield. Remove the four screws and washers from the head and immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve and O-rings. If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.

Before disassembling the check valves, note the orientation of the valve.

4. Install new check valves in each location. Ensure that the cartridges are oriented correctly.

5.5 Injection Check Valve Parts Replacement

Depressurize and drain pipeline (or isolate Injection Check Valve point using valves) so that Injection Check Valve can safely be disassembled.

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

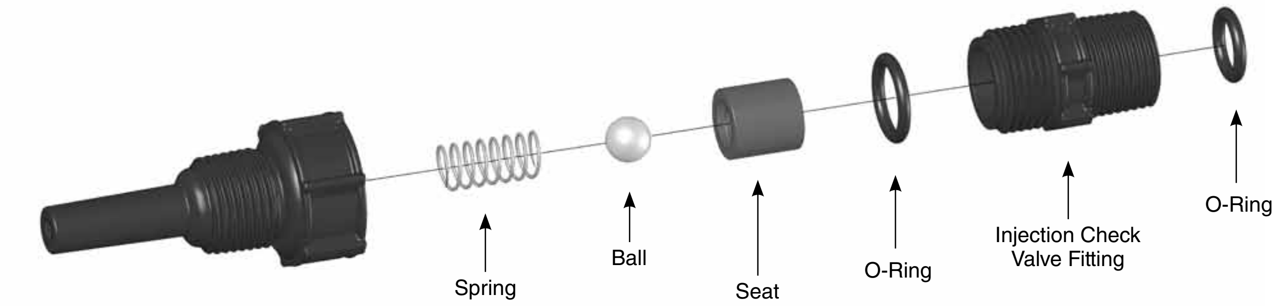
1. Isolate Injection Check Valve and depressurize pipe or drain pipeline.
2. Carefully depressurize and disconnect the discharge line (see Section 5.1 or 5.2 in this manual).

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

3. Carefully disconnect the tubing leading to the Injection Check Valve, then remove the Injection Check Valve Fitting. Remove and replace the worn spring, seat, ball, and O-ring.

Before disassembling the check valve, note the orientation of the parts.

4. Install a new spring, seat, ball, and O-ring. Ensure that the parts are oriented correctly.



5.6 FastPrime™ Valve O-Ring Replacement

ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your FastPrime™ valve and runs back to your solution drum or tank.

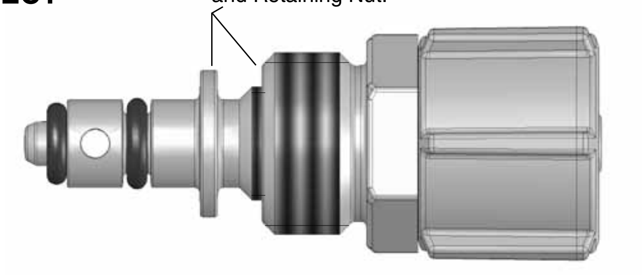
2. Turn the FastPrime™ Knob one-and-a-half turns counter-clockwise ↺. This will depressurize the head. Keep valve open. Carefully remove the return line by gently pulling tubing and moving it from side to side to gradually back tubing off of the barbed fitting.

3. Hold return line tubing upright until solution drains back into solution drum or tank.

4. Using a 3/4" (or 19mm) socket or wrench remove Retaining Nut, and pull out the entire FastPrime™ Valve assembly. Remove and replace the two small O-rings.

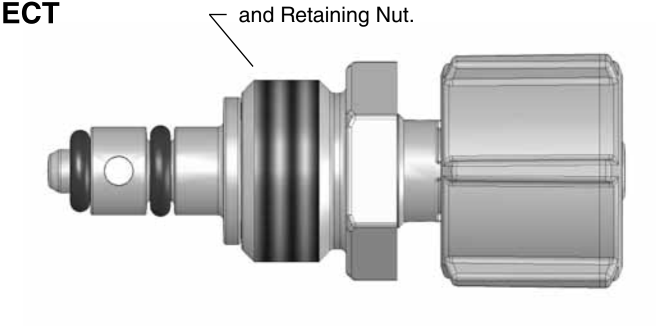
5. Reinsert the FastPrime™ Valve assembly and retighten the Retaining Nut. Then turn the FastPrime™ Knob clockwise ↻ to tighten knob to closed position. To avoid damaging the parts, it is important that the flange on the FastPrime™ Valve is flush with the Retaining Nut prior to reassembly.

INCORRECT



Note gap between Flange and Retaining Nut.

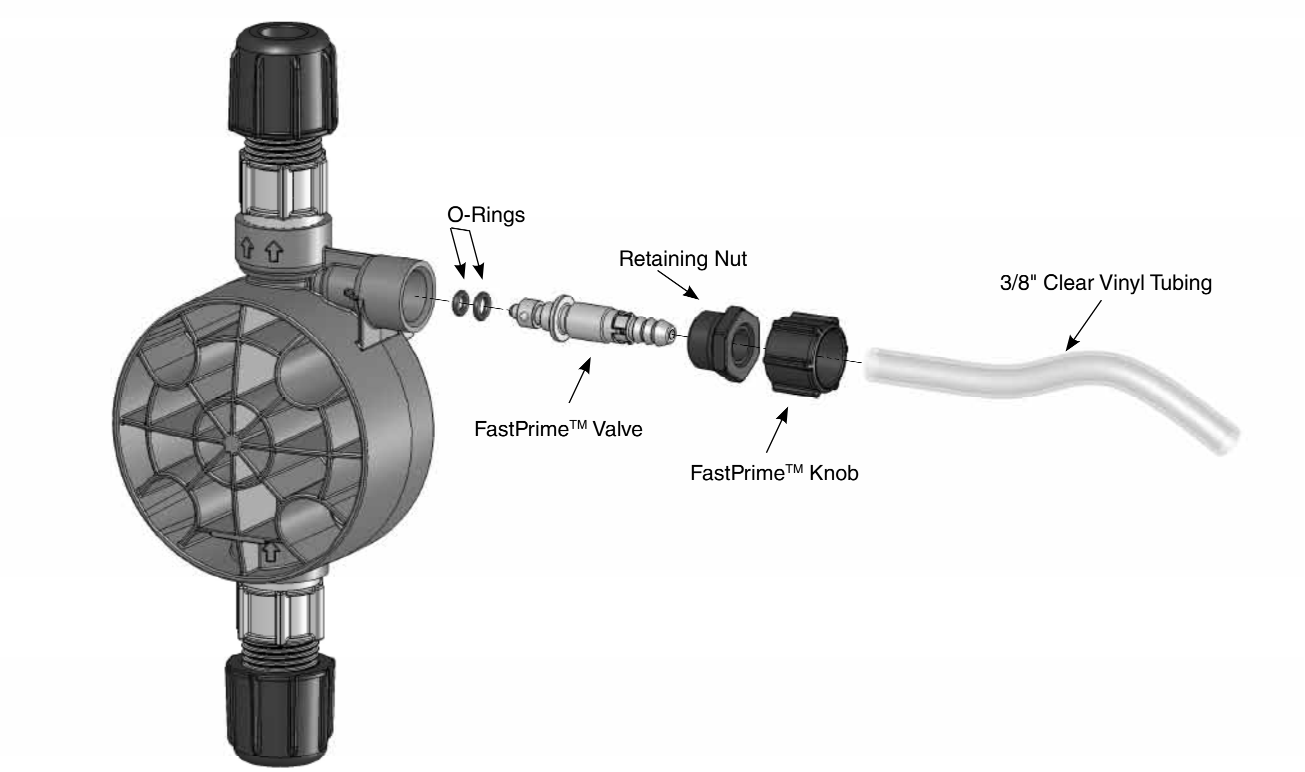
CORRECT



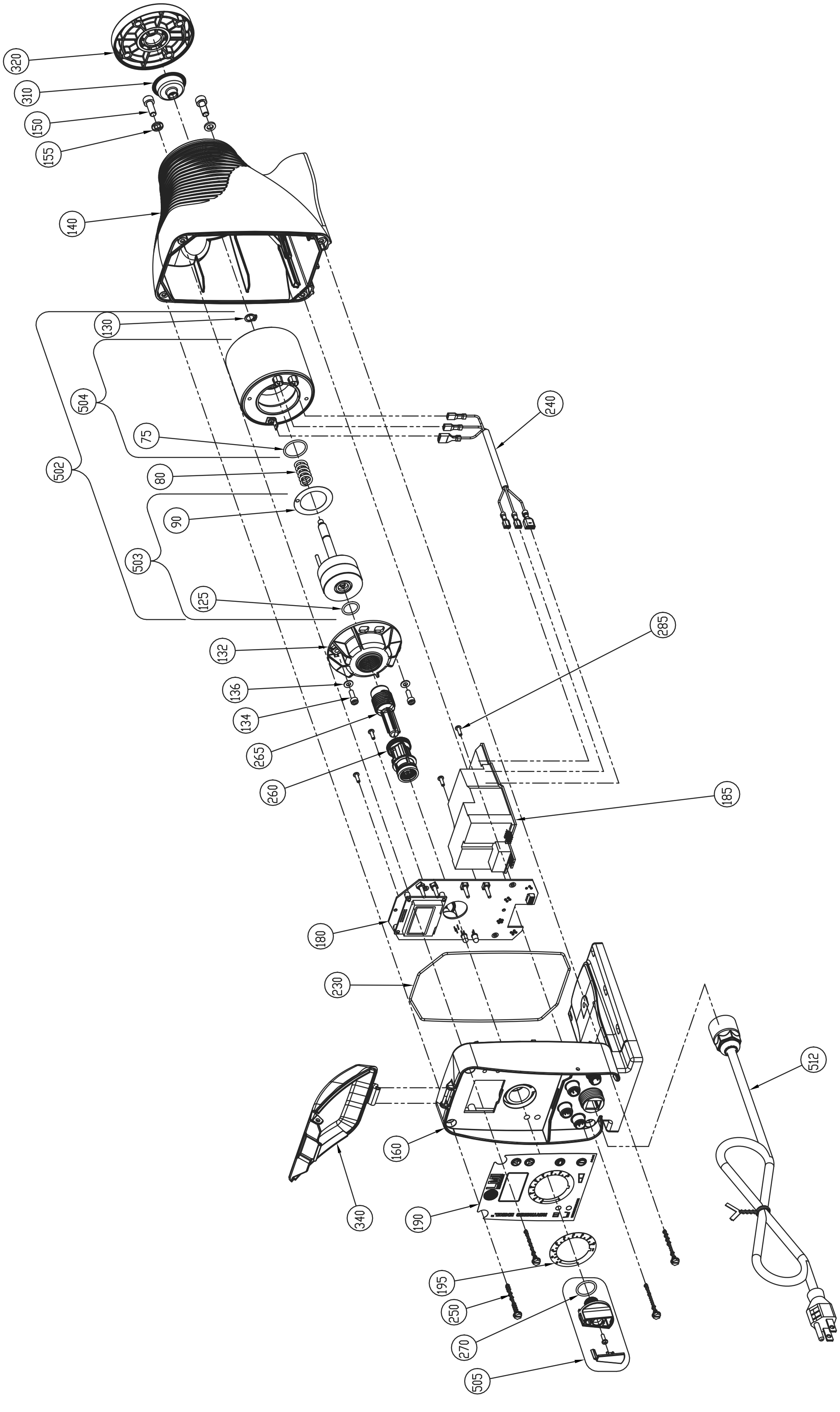
No gap between Flange and Retaining Nut.

5.6 FastPrime™ Valve O-Ring Replacement (continued)

6. Recut 1 to 2 inches off the tip of the return line and ensure the end is squared. Press the return line tubing on completely past the barbs.



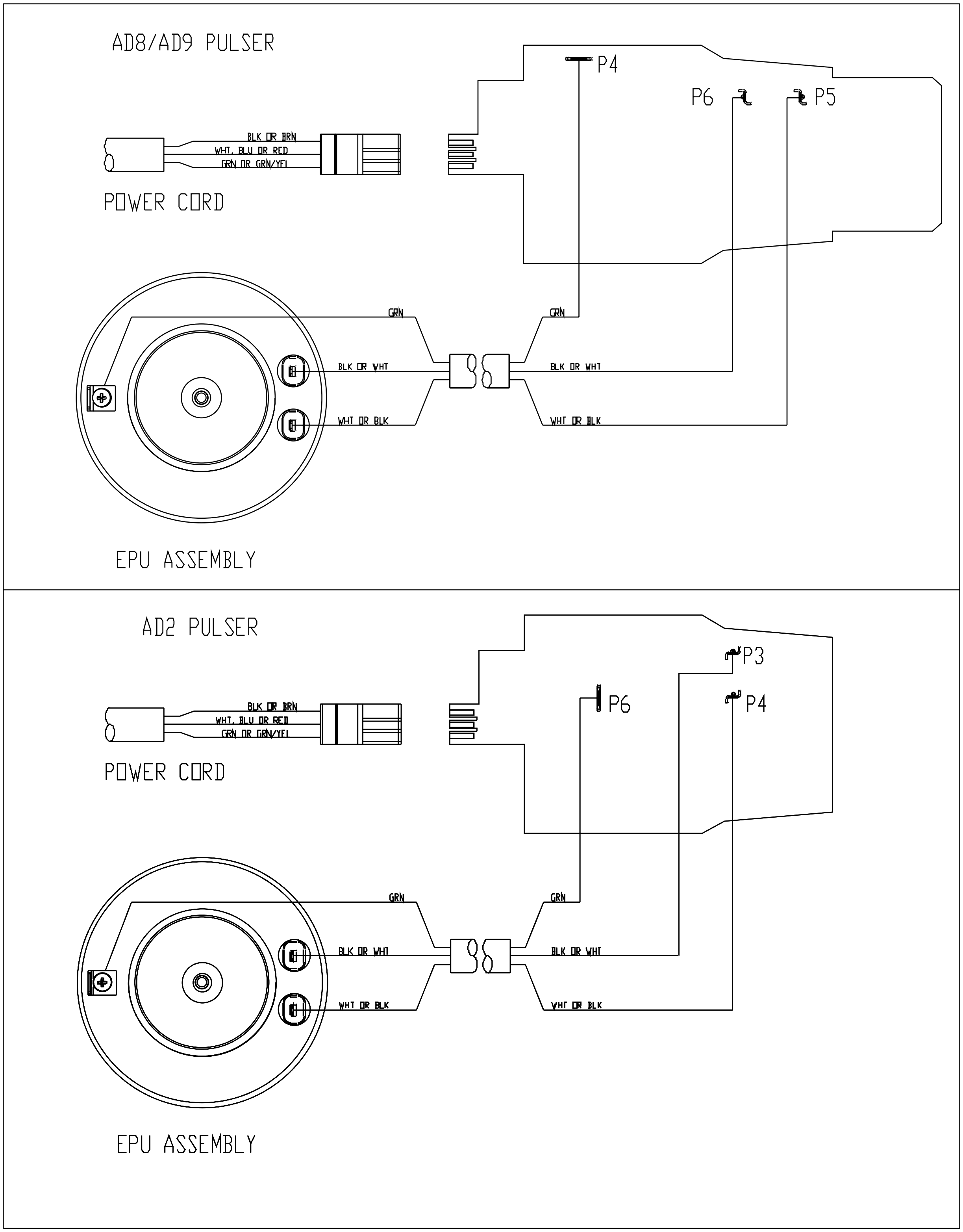
5.7 Drive Parts List



Bubble Number	Description
75	EPU O-Ring
80	EPU Return Spring
90	EPU Shim
125	Plunger O-Ring
130	Retaining Ring
132	Stroke Bracket
134	Stroke Bracket Screw
136	Stroke Bracket Washer
140	Drive Housing
150	EPU Attachment Bolt
155	EPU Attachment Washer
160	Control Panel
180	Control Board
185	Power Board
190	Nameplate
195	Stroke Dial

Bubble Number	Description
230	Control Panel O-Ring
240	Wire Harness
250	Drive Assembly Screws
260	Female Stroke Shaft
265	Male Stroke Shaft
270	Stroke Shaft O-Ring
285	PCB Attachment Screw
310	Shaft Seal
320	Adapter Disk
340	Clear Cover
502	EPU Assembly
503	Plunger Assembly
504	Pole Piece Assembly
505	Stroke Knob Assembly
512	Power Cord Assembly

5.8 EPU Wiring Diagram

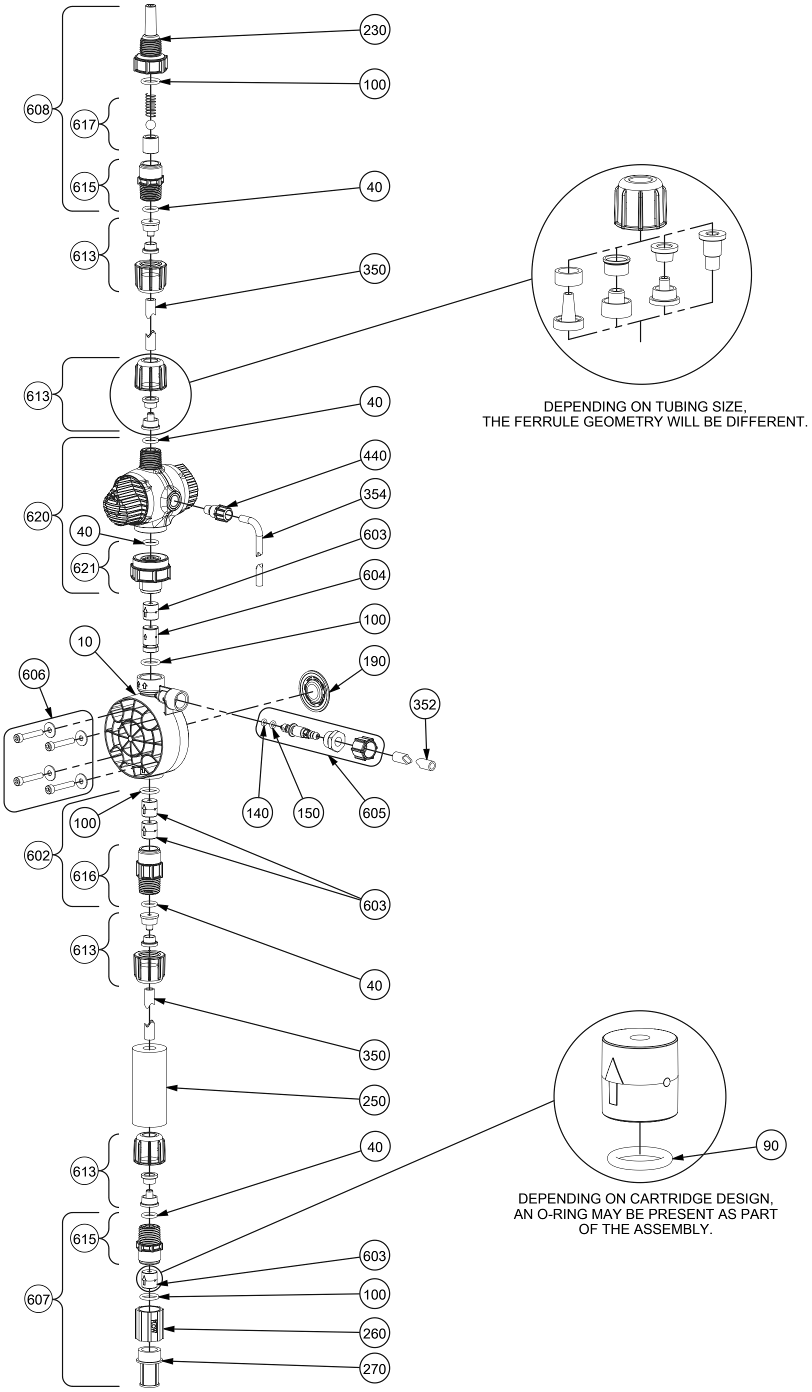


5.9 Liquid End Parts

For the latest and most accurate information on your liquid end, please refer to the Liquid End Sheets available in the LMI Online Library at: www.lmipumps.com.

1. Select "Online Literature Library" in the Navigation Bar on left.
2. Once on Online Literature Library use "Product" drop down to select "Liquid Handling Assemblies."
3. Select "Gallery" or "Index" to view Liquid End sheets.

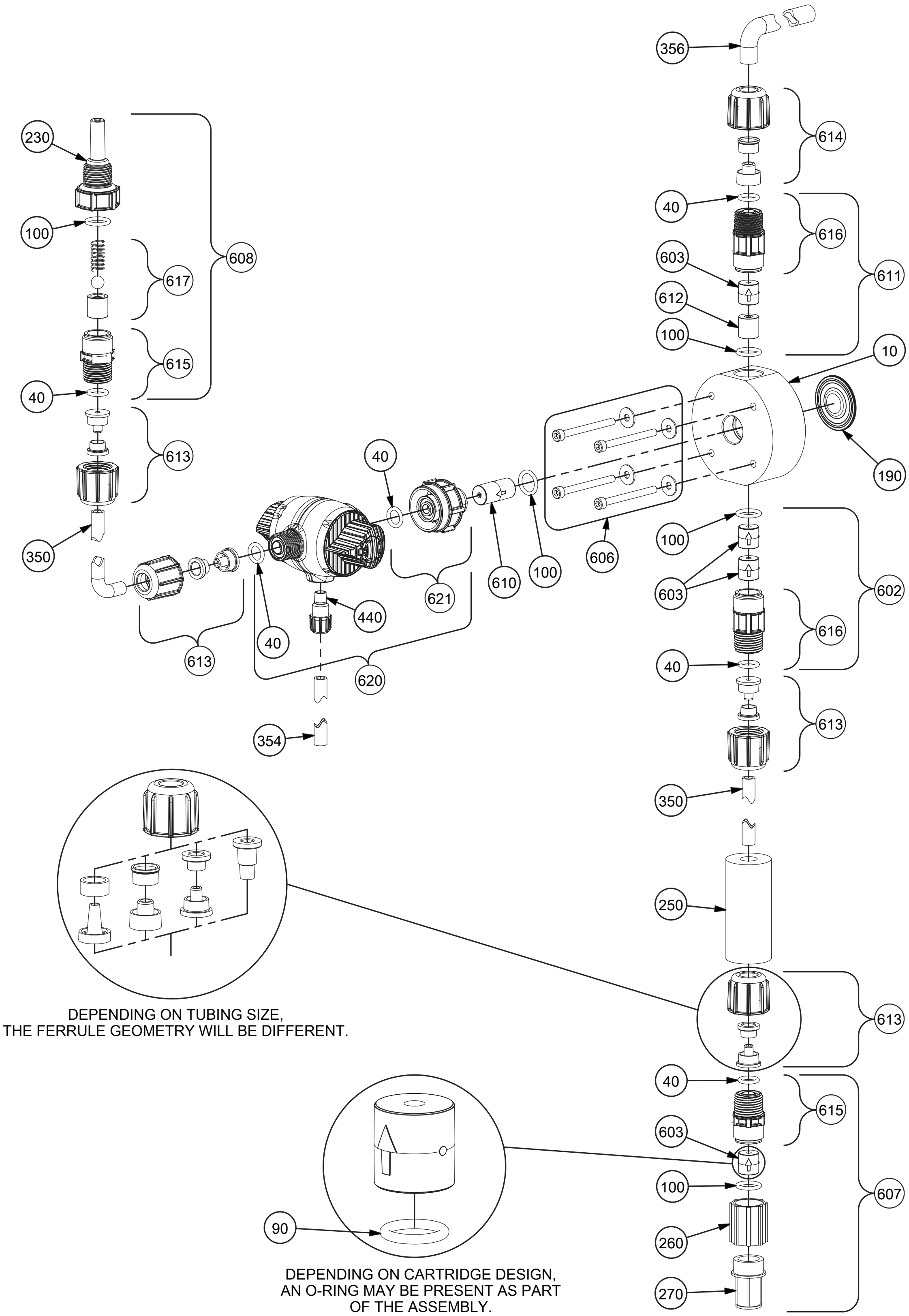
The following images are for reference and may not represent your particular liquid end.



DEPENDING ON TUBING SIZE,
THE FERRULE GEOMETRY WILL BE DIFFERENT.

DEPENDING ON CARTRIDGE DESIGN,
AN O-RING MAY BE PRESENT AS PART
OF THE ASSEMBLY.

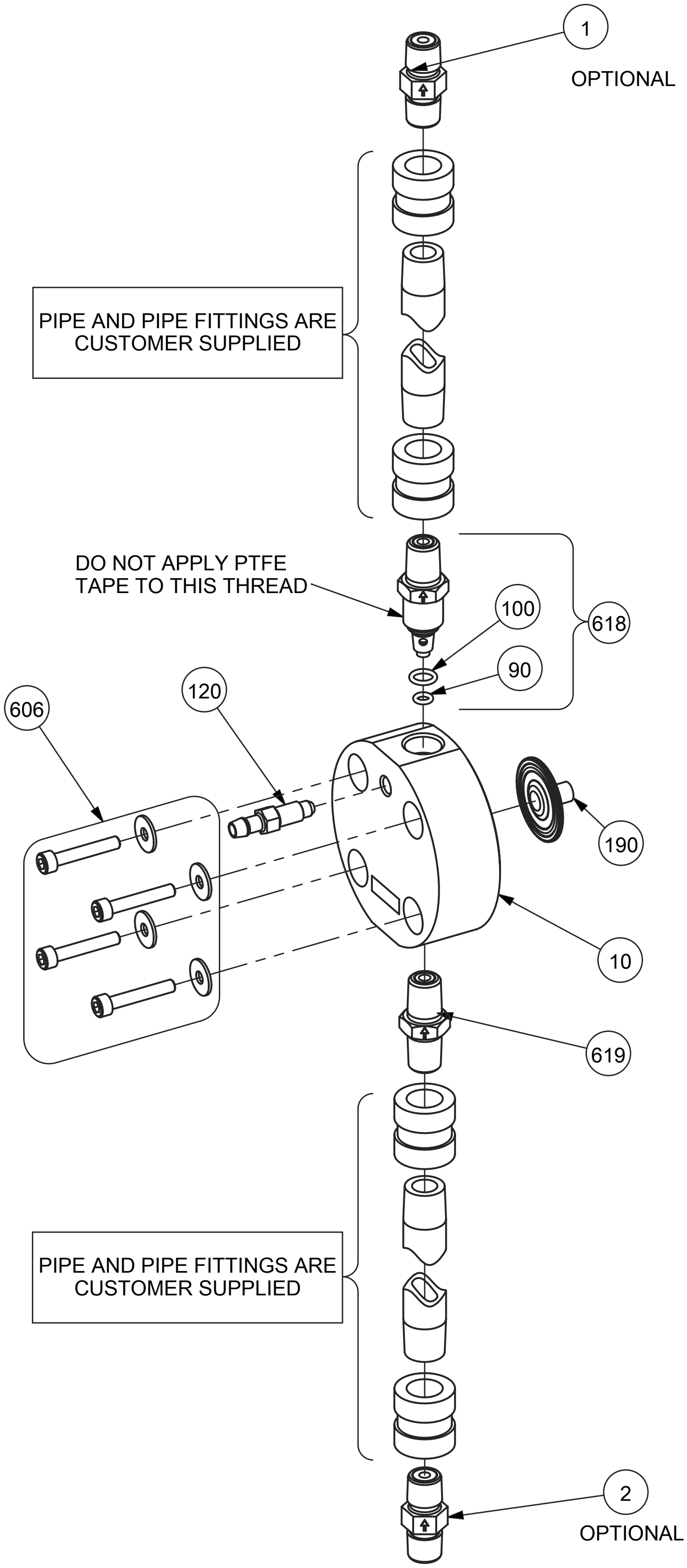
FastPrime™ Liquid End Assembly



DEPENDING ON TUBING SIZE,
THE FERRULE GEOMETRY WILL BE DIFFERENT.

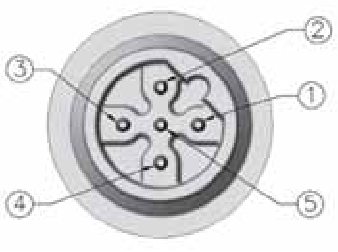
DEPENDING ON CARTRIDGE DESIGN,
AN O-RING MAY BE PRESENT AS PART
OF THE ASSEMBLY.

AutoPrime™ Liquid End Assembly



Stainless Steel Liquid End Assembly

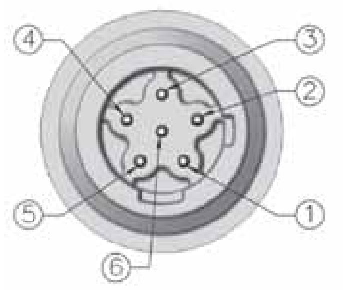
6.0 Wiring Diagrams



5 PIN CONNECTOR

USE 5 PIN CABLE (LMI P/N 48414)

PIN	WIRE	SIGNAL
1	Brown	Remote On-Off
2	White	Ground-Return
3	Blue	External Pulse Input
4	Black	Power Supply, 24V 75 mA
5	Green-Yellow	4-20 mA Input



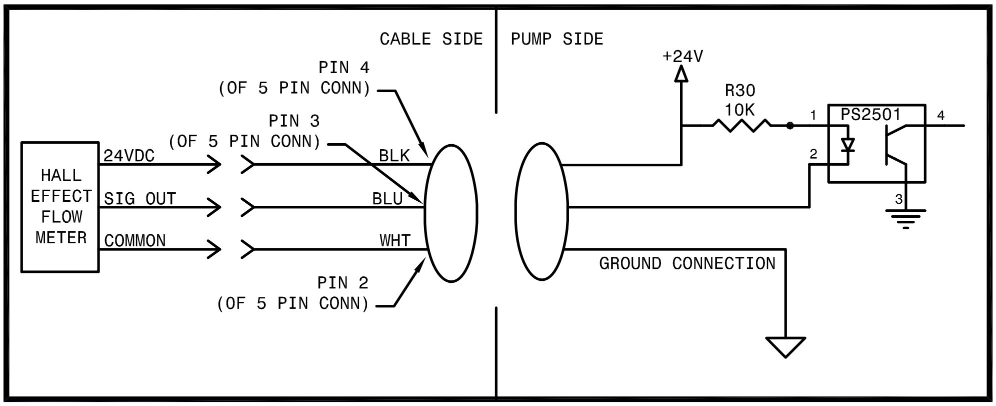
6 PIN CONNECTOR

USE 6 PIN CABLE (LMI P/N 49035)

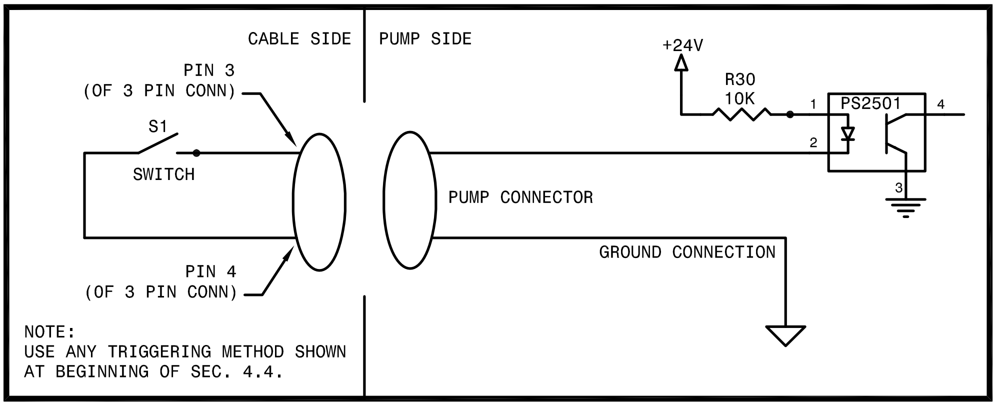
PIN	WIRE	SIGNAL
1	Red-White	Alarm Output or Internal-External indicator
2	Red	Alarm Return
3	Green	Remote Internal-External mode
4	Red-Yellow	Pulse Output
5	Red-Black	4-20 mA Output
6	Red-Blue	Ground-Return

INPUT WIRING DIAGRAMS

HALL EFFECT FLOWMETER
INPUT CONNECTION REFERENCE:



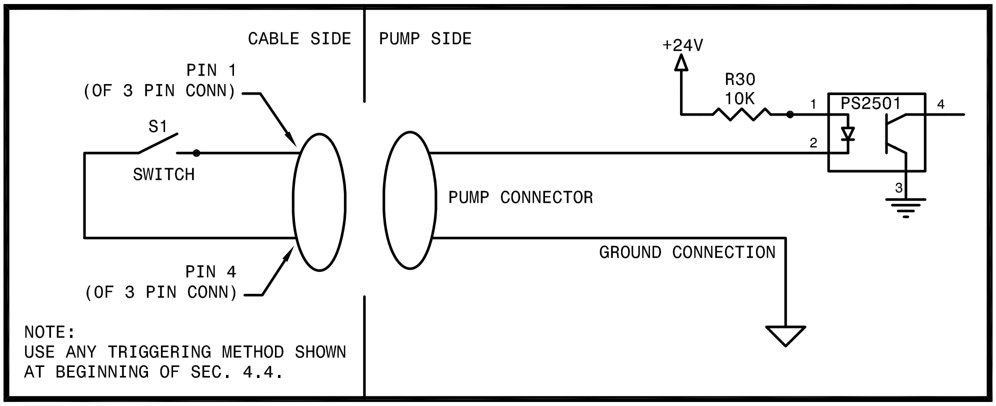
TANK LOW
INPUT CONNECTION REFERENCE:



NOTE:
USE ANY TRIGGERING METHOD SHOWN
AT BEGINNING OF SEC. 4.4.

NOTE: A CABLE CORD SET FOR THIS APPLICATION IS INCLUDED WITH AN OPTIONAL LMI DUAL LEVEL SWITCH ASSEMBLY P/N 49249

TANK EMPTY
INPUT CONNECTION REFERENCE:

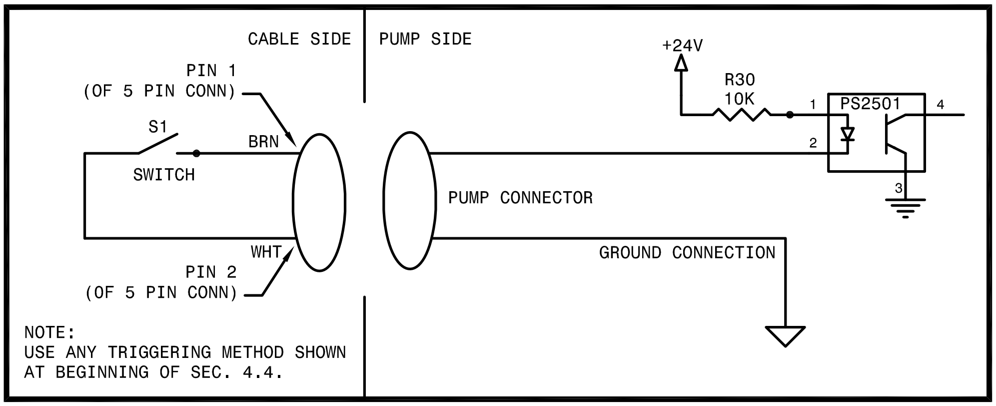


NOTE:
USE ANY TRIGGERING METHOD SHOWN
AT BEGINNING OF SEC. 4.4.

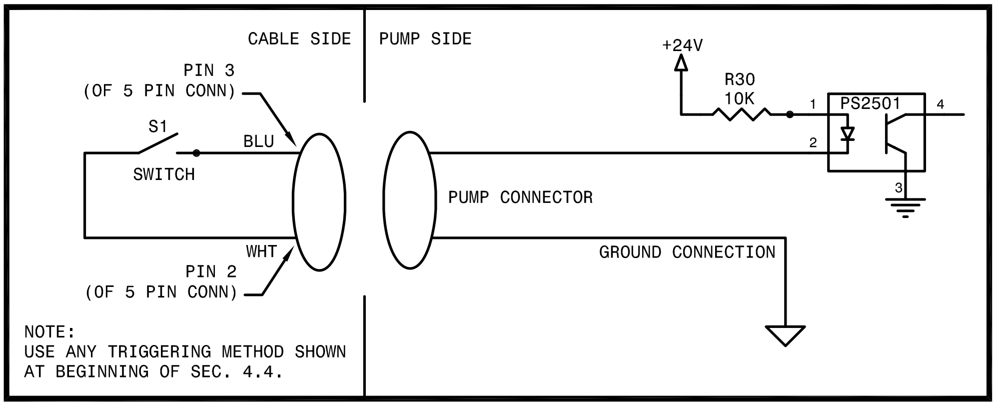
NOTE: A CABLE CORD SET FOR THIS APPLICATION IS INCLUDED WITH AN OPTIONAL LMI LOW LEVEL SWITCH ASSEMBLY P/N 49246 OR A LMI DUAL LEVEL SWITCH ASSEMBLY P/N 49249

INPUT WIRING DIAGRAMS

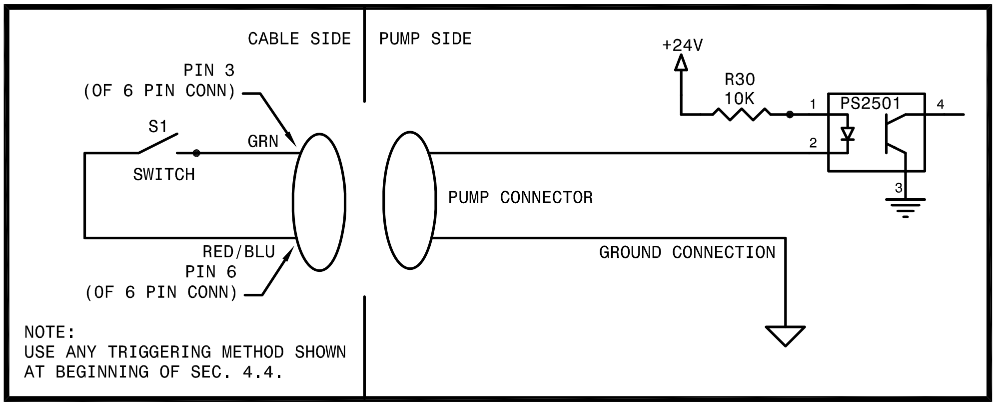
REMOTE ON-OFF INPUT CONNECTION REFERENCE:



EXTERNAL PULSE INPUT CONNECTION REFERENCE:

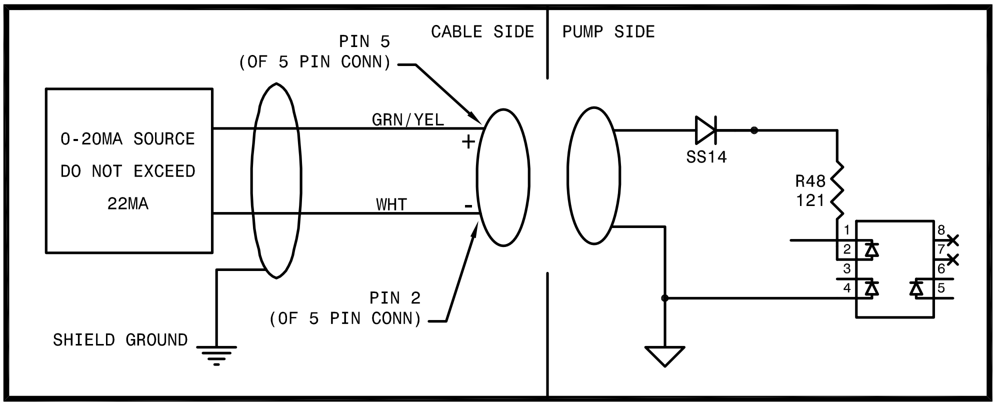


INTERNAL/EXTERNAL CONTROL INPUT CONNECTION REFERENCE:



INPUT WIRING DIAGRAM

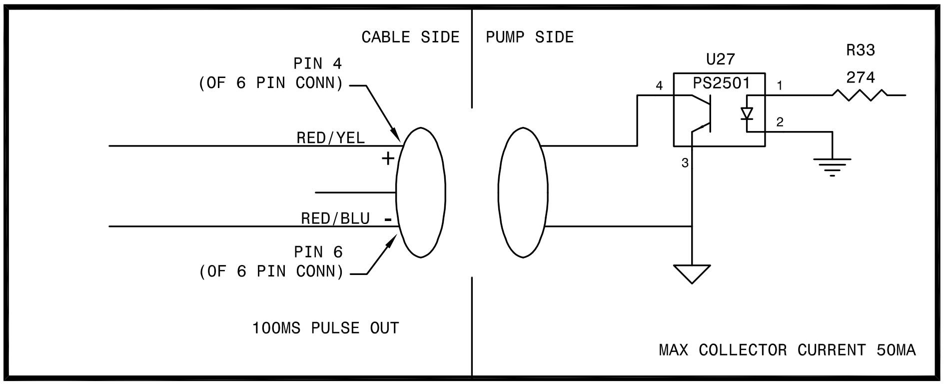
4-20 MA
INPUT CONNECTION REFERENCE:



NOTE: 0 TO 20 INPUT IMPEDENCE IS DYNAMIC AND WILL WORK WITH SUPPLY CURRENTS NEEDING 130 OHM OR ABOVE IMPEDENCE

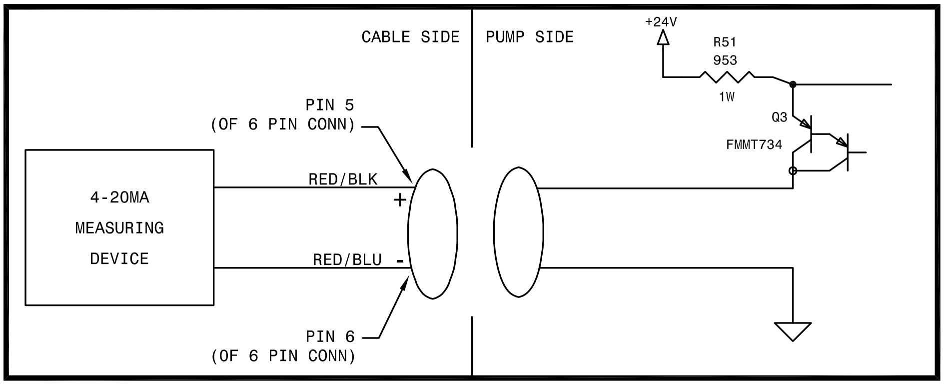
OUTPUT WIRING DIAGRAMS

PULSE
OUTPUT CONNECTION REFERENCE:

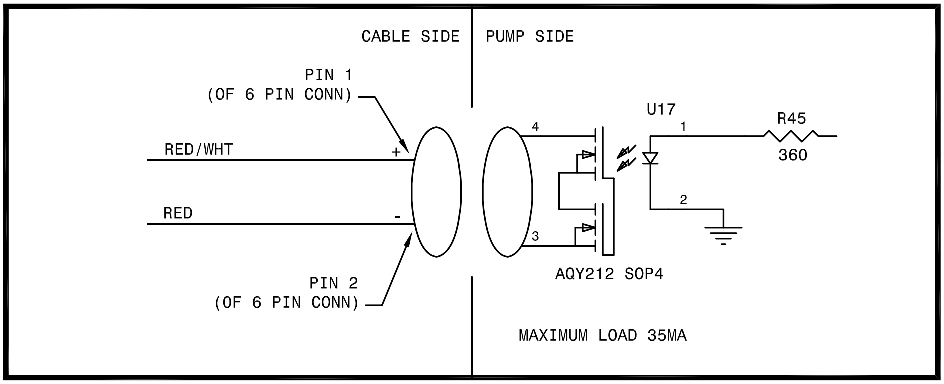


NOTE: WHEN USING A "PULL UP" OPTION USE A 10K RESISTOR AND A 24VDC SOURCE (CAN BE USED WITH PIN 5 OF 5 PIN CONN)

4 TO 20 MA
OUTPUT CONNECTION REFERENCE:



ALARM
OUTPUT CONNECTION REFERENCE:



NOTE: USE TO SWITCH ON 24V SOURCE OR LESS. DO NOT USE TO SWITCH ON AC LINE VOLTAGE WITHOUT RELAY. RELAY COILS SHOULD BE 24VDC OR LESS WITH MAXIMUM CURRENT OF 35MA.

7.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Pump Will Not Prime	1. Pump not turned on or plugged in.	1. Turn on pump/plug in pump.
	2. Output dials not set properly.	2. Always prime pump with speed and stroke at 100%.
	3. Foot Valve not in vertical position on bottom of tank.	3. Foot Valve must be vertical (see Foot Valve Installation, Section 3.7).
	4. Pump suction lift too high.	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing is curved or coiled in tank.	5. Suction tubing must be vertical. Use LMI ceramic weight supplied with pump (see Section 3.7).
	6. Fittings are over tightened.	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Air trap in suction valve tubing.	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 3.2.1).
	8. Too much pressure at discharge. (Pumps without multi-function valve.)	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 4.2). When pump is primed, reconnect discharge tubing.
	9. Air leak around fitting.	9. Check for missing or damaged O-rings at ends of fittings.
Pump Loses Prime	1. Solution container ran dry.	1. Refill container with solution and reprime (see Section 4.2).
	2. Foot Valve is not in a vertical position on the bottom of the tank.	2. Foot Valve must be vertical (see Foot Valve Installation, Section 3.7).
	3. Pump suction lift is too high.	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing is curved or coiled in tank.	4. Suction tubing must be vertical. Use LMI ceramic weight supplied with pump (see Section 3.7).
	5. Fittings are over tightened.	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Air trap in suction valve tubing.	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 3.2.1).
	7. Air leak on suction side.	7. Check for pinholes, cracks. Replace if necessary.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Leakage at tubing	1. Worn tubing ends.	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Loose or cracked fitting.	2. Replace fitting if cracked. Carefully hand tighten fittings. **DO NOT USE PIPE WRENCH.** An additional 1/8 or 1/4 turn may be necessary
	3. Worn seal rings.	3. Replace balls and seal rings (see Section 5.4)
	4. Solution attacking Liquid Handling Assembly	4. Consult your local distributor for alternate materials.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn Seal Rings.	2. Worn seal rings or cartridge valves may need replacement (see Section 5.4).
	3. Ruptured Liquifram™.	3. Replace Liquifram™ (see Section 5.3).
	4. Incorrect stroke length.	4. Recalibrate Output (see Section 4.3.2)
	5. Tubing run on discharge may be too long.	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Clogged Foot Valve strainer.	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
Failure to Run	1. Pump not turned on or plugged in.	1. Turn on or plug in pump.
	2. EPU failure.	2. Disassemble pump and measure resistance across the EPU terminals. If this measures as an open circuit then the EPU should be replaced. (see Section 5.8).
	3. Pulser failure.	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 3.4).
	2. Little or no pressure at injection point.	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 3.4).
	3. Excessive strokes per minute.	3. Replace pulser or resistor. Consult factory.

— NOTES —

— NOTES —

LMI
MILTON ROY

201 Ivyland Rd.
Ivyland, PA 18974
TEL: (215) 293-0401
FAX: (215) 293-0445
http://www.lmipumps.com

MATERIAL SAFETY
DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product: **HYPERFLOC® AE 800, AE 800 LLP Series**

Supplier:
HYCHEM, INC.
10014 N. Dale Mabry Highway, Suite 213
Tampa, FL 33618

Current Revision Date: 9/1/13 **Last Revision Date:** 9/1/10

Emergency Telephone Numbers:
(800) 327-2998 - Hychem, Inc. (weekdays)
(800) 424-9300 - Chemtrec (24 Hours)

2. HAZARDOUS IDENTIFICATION

Apperance and Odor:
Form: Viscous liquid
Color: Milky
Odor: Alipathic

Spills produce extremely slippery surfaces.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Family: Anionic water-soluble polymer in emulsion.

Hazardous Components:

4. FIRST AID MEASURES

Inhalation:	Move to fresh air.
Skin Contact:	Wash off immediately with soap and plenty of water. In case of skin irritation, consult a physician.
Eye Contact:	Rinse with plenty of water. If eye irritation persists, consult a specialist.
Ingestion:	The product is not considered toxic based on studies on laboratory animals.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release, and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process unless specified in the text.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media:	Water, water spray, foam, dry powder, carbon dioxide (CO_2)
Special Fire-Fighting Precautions:	Spills produce extremely slippery surfaces.
Special Protective Equipment for Firefighters:	No special protective equipment required.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions:	No special precautions required.
Environmental Precautions:	Avoid contaminating water.
Methods for Cleaning Up:	<u>Do not flush with water.</u> Dam up. Soak up with inert absorbent material. If liquid has been spilled in large quantities clean up promptly by scoop or vacuum. Keep in suitable and closed containers for disposal. <u>After cleaning</u>, flush away traces with water.

7. HANDLING AND STORAGE

Handling:	Avoid contact with skin and eyes. When preparing the working solution ensure there is adequate ventilation. When using do not smoke.
Storage:	Keep in a dry, cool place (0 - 30ºC). When preparing the working solution ensure there is adequate ventilation. Freezing will affect the physical condition and may damage the material.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls	Use local exhaust if misting occurs. Natural ventilation is adequate in absence of mists.

<u>Personal Protection Equipment</u>

- Respiratory Protection:	In case of insufficient ventilation and/or misty conditions, wear NIOSH approved organic filter respirator
- Hand Protection:	Rubber gloves.
- Eye Protection:	Safety glasses with side shields. Do not wear contact lenses.
- Skin and Body Protection:	Chemical resistant apron or protective suit if splashing or repeated contact with solution is likely.
Hygiene Measures:	Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form:	Viscous liquid
Color:	Milky
Odor:	Aliphatic
pH:	6 - 8 @ 5 g/l for product series. See Technical Bulletin for specific value.
Melting Point (ºC):	Not applicable
Flash Point (ºC):	Does not flash.
Autoignition Point (ºC):	Does not ignite.
Bulk Density:	1.03
Water Solubility:	See Technical Bulletin
Viscosity (mPa s):	See Technical Bulletin

10. STABILITY AND REACTIVITY

Stability:	Stable, no hazardous polymerization will occur.
Materials to Avoid:	Oxidizing agents may cause exothermic reactions.
Hazardous Decomposition Products:	Thermal decomposition may produce: carbon oxides and nitrogen oxides (NOx).

11. TOXICOLOGICAL INFORMATION

Acute toxicity:

- **Oral:**	LD50/oral/rat > 5000 mg/kg
- **Dermal:**	The product is not expected to be toxic in contact with the skin.
- **Inhalation:**	The product is not expected to be toxic by inhalation.

Irritation

- **Skin**	May cause skin irritation with susceptible persons.
- **Eyes:**	May cause eye irritation with susceptible persons.
Sensitization:	The product is not expected to be sensitizing.
Chronic Toxicity:	Prolonged skin contact may defat the skin and produce dermatitis.

12. ECOLOGICAL INFORMATION

- Fish:	LC50/96 hours > 100 mg/L (OECD 203) (Based on the toxicity of the components using the conventional method)
- Algae:	IC50/ Scenedesmus subspicatus72hr /> 100 mg/L (OECD 201) (Based on the toxicity of the components using the conventional method)
- Daphnia:	EC50/48 hr > 100mg/L (OECD 202) (Based on the toxicity of the components using the conventional method)
Bioaccumulation:	The product is not expected to bioaccumulate.
Persistence / Degradability:	Not readily biodegradable.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products:	In accordance with federal, state and local regulations.
Contaminated Packaging:	Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local regulations.

14. TRANSPORT INFORMATION

Not regulated by the Department of Transportation, IATA, IMDG.

15. REGULATORY INFORMATION

International Inventories:

European Union (EINECS/ELINCS): Existing polymer according to the definition in the 7th Amendement to Directive 67-548-EEC. All starting materials and additives are listed in EINECS.

USA (TSCA): All components of this product are either listed on the inventory or are exempt from listing.

Canada (DSL): All components of this product are either listed on the inventory or are exempt from listing.

Australia (AICS): All components of this product are either listed on the inventory or are exempt from listing.

Korea (ECL): All components of this product are either listed on the inventory or are exempt from listing.

China (IECSC): All components of this product are either listed on the inventory or are exempt from listing.

Japan (ENCS): All components of this product are either listed on the inventory or are exempt from listing.

Philippines (PICCS): All components of this product are either listed on the inventory or are exempt from listing.

RCRA status:	Not a hazardous waste.
Hazardous Waste Number:	Not applicable.
Reportable Quantity (40 CFR 302):	Not applicable.

Threshold Planning Quantity (40 CFR 355): Not applicable.

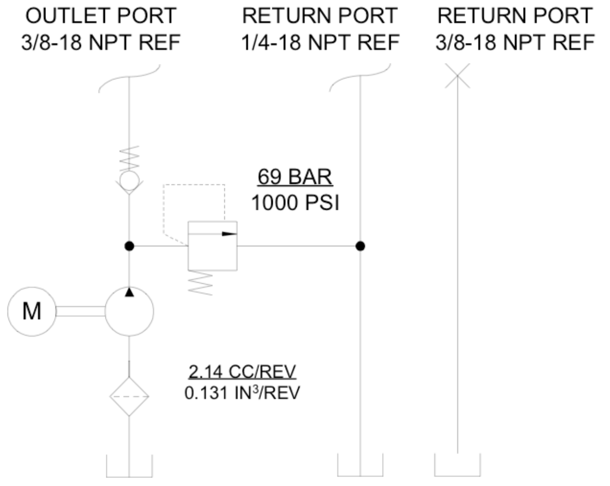
HMIS & NFPA Ratings:

	HMIS	**NFPA**
Health:	1	1
Flammability:	1	1
Reactivity:	0	0

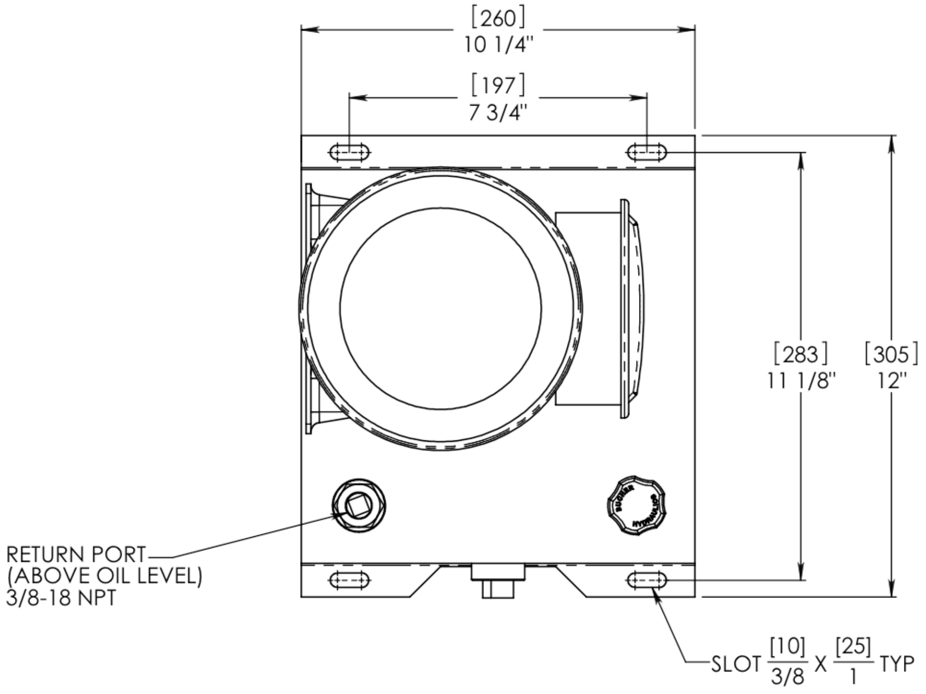
California Proposition 65 Information: The following statement is made in order to comply with the California Safe Drinking Water and Toxic Enforcement Act of 1986: This product contains a chemical(s) known to the State of California to cause cancer: residual acrylamide.

16. OTHER INFORMATION

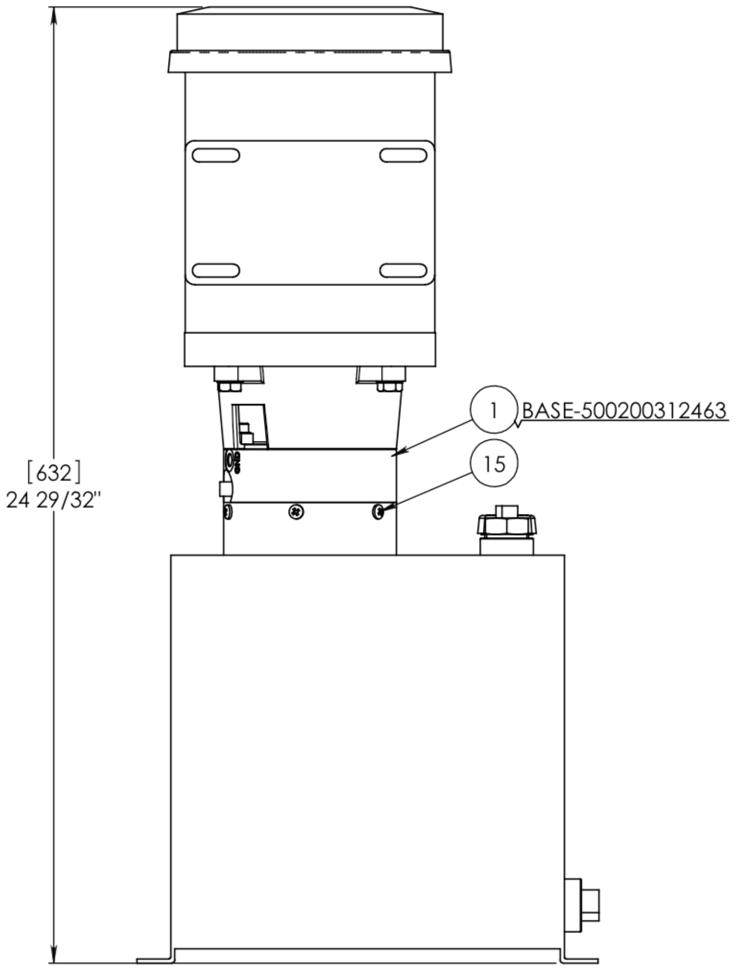
Person to Contact: A. Sands

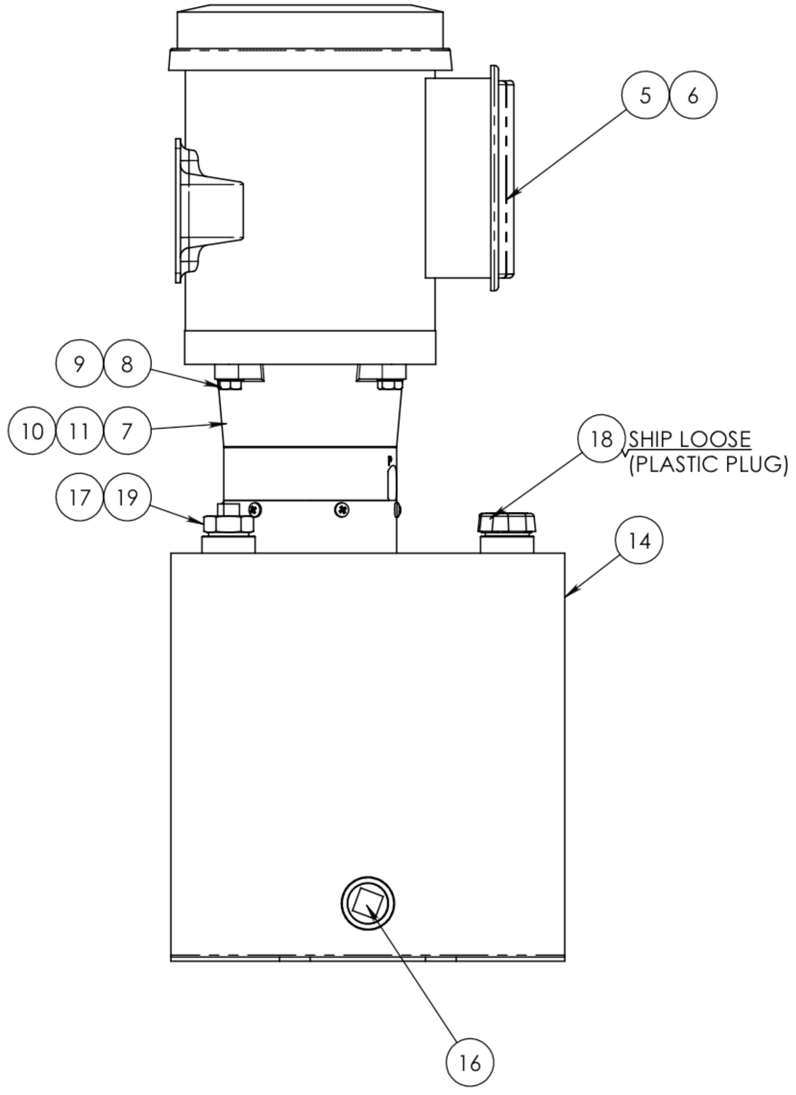


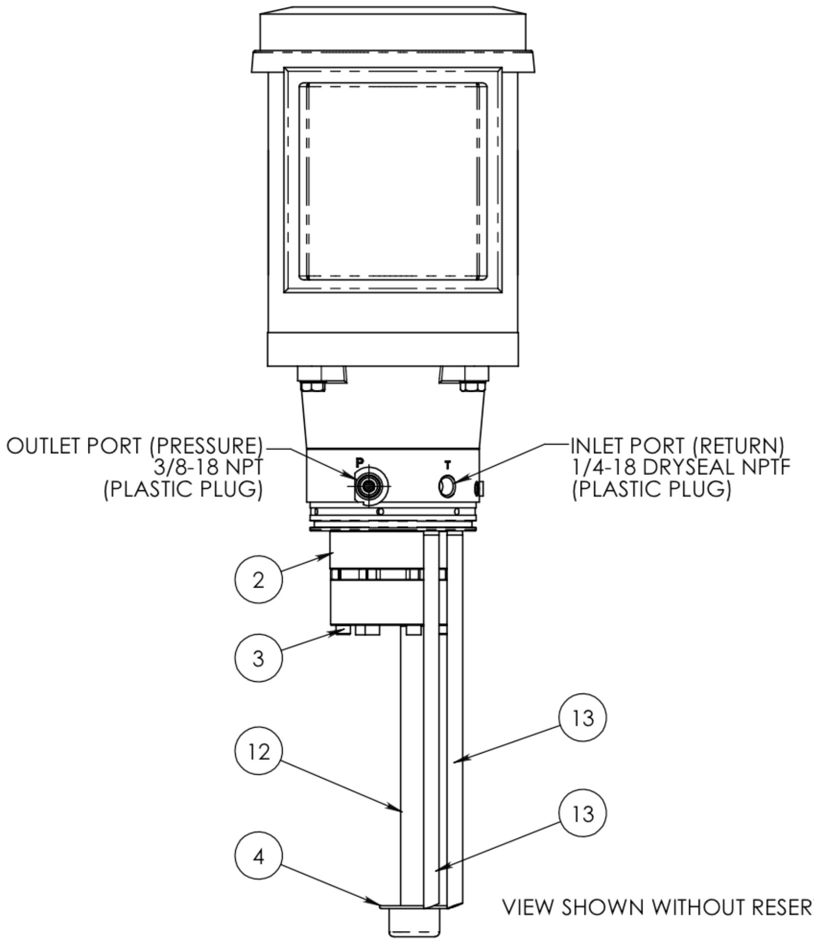
SCHEMATIC



ITEM NO	QTY	PART NO	DESCRIPTION
1	1	12462	BASE ASSY,M404,MOD,W/O MT
2	1	500216312172270	P ASSY,QM MDLR,AC,BRGS BLD RSV
3	4	500206907818	SCREW,SHC,1/4-20 X 3.0,BLK OX
4	1	500203201134	FILTER,SCREEN M-SERIES SUCT.
5	1	08744	MOTOR,AC,1HP,1725RPM,TEFC,SS
6	1	500212218002	COUPLING ASSY,L070,5/8X7/16
7	1	500204501605	HOUSING,PUMP/MOTOR ADAPT M-404
8	4	500206907817	SCREW,HHC,3/8-16 X 7/8,GRD2,ZI
9	4	500208607839	WASHER,INTERNAL TOOTH LOCK,3/8
10	4	500206907760	SCREW,SHC,1/4-20 X 1.0,BLK OX
11	4	500208607735	WASHER,INTERNAL TOOTH,1/4
12	1	500208301459085	TUBE,SUCT,STR,3/8 NPT,NYLON
13	2	500208301479100	TUBE,RTN,STR,1/8 NPT,NYLON
14	1	06881	RESV,10.25X10.25X10.25,M-400
15	6	500206907703	SCREW,SELF TAPPING,10-24 3/8
16	1	500205901075	PLUG,PIPE,SQ HD,5/8,3/4-14
17	1	500205901107	PLUG,SQUARE HEAD 3/8 NPT,ZINC
18	1	500205901143	PLUG,RESEV,BREATHER-FILLER
19	1	500200001807	ADAPTER,3/8 FX3/4 MX3/8 F







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.XX ± .020
.XXX ± .010
FRACT. ± 5/64
ANGLES ± 5°

BREAK EDGES
.005-.010
REMOVE BURRS

[MILLIMETER]
INCH

REV	DESCRIPTION

DESCRIPTION:
PUMP UNIT, M-4304-0130, VERT MT,
230/460/3 AC

SIZE: D
REV BY: -
REV DATE:

CUSTOMER:
AIRLINE HYDRAULICS

REV: AA

DATE: 2/29/2012
DRAWN BY: ALC
EWR: 17262

DRAWING #: 162
500430410130

SHEET 1 OF: 1

SPECIFICATION DATA

DISTRIBUTION TYPE			**YMM 8**	**YMM 12**	**YMM 20**	**YMM 32**	**YMM 40**	**YMM 50**
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[.50]	[.79]	[1.21]	[1.93]	[2.43]	[3.07]
		cm^3/rev.	**8.2**	**12.9**	**19.9**	**31.6**	**39.8**	**50.3**
MAX. SPEED RPM		RATED	1537	1256	814	513	452	358
		CONT.	1950	1550	1000	630	500	400
		INT.	**2450**	**1940**	**1250**	**800**	**630**	**500**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[71]	[115]	[168]	[274]	[327]	[292]
		N*M	**8**	**13**	**19**	**31**	**37**	**33**
	CONT.	[LB. IN.]	[97]	[142]	[221]	[354]	[398]	[407]
		N*M	**11**	**16**	**25**	**40**	**45**	**46**
	INT.	[LB. IN.]	[133]	[203]	[310]	[504]	[619]	[778]
		N*M	**15**	**23**	**35**	**57**	**70**	**88**
	PEAK	[LB. IN.]	[186]	[292]	[451]	[566]	[725]	[884]
		N*M	**21**	**33**	**51**	**64**	**82**	**100**
MAX. OUTPUT [HP] KW	RATED	[HP]	[1.7]	[2.3]	[2.3]	[2.3]	[2.3]	[1.6]
		KW	**1.3**	**1.7**	**1.7**	**1.7**	**1.7**	**1.2**
	CONT.	[HP]	[2.4]	[3.2]	[3.2]	[3.2]	[2.9]	[2.4]
		KW	**1.8**	**2.4**	**2.4**	**2.4**	**2.2**	**1.8**
	INT.	[HP]	[3.4]	[4.3]	[4.3]	[4.3]	[4.3]	[4.3]
		KW	**2.6**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[1305]	[1305]	[1305]	[1305]	[1232]	[870]
		MPa	**9**	**9**	**9**	**9**	**8.5**	**6**
	CONT.	[PSI]	[1450]	[1450]	[1450]	[1450]	[1305]	[1015]
		MPa	**10**	**10**	**10**	**10**	**9**	**7**
	INT.	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[2030]
		MPa	**14**	**14**	**14**	**14**	**14**	**14**
	PEAK	[PSI]	[2900]	[2900]	[2900]	[2320]	[2320]	[2320]
		MPa	**20**	**20**	**20**	**16**	**16**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[3.7]	[4.7]	[4.7]	[4.7]	[5.2]	[5.2]
		L/MIN	**14**	**18**	**18**	**18**	**20**	**20**
	CONT.	[GPM]	[4.2]	[5.2]	[5.2]	[5.2]	[5.2]	[5.2]
		L/MIN	**16**	**20**	**20**	**20**	**20**	**20**
	INT.	[GPM]	[5.2]	[6.6]	[6.6]	[6.6]	[6.6]	[6.6]
		L/MIN	**20**	**25**	**25**	**25**	**25**	**25**
WEIGHT [LB] KG		[LB]	[4]	[4]	[5]	[5]	[5]	[5]
		KG	**1.9**	**2**	**2.1**	**2.2**	**2.3**	**2.4**

- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Continuous pressure: Max. value of operating motor continuously.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

INDEX

YMM

The **YMM** series motors use the **spool valve** shaft distribution design for simplicity and efficiency. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This motor series uses the “**ROTOR**” gear type manufactured with most advanced technology and quality available to provide high torque and low speed. The gear set of the “rotor” multiplies the output torque without the need of gear reducers that could be required in many applications.

These motors are very compact, economical, powerful, efficient and are designed for medium duty applications.

The large number of displacements, mounting flanges, shafts, valving and other options available for these motors makes them a very flexible unit for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distribution	YMM	[in^3./rev]	[.50~3.07]	[PSI]	[1450]	RPM	[HP]	[3]
		cm^3/rev.	80 ~ 375	MPa	10	22~1950	Kw	2.4

QUICK REFERENCE GUIDE

YMM SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[.50]	8.2	FLOW UP TO	25 LPM	[6.61 GPM]
[.79]	12.9	PRESSURE UP TO	20 MPa	[2900 PSI]
[1.21]	19.9	TORQUE UP TO	100 Nm	[884 In. Lb.]
[1.93]	31.6	SPEED UP TO	2450	RPM
[2.43]	39.8			
[3.05]	50.03			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:
* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40^o C
* Different shafts are used when there at start a radial load or not. Check data pages
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YMM 8	YMM 12	YMM 20	YMM 32	YMM 40	YMM 50
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[.50]	[.79]	[1.21]	[1.93]	[2.43]	[3.07]
		cm^3/rev.	**8.2**	**12.9**	**19.9**	**31.6**	**39.8**	**50.3**
MAX. SPEED RPM		RATED	1537	1256	814	513	452	358
		CONT.	1950	1550	1000	630	500	400
		INT.	**2450**	**1940**	**1250**	**800**	**630**	**500**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[71]	[115]	[168]	[274]	[327]	[292]
		N*M	**8**	**13**	**19**	**31**	**37**	**33**
	CONT.	[LB. IN.]	[97]	[142]	[221]	[354]	[398]	[407]
		N*M	**11**	**16**	**25**	**40**	**45**	**46**
	INT.	[LB. IN.]	[133]	[203]	[310]	[504]	[619]	[778]
		N*M	**15**	**23**	**35**	**57**	**70**	**88**
	PEAK	[LB. IN.]	[186]	[292]	[451]	[566]	[725]	[884]
		N*M	**21**	**33**	**51**	**64**	**82**	**100**
MAX. OUTPUT [HP] KW	RATED	[HP]	[1.7]	[2.3]	[2.3]	[2.3]	[2.3]	[1.6]
		KW	**1.3**	**1.7**	**1.7**	**1.7**	**1.7**	**1.2**
	CONT.	[HP]	[2.4]	[3.2]	[3.2]	[3.2]	[2.9]	[2.4]
		KW	**1.8**	**2.4**	**2.4**	**2.4**	**2.2**	**1.8**
	INT.	[HP]	[3.4]	[4.3]	[4.3]	[4.3]	[4.3]	[4.3]
		KW	**2.6**	**3.2**	**3.2**	**3.2**	**3.2**	**3.2**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[1305]	[1305]	[1305]	[1305]	[1232]	[870]
		MPa	**9**	**9**	**9**	**9**	**8.5**	**6**
	CONT.	[PSI]	[1450]	[1450]	[1450]	[1450]	[1305]	[1015]
		MPa	**10**	**10**	**10**	**10**	**9**	**7**
	INT.	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[2030]
		MPa	**14**	**14**	**14**	**14**	**14**	**14**
	PEAK	[PSI]	[2900]	[2900]	[2900]	[2320]	[2320]	[2320]
		MPa	**20**	**20**	**20**	**16**	**16**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[3.7]	[4.7]	[4.7]	[4.7]	[5.2]	[5.2]
		L/MIN	**14**	**18**	**18**	**18**	**20**	**20**
	CONT.	[GPM]	[4.2]	[5.2]	[5.2]	[5.2]	[5.2]	[5.2]
		L/MIN	**16**	**20**	**20**	**20**	**20**	**20**
	INT.	[GPM]	[5.2]	[6.6]	[6.6]	[6.6]	[6.6]	[6.6]
		L/MIN	**20**	**25**	**25**	**25**	**25**	**25**
WEIGHT [LB] KG		[LB]	[4]	[4]	[5]	[5]	[5]	[5]
		KG	**1.9**	**2**	**2.1**	**2.2**	**2.3**	**2.4**

• Rated speed and rated torque:	Output value of speed and torque under rated flow and rated pressure.
• Continuous pressure:	Max. value of operating motor continuously.
• Intermittent pressure:	Max. value of operating motor in 6 seconds per minute.
• Peak pressure:	Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YMM 8 [0.50 in^3/rev] 8.2 cm^3/rev.

		[507] 3.5	[725] 5	[1015] 7	Max cont. [1450] 10	[1740] 12	Max int. [2030] 14	[PSI] MPa
GPM L/min	[0.53] 2	[27] 3 **228**	[44] 5 **218**	[71] 8 **206**	[88] 10 **156**	[106] 12 **111**	[124] 14 **58**	
Flow (L/min)	[1.1] 4	[27] 3 **474**	[44] 5 **471**	[62] 7 **463**	[97] 11 **426**	[115] 13 **391**	[133] 15 **331**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[2.1] 8	[27] 3 **953**	[44] 5 **946**	[62] 7 **926**	[97] 11 **884**	[115] 13 **855**	[133] 15 **816**	
	[3.2] 12	[18] 2 **1444**	[44] 5 **1426**	[62] 7 **1402**	[88] 10 **1360**	[115] 13 **1324**	[133] 15 **1288**	
Max cont	[3.9] 15		[35] 4 **1912**	[62] 7 **1900**	[88] 10 **1861**	[106] 12 **1833**	[124] 14 **1780**	Max cont.
Max int.	[5.3] 20		[0.00] 0 **2432**	[53] 6 **2395**	[88] 10 **2350**	[97] 11 **2328**	[124] 14 **2281**	Max int.

YMM 12.5 [0.79 in^3/rev] 12.9 cm^3/rev.

		[507] 3.5	[725] 5	[1015] 7	Max cont. [1450] 10	[1740] 12	Max int. [2030] 14	[PSI] MPa
GPM L/min	[0.53] 2	[53] 6 **140**	[71] 8 **136**	[97] 11 **119**	[142] 16 **68**	[168] 19 **35**		
Flow (L/min)	[1.1] 4	[53] 6 **296**	[71] 8 **289**	[106] 12 **274**	[150] 17 **229**	[168] 19 **200**	[203] 23 **145**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[2.1] 8	[44] 5 **605**	[71] 8 **596**	[106] 12 **583**	[150] 17 **543**	[177] 20 **514**	[212] 24 **469**	
	[3.2] 12	[44] 5 **912**	[71] 8 **905**	97] 11 **895**	[141] 16 **859**	[177] 20 **834**	[212] 24 **784**	
	[3.9] 15	[44] 5 **1152**	[62] 7 **1144**	[389] 44 **1136**	[407] 46 **1102**	[168] 19 **1078**	[203] 23 **1036**	
Max cont	[5.3] 20	[27] 3 **1542**	[62] 7 **1532**	[88] 10 **1521**	[133] 15 **1500**	[168] 19 **1482**	[195] 22 **1437**	Max cont.
Max int.	[6.6] 25	[18] 2 **1910**	[53] 6 **1891**	[80] 9 **1878**	[124] 14 **1848**	[159] 18 **1828**	[195] 22 **1788**	Max int.

YMM 20 [1.21 in^3/rev] 19.9 cm^3/rev.

		[246] 1.7	[507] 3.5	[725] 5	[1015] 7	Max cont. [1450] 10	[1740] 12	Max int. [2030] 14	[PSI] MPa
GPM L/min	[0.53] 2	[27] 3 **99**	[80] 9 **96**	[124] 14 **89**	[168] 19 **74**	[230] 26 **42**	[265] 30 **21**		
Flow (L/min)	[1.1] 4	[35] 4 **197**	[80] 9 **191**	[124] 14 **182**	[168] 19 **178**	[230] 26 **134**	[274] 31 **112**	[318] 36 **74**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[2.1] 8	[35] 4 **398**	[80] 9 **395**	[115] 13 **391**	[168] 19 **377**	[239] 27 **340**	[274] 31 **319**	[318] 36 **288**	
	[3.2] 12	[27] 3 **596**	[71] 8 **594**	[115] 13 **588**	[159] 18 **579**	[230] 26 **545**	[274] 31 **523**	[327] 37 **493**	
	[3.9] 15	[27 3 **745**	[71] 8 **741**	[106] 12 **738**	[150] 17 **728**	[221] 25 **695**	[265] 30 **684**	[318] 36 **660**	
Max cont	[5.3] 20	[9] 1 **998**	[53] 6 **995**	[97] 11 **991**	[168] 19 **985**	[212] 24 **962**	[256] 29 **1916**	[310] 35 **1885**	Max cont.
Max int.	[6.6] 25		[35] 4 **1247**	[80] 9 **1245**	[124] 14 **1242**	[203] 23 **1189**	[248] 28 **1180**	[292] 33 **1176**	Max int.

YMM 32 [1.93 in^3/rev] 31,6 cm^3/rev.

		[246] 2	[507] 3.5	[725] 5	[1015] 7	Max cont. [1450] 10	[1740] 12	Max int. [2030] 14	[PSI] MPa
GPM L/min	[0.53] 2	[62] 7 **61**	[133] 15 **57**	[186] 21 **52**	[248] 28 **47**	[354] 40 **16**			
Flow (L/min)	[1.1] 4	[62] 7 **126**	[133] 15 **121**	[186] 21 **114**	[256] 29 **106**	[363] 41 **82**	[424] 48 **67**	[504] 57 **49**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[2.1] 8	[62] 7 **250**	[133] 15 **244**	[186] 21 **239**	[256] 29 **231**	[363] 41 **207**	[433] 49 **194**	[513] 58 **167**	
	[3.2] 12	[53] 6 **378**	[115] 13 **374**	[177] 20 **369**	[248] 28 **362**	[354] 40 **338**	[424] 48 **322**	[513] 58 **297**	
	[3.9] 15	[35] 4 **476**	[106] 12 **472**	[159] 18 **468**	[239] 27 **462**	[345] 39 **441**	[415] 47 **429**	[504] 57 **406**	
Max cont	[5.3] 20	[27] 3 **633**	[88] 10 **630**	[150] 17 **627**	[221] 25 **619**	[327] 37 **601**	[407] 46 **585**	[486] 55 **566**	Max cont.
Max int.	[6.6] 25	[9] 1 **791**	[70] 8 **789**	[133] 15 **787**	[203] 23 **783**	[309] 35 **766**	[380] 43 **753**	[460] 52 **732**	Max int.

PERFORMANCE DATA

YMM 40 [2.43 in^3/rev] 39.8 cm^3/rev.

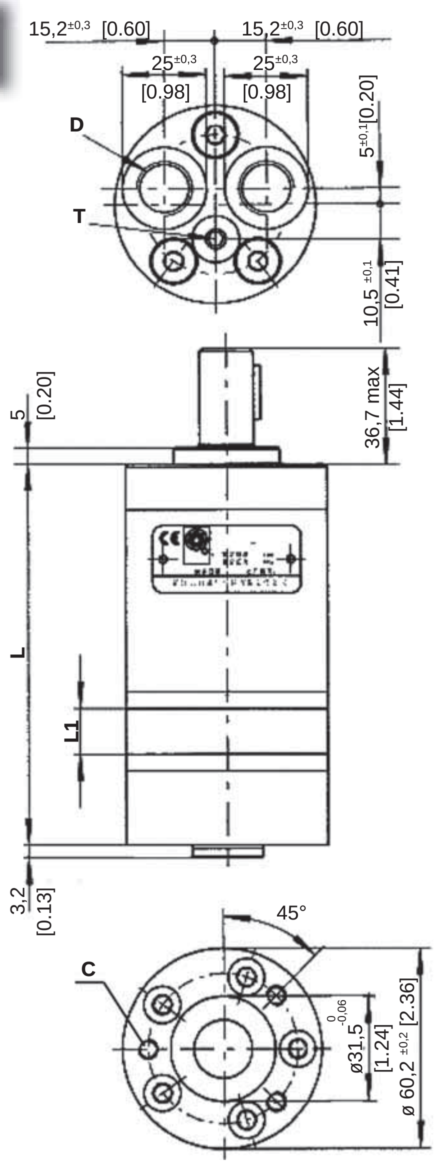
						Max cont.		Max int.	
			[435] 3	[725] 5	[1015] 7	[1232] 9	[1450] 10	[1740] 12	[PSI] MPa
GPM L/min	[0.53] 2		[142] 16 **45**	[239] 27 **40**	[318] 36 **34**	[389] 44 **28**	[451] 51 **17**		
	[1.1] 4		[142] 16 **96**	[239] 27 **93**	[327] 37 **85**	[389] 44 **79**	[460] 52 **65**	[548] 62 **52**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[2.1] 8		[133] 15 **197**	[230] 26 **195**	[319] 36 **182**	[389] 44 **176**	[460] 52 **166**	[557] 63 **154**	
	[3.2] 12		[124] 14 **293**	[221] 25 **287**	[310] 35 **282**	[380] 43 **277**	[451] 51 **268**	[548] 62 **257**	
	[3.9] 15		[115] 13 **371**	[212] 24 **365**	[301] 34 **360**	[371] 42 **355**	[442] 50 **347**	[548] 62 **338**	
Max cont	[5.3] 20		[88] 10 **497**	[186] 21 **492**	[274] 31 **487**	[345] 39 **480**	[425] 48 **472**	[522] 59 **463**	Max cont.
Max int.	[6.6] 25		[62] 7 **622**	[168] 19 **617**	[256] 29 **612**	[327] 37 **607**	[389] 44 **600**	[495] 56 **591**	Max int.

YMM 50 [3.07 in^3/rev] 50.3 cm^3/rev.

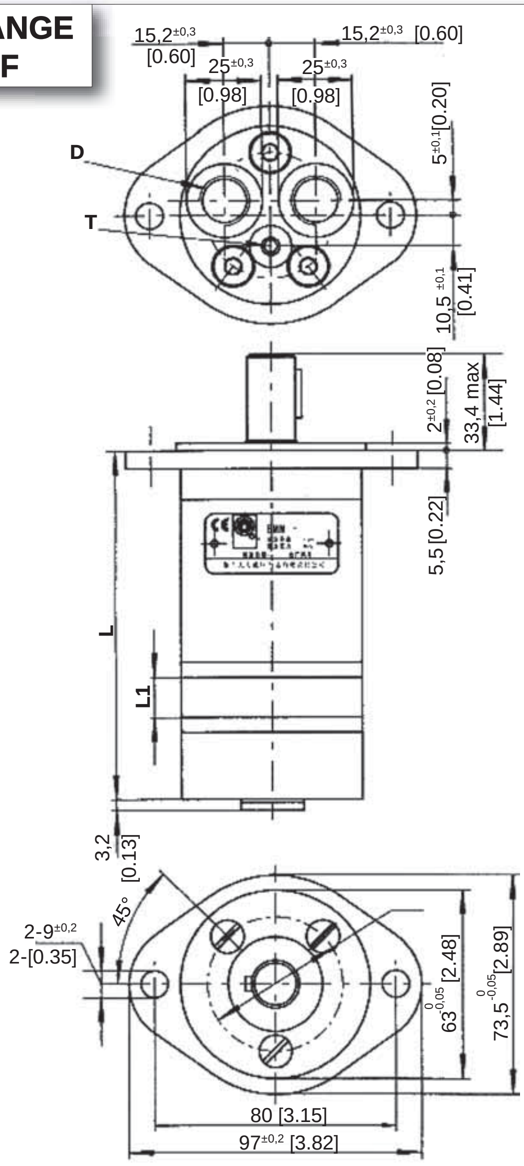
					Max cont.	Max int.	
		[217] 1.5	[435] 3	[725] 5	[1015] 7	[1450] 10	[PSI] MPa
GPM L/min	[0.53] 2	[97] 11 **37**	[203] 23 **33**	[318] 36 **27**	[442] 50 **22**		
	[1.1] 4	[97] 11 **76**	[195] 22 **73**	[318] 36 **68**	[442] 50 **63**	[619] 70 **55**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[2.1] 8	[97] 11 **157**	[186] 21 **154**	[310] 35 **149**	[442] 50 **145**	[628] 71 **137**	
	[3.2] 12	[97] 11 **237**	[177] 20 **234**	[292] 33 **231**	[433] 49 **226**	[628] 71 **218**	
	[3.9] 15	[88] 10 **296**	[159] 18 **295**	[283] 32 **294**	[416] 47 **288**	[610] 69 **282**	
Max cont	[5.3] 20	[71] 8 **395**	[124] 14 **395**	[256] 29 **393**	[389] 44 **390**	[566] 64 **381**	Max cont.
Max int.	[6.6] 25	[35] 4 **498**	[88] 10 **496**	[221] 25 **494**	[354] 40 **490**	[522] 59 **484**	Max int.

YMM END PORT DIMENSIONS AND MOUNTING DATA

FLANGE M - U



FLANGE F

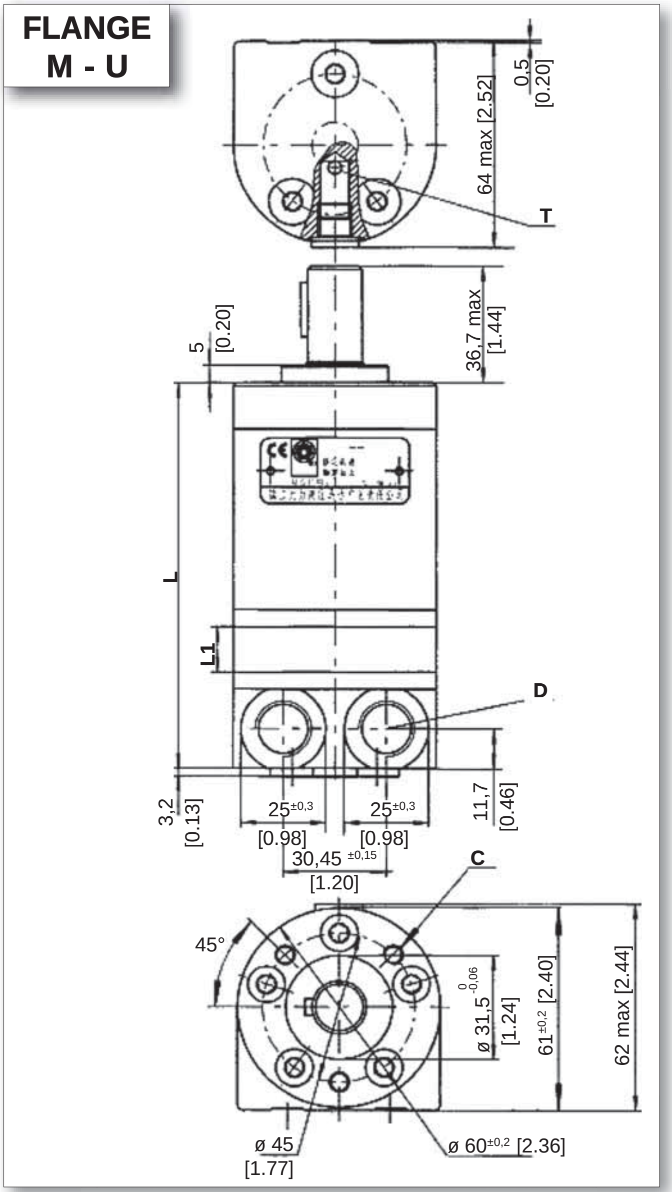


	M , U				F			
	[INCHES]		MM		[INCHES]		MM	
MODEL	**L**	**L1**	**L**	**L1**	**L**	**L1**	**L**	**L1**
YMM 8	[4.09]	[.14]	104	3.5	[4.21]	[.14]	107	3.5
YMM 12.5	[4.17]	[.22]]	106	5.5	[4.29]	[.22]	109	5.5
YMM 20	[4.29]	[.33]	109	8.5	[4.41]	[.33]	112	8.5
YMM 32	[4.49]	[.53]	114	13.5	[4.61]	[.53]	117	13.5
YMM 40	[4.65]	[.67]	118	17	[4.65]	[.67]	118	17
YMM 50	[4.80]	[.85]	122	21.5	[4.92]	[.85]	125	21.5

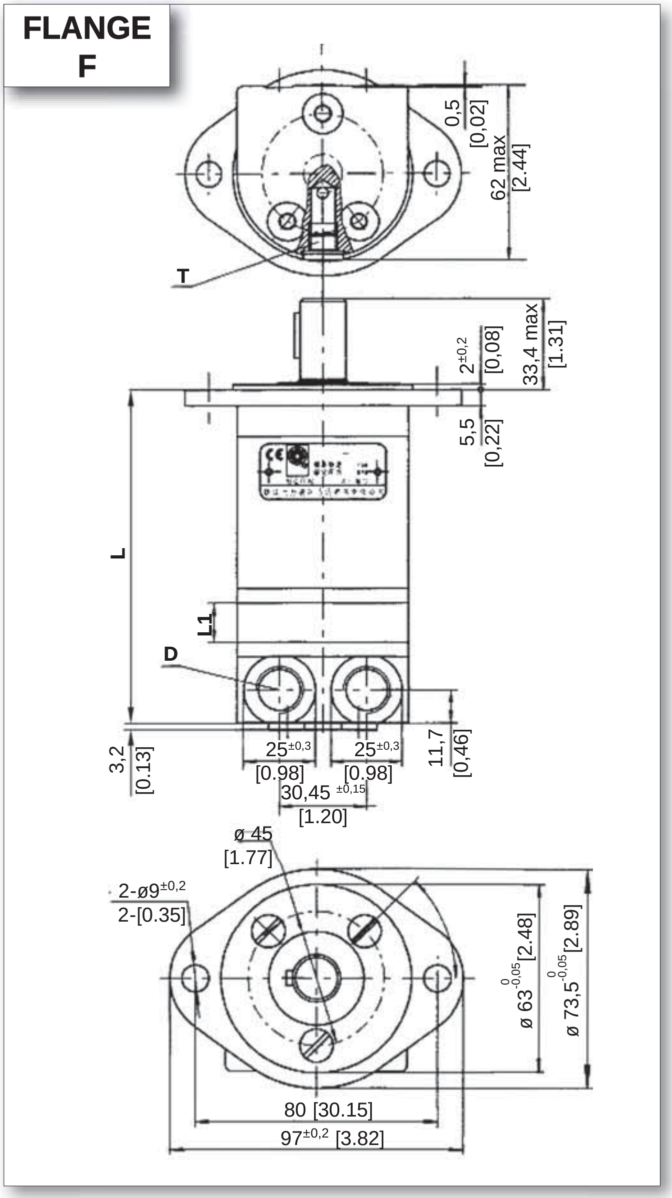
MOUNING CODE	M , U				F			
ORDERING CODE	**1E**	**DEPTH**	**1U**	**DEPTH**	**1E**	**DEPTH**	**1U**	**DEPTH**
C	M6	10 MM	1/4-28UNF-2B	10 MM				
D	G 3/8	12 MM	9/16-18 UNF	12 MM	G 3/8	12 MM	9/16-18UNF	12 MM
T	G 1/8	8 MM	3/8-24 UNF	8 MM	G 1/8	8 MM	3/8-24UNF	8 MM

YMM SIDE PORT DIMENSIONS AND MOUNTING DATA

FLANGE M - U



FLANGE F

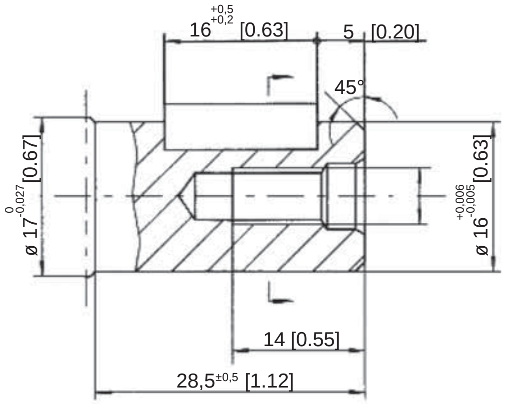


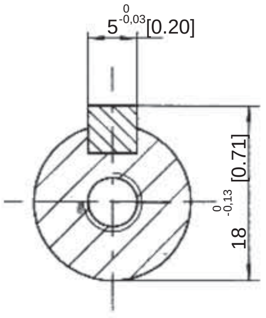
	M , U				F			
	[INCHES]		MM		[INCHES]		MM	
MODEL	**L**	**L1**	**L**	**L1**	**L**	**L1**	**L**	**L1**
YMM 8	[4.13]	[.14]	105	3.5	[4.29]	[.14]	109	3.5
YMM 12.5	[4.21]	[.22]	107	5.5	[4.37]	[.22]	111	5.5
YMM 20	[4.33]	[.33]	110	8.5	[4.49]	[.33]	114	8.5
YMM 32	[4.53]	[.53]	115	13.5	[4.69]	[.53]	119	13.5
YMM 40	[4.65]	[.67]	118	17	[4.65]	[.67]	118	17
YMM 50	[4.84]	[.85]	123	21.5	[5.00]	[.85]	127	21.5

MOUNING CODE	**M , U**				**F**			
ORDERING CODE	**E**	**DEPTH**	**U**	**DEPTH**	**E**	**DEPTH**	**U**	**DEPTH**
C	M6	10 mm	1/4-28UNF-2B	10 mm				
D	G 3/8	12 mm	9/16-18 UNF	12 mm	G 3/8	12 mm	9/16-18UNF	12 mm
T	G 1/8	8 mm	3/8-24 UNF	8 mm	G 1/8	8 mm	3/8-24UNF	8 mm

MOTOR SHAFT EXTENSIONS

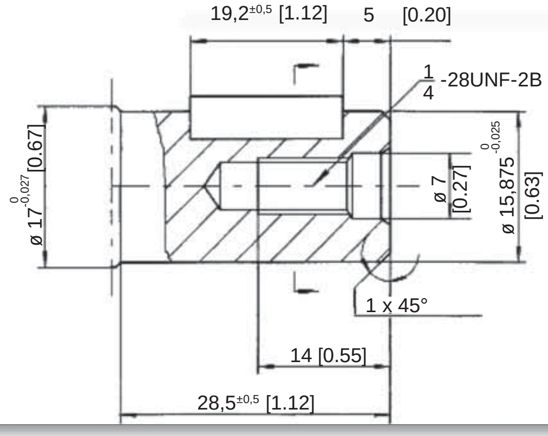
A

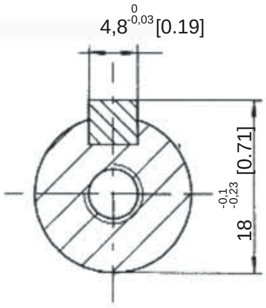




Shaft A: 16 mm Keyed
Parallel key 5x5x16

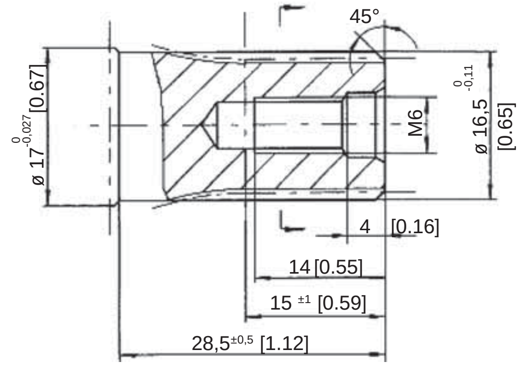
B

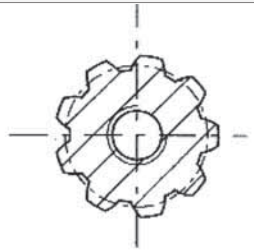




Shaft B:15.875 mm Keyed
Parallel key 4.8x4.8x19.35

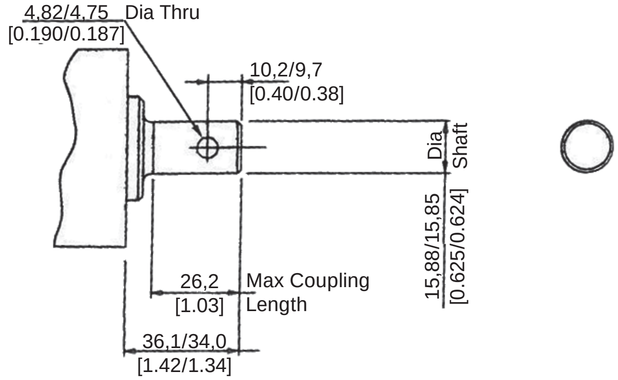
C





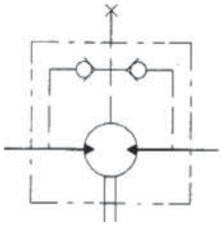
Shaft C: Involute splined shaft
B17x14 DIN5482

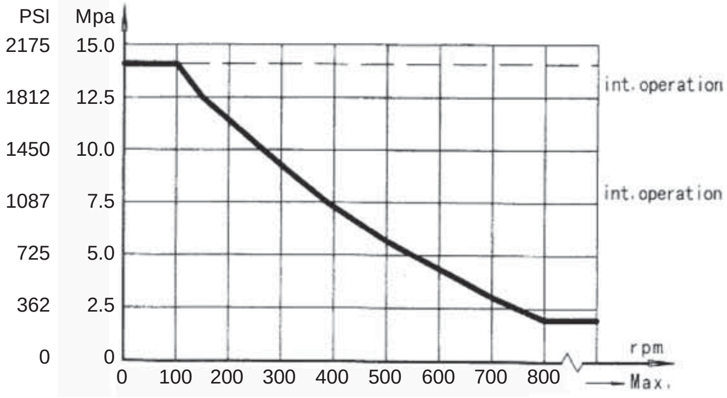
H



ADDITIONAL INFORMATION

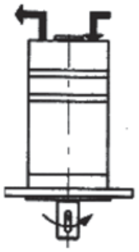
PERMISSIBLE SHAFT SEAL PRESSURE



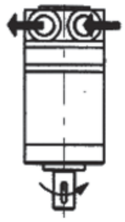


IN APPLICATIONS WITHOUT A DRAIN LINE,THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. APPLICATIONS USING A DRAIN LINE ,THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN THE DRAIN LINE.

SHAFT ROTATION DIREACTION



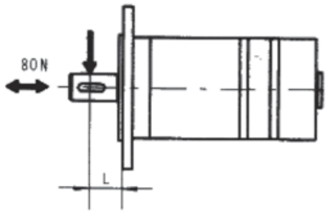
YMM



YMM

STATUS OF THE SHAFT'S RADIAL FORCE

$$F_r = \frac{130400}{61.5+L} \text{ N}$$



F_r =Radial Force (N)
L =Distance (mm)
n =Speed (rpm)
Rhomb-flange L=15mm
Square-flange L=20mm

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMM							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
8	**M**	3-M6 Round Flange Pilot Ø 31.5X5	**A**	Shaft Ø 16, Parallel Key 5x5x16	**E**	Side Port G 3/8, G 1/8	**N0NE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
12.5	**U**	3-1/4-28 UNF Round Flange Pilot Ø 31.5X5	**B**	Shaft Ø 15.875, Parallel Key 4.8x4.8x19.35	**U**	Side Port 9/16-18 UNF, 3/8-24 UNF	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
16	**F**	2- Ø 9 Rhomb-Flange, Pilot Ø 63x2	**C**	Shaft Ø 16.5 Splined Involute B17x14 Din5482	**IE**	End Port Back Port G 3/8, G 1/8			**B**	BLACK	**LL**	LOW LEAKAGE VALVE
20			**H**	Shaft 15.815 ø Straight w/cross hole 4.82/4.25 (.1901/.187)	**IU**	End Port Back Port 9/16-18 UNF, 3/8-24 UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
32											**CRS**	CORROSION RESISTANT SHAFT
40											**HPS**	HIGH PRESSURE SEAL
50											**HTS**	HIGH TEMP SEAL

Ordering code:
All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

YMP

The **YMP** series motors use the spool valve shaft distribution design for simplicity and efficiency. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This motor series uses the “**ROTOR**” gear type manufactured with most advanced technology and quality available to provide high torque and low speed. The gear set of the “rotor” multiplies the output torque without the need of gear reducers that could be required in many applications.

These motors are very compact, economical, powerful, efficient and are designed for medium duty applications.

The large number of displacements, mounting flanges, shafts, valving and other options available for these motors makes them a very flexible unit for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distribution	YMP	[in^3./rev]	[2.18~24.41]	[PSI]	[2400]	RPM	[HP]	[27]
		cm^3/rev.	36 ~ 400	MPA	16.5	30~879	Kw	10

QUICK REFERENCE GUIDE

YMP SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[2.18]	36			
[3.15]	51.7	FLOW UP TO	75 LPM	[20 GPM]
[4.74]	77.7	PRESSURE UP TO	16.5 MPa	[2392 PSI]
[5.87]	96.2	TORQUE UP TO	533 Nm	[4847 Lb.In.]
[7.19]	117.9	SPEED UP TO	975 RPM	
[9.49]	155.5			
[11.59]	189.9			
[14.10]	231			
[19.00]	311.7			
[23.57]	386.2			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

- Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40^o C
- Different shafts are used when there is a radial load or not. Check data pages
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YMP 36	YMP 50	YMP 80	YMP 100	YMP 125	YMP 160	YMP 200	YMP 250	YMP 315	YMP 400
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[2.20]	[3.15]	[4.74]	[5.87]	[7.19]	[9.49]	[11.59]	[14.10]	[19.01]	[23.57]
		cm^3/rev.	36	51.7	77.7	96.2	117.9	155.5	189.9	231	311.7	386.2
MAX. SPEED RPM		RATED	1050	850	650	520	390	310	260	200	156	130
		CONT.	1078	879	740	589	475	370	296	237	189	149
		INT.	1210	975	827	673	594	463	370	297	236	185
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[486]	[716]	[1141]	[1424]	[1786]	[1804]	[2291]	[2874]	[3051]	[3847]
		N*M	55	81	129	161	202	204	259	325	345	435
	CONT.	[LB. IN.]	[486]	[716]	[1141]	[1423]	[1786]	[2167]	[2529]	[3184]	[3591]	[4847]
		N*M	55	81	129	161	202	245	286	360	406	435
	INT.	[LB. IN.]	[672]	[955]	[1512]	[1884]	[2370]	[3025]	[3449]	[4033]	[4466]	[4714]
		N*M	76	108	171	213	268	342	390	456	505	533
MAX. OUTPUT [HP] KW	RATED	[HP]	[8]	[9]	[12]	[12]	[11]	[9]	[9]	[9]	[7]	[8]
		KW	6	7	8.6	8.6	8	6.5	6.9	6.6	5.5	5.8
	CONT.	[HP]	[8]	[9]	[12]	[12]	[12]	[12]	[11]	[11]	[10]	[10]
		KW	6	7	9.1	9	9.1	8.7	8.1	8.2	7.2	6.1
	INT.	[HP]	[10]	[12]	[16]	[16]	[16]	[16]	[15]	[14]	[12]	[10]
		KW	8	8.9	11.8	11.9	11.8	11.9	10.9	10.1	8.6	7.2
MAX. PRES-SURE DROP [PSI] MPa	RATED	[PSI]	[1812]	[1812]	[1812]	[1812]	[1812]	[1450]	[1450]	[1450]	[1232]	[1232]
		MPa	12.5	12.5	12.5	12.5	12.5	10	10	10	8.5	8.5
	CONT.	[PSI]	[1812]	[1812]	[1812]	[1812]	[1812]	[1812]	[1595]	[1595]	[1595]	[1450]
		MPa	12.5	12.5	12.5	12.5	12.5	12.5	11	11	11	10
	INT.	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPa	16.5	16.5	16.5	16.5	16.5	16.5	16.5	14	12.5	10.5
	PEAK	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPa	16.5	16.5	16.5	16.5	16.5	16.5	16.5	14	12.5	10.5
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[10.4]	[11.8]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]
		L/MIN	40	45	55	55	55	55	55	55	55	55
	CONT.	[GPM]	[10.4]	[11.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	40	45	60	60	60	60	60	60	60	60
	INT.	[GPM]	[11.8]	[13.2]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	45	50	75	75	75	75	75	75	75	75
WEIGHT [LB] KG		[LB]	[12]	[12]	[13]	[13]	[13]	[14]	[14]	[15]	[15]	[16]
		KG	5.6	5.6	5.7	5.9	6	6.2	6.4	6.6	6.9	7.4

* Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
* Continuous pressure: Max. value of operating motor continuously.
* Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
* Peak pressure: Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YMP 36 [2.19 in³/rev] 36 cm³/rev.

	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	Max cont. [1813] 12	Max int. [2493] 16.5
GPM L/ min	[2.1] 8	[115] 13 **214**	[212] 24 **205**	[256] 29 **200**	[301] 34 **194**	[380] 43 **187**	[424] 48 **179**	[486] 55 **168**	[654] 74 **138**
Flow (L/min)	[4.0] 15	[115] 13 **406**	[221] 25 **398**	[256] 29 **391**	[301] 34 **383**	[380] 43 **374**	[424] 48 **353**	[495] 56 **353**	[663] 75 **324**
	[5.3] 20	[115] 13 **541**	[212] 24 **534**	[256] 29 **528**	[301] 34 **521**	[380] 43 **513**	[424] 48 **500**	[495] 56 **486**	[627] 76 **458**
	[7.9] 30	[106] 12 **814**	[212] 24 **804**	[256] 29 **792**	[301] 34 **778**	[380] 43 **763**	[424] 48 **749**	[495] 56 **726**	[672] 76 **701**
	[9.2] 35	[106] 12 **952**	[203] 23 **944**	[248] 28 **930**	[301] 34 **913**	[380] 43 **897**	[424] 48 **879**	[495] 56 **858**	[672] 76 **833**
Max cont	[11.9] 45	[106] 12 **1090**	[203] 23 **1078**	[248] 28 **1064**	[283] 32 **1048**	[362] 41 **1024**	[415] 47 **998**	[486] 55 **977**	[663] 75 **943**
Max int.	[13.2] 50	[97] 11 **1232**	[194] 22 **1218**	[230] 26 **1196**	[283] 32 **1175**	[362] 41 **1149**	[407] 46 **1118**	[477] 54 **1080**	[654] 74 **1044**

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMP 50 [3.15 in³/rev] 51.7 cm³/rev.

	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	Max cont. [1813] 12	Max int. [2393] 16
GPM L/ min	[2.1] 8	[150] 17 **154**	[336] 38 **149**	[389] 44 **144**	[442] 50 **141**	[557] 63 **135**	[619] 70 **129**	[699] 79 **123**	[920] 104 **92**
Flow (L/min)	[4.0] 15	[168] 19 **292**	[336] 38 **286**	[389] 44 **238**	[442] 50 **277**	[566] 64 **273**	[628] 71 **267**	[708 80 **262**	[929] 105 **231**
	[5.3] 20	[150] 17 **390**	[336] 38 **385**	[389] 44 **382**	[451] 51 **376**	[566] 64 **374**	[628] 71 **367**	[708] 80 **360**	[946] 107 **332**
	[7.9] 30	[142] 16 **586**	[327] 37 **579**	[389] 44 **572**	[442] 50 **568**	[566] 64 **562**	[628] 71 **556**	[716] 81 **546**	[955] 108 **516**
	[9.2] 35	[133] 15 **683**	[318] 36 **675**	[380] 43 **670**	[442] 50 **663**	[557] 63 **656**	[628] 71 **647**	[708] 80 **641**	[946] 107 **614**
Max cont	[11.9] 45	[124] 14 **879**	[301] 34 **868**	[371] 42 **862**	[433] 49 **855**	[557] 63 **849**	[619] 70 **840**	[708] 80 **833**	[946] 107 **799**
Max int.	[13.2] 50	[115] 13 **975**	[292] 33 **962**	[363] 41 **955**	[425] 48 **949**	[548] 62 **943**	[601] 68 **937**	[699] 79 **927**	

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMP 80 [4.74 in³/rev] 77.7 cm³/rev.

	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	Max cont. [1814] 12	Max int. [2394] 16
GPM L/ min	[2.1] 8	[256] 29 **97**	[531] 60 **94**	[619] 70 **91**	[708] 80 **88**	[893] 101 **84**	[982] 111 **79**	[1132] 128 **74**	[1486] 168 **50**
Flow (L/min)	[4.0] 15	[256] 29 **184**	[539] 61 **181**	[628] 71 **178**	[716] 81 **175**	[893] 101 **171**	[1008] 114 **167**	[1141] 129 **162**	[1503] 170 **140**
	[5.3] 20	[248] 28 **247**	[531] 60 **243**	[628] 71 **241**	[716] 81 **238**	[893] 101 **235**	[931] 112 **231**	[1141] 129 **225**	[1503] 170 **205**
	[7.9] 30	[221] 25 **370**	[515] 58 **366**	[610] 69 **363**	[699] 79 **360**	[884] 100 **356**	[982] 111 **351**	[1132] 128 **346**	[1512] 171 **323**
	[9.2] 35	[212] 24 **432**	[504] 57 **427**	[601] 68 **424**	[690] 78 **421**	[876] 99 **416**	[973] 110 **412**	[1114] 126 **407**	[1512] 171 **387**
	[11.9] 45	[195] 22 **555**	[478] 54 **550**	[584] 66 **546**	[681] 77 **542**	[858] 97 **538**	[964] 109 **532**	[1097 124 **528**	[1495] 169 **503**
	[13.2] 50	[177] 20 **616**	[469] 53 **609**	[566] 64 **606**	[633] 75 **603**	[849] 96 **599**	[946] 107 **594**	[1088] 123 **588**	[1486] 168 **561**
Max cont	[15.8] 60	[168] 19 **740**	[460] 52 **732**	[557] 63 **727**	[654] 74 **723**	[840] 95 **718**	[946] 107 **713**	[1088] 123 **707**	[1486] 168 **675**
Max int.	[19.8] 75	[142 16 **827**	[416] 47 **820**	[522] 59 **817**	[637] 72 **813**	[805] 91 **808**	[929] 105 **804**	[1070] 121 **796**	

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMP 100 [5.87 in³/rev] 96.2 cm³/rev.

	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	Max cont. [1813] 12	Max int. [2393] 16
GPM L/ min	[2.1] 8	[318] 36 **78**	[663] 75 **75**	[778] 88 **73**	[893] 101 **70**	[1114] 126 **63**	[1247] 141 **67**	[1415] 160 **56**	[1857] 210 **34**
Flow (L/min)	[4.0] 15	[310] 35 **149**	[663] 75 **145**	[787] 89 **143**	[893] 101 **141**	[1132] 128 **137**	[1247] 141 **134**	[1415] 160 **129**	[1884] 213 **109**
	[5.3] 20	[292] 33 **199**	[654] 74 **196**	[778] 88 **195**	[893] 101 **191**	[1114] 126 **189**	[1238] 140 **185**	[1424] 161 **179**	[1875] 212 **161**
	[7.9] 30	[274] 31 **299**	[637] 72 **296**	[752] 85 **293**	[867] 98 **291**	[1088] 123 **288**	[1212] 137 **284**	[1386] 157 **280**	[1884] 213 **259**
	[9.2] 35	[256] 29 **349**	[610] 69 **345**	[734] 83 **344**	[849] 96 **341**	[1070] 121 **337**	[1194] 135 **335**	[1371] 155 **330**	[1875] 212 **310**
	[11.9] 45	[248] 28 **449**	[584] 66 **445**	[716] 81 **442**	[831] 94 **439**	[1052] 119 **435**	[1176] 133 **432**	[1353] 153 **428**	[1840] 208 **405**
	[13.2] 50	[212] 24 **498**	[575] 65 **493**	[690] 78 **491**	[822] 93 **490**	[1565] 117 **486**	[1167] 132 **481**	[1344] 152 **477**	[1831] 207 **457**
Max cont	[15.8] 60	[203] 23 **598**	[557] 63 **593**	[681] 77 **589**	[814] 92 **587**	[1026] 116 **583**	[1158] 131 **578**	[1335] 151 **573**	[1831] 207 **549**
Max int.	[19.8] 75	[177] 20 **673**	[504] 57 **667**	[654] 74 **664**	[778] 88 **661**	[999] 113 **657**	[1141] 129 **654**	[1327] 150 **648**	

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

PERFORMANCE DATA

YMP 125 [7.19 in^3/rev] 117,9 cm^3/rev.

								Max cont.	Max int.	
		[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	[1813] 12	[2393] 16	[PSI] MPa
GPM L/ min	[2.1] 8	[398] 45 **62**	[831] 94 **60**	[982] 111 **59**	[1123] 127 **56**	[1397] 158 **54**	[1557] 176 **50**	[1778] 201 **46**	[2326] 263 **26**	
	[4.0] 15	[389] 44 **118**	[831] 94 **115**	[982] 111 **114**	[1123] 127 **113**	[1415] 160 **110**	[1565] 177 **108**	[1786] 202 **105**	[2361] 267 **86**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[5.3] 20	[371] 42 **158**	[822] 93 **156**	[973] 110 **155**	[1123] 127 **152**	[1406] 159 **150**	[1557] 176 **148**	[1786] 202 **144**	[2370] 268 **129**	
Flow (L/min)	[7.9] 30	[354] 40 **238**	[808] 91 **235**	[955] 108 **233**	[1097] 124 **231**	[1380] 156 **229**	[1539] 174 **225**	[1751] 198 **222**	[2370] 268 **205**	
	[9.2] 35	[336] 38 **227**	[787] 89 **274**	[937] 106 **273**	[1079] 122 **272**	[1362] 154 **268**	[1521] 172 **266**	[1733] 196 **263**	[2361] 267 **247**	
	[11.9] 45	[327] 37 **356**	[752] 85 **353**	[911] 103 **352**	[1061] 120 **349**	[1335] 151 **347**	[1503] 170 **343**	[1716] 194 **341**	[2326] 263 **321**	
	[13.2] 50	[292] 33 **396**	[743 84 **392**	[884] 100 **390**	[1044] 118 **390**	[1318] 149 **387**	[1477] 167 **383**	[1698] 192 **380**	[2299] 260 **363**	
Max cont	[15.8] 60	[283] 32 **475**	[716] 81 **471**	[876] 99 **469**	[1026] 116 **467**	[1300] 147 **465**	[1468] 166 **461**	[1689] 191 **457**	[2291] 259 **436**	Max cont.
Max int.	[19.8] 75	[230] 26 **594**	[663] 75 **588**	[822] 93 **587**	[973] 110 **581**	[1256] 142 **576**	[1406] 159 **584**	[1636] 185 **579**		Max int.

YMP 160 [9.49 in^3/rev] 155.5 cm^3/rev.

								Max cont.	Max int.	
		[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	[2030] 14	[2393] 16	[PSI] MPa
GPM L/ min	[2.1] 8	[504] 57 **48**	[1070] 121 **47**	[1256] 142 **46**	[1433] 162 **44**	[1786] 202 **42**	[1990] 225 **40**	[2419] 243 **39**	[2954] 334 **24**	
	[4.0] 15	[495] 56 **93**	[1070] 121 **90**	[1256 142 **90**	[1433] 162 **89**	[1804] 204 **88**	[2008] 227 **86**	[2167] 245 **86**	[3016] 341 **75**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[5.3] 20	[486] 55 **123**	[1061] 120 **122**	[1238] 140 **121**	[1433] 162 **119**	[1795] 203 **117**	[1999] 226 **116**	[2158] 244 **116**	[3025] 342 **104**	
Flow (L/min)	[7.9] 30	[478] 54 **185**	[1035] 117 **183**	[1229] 139 **182**	[1415] 160 **180**	[1778] 201 **178**	[1981] 224 **176**	[2140] 242 **175**	[3007] 340 **163**	
	[9.2] 35	[460] 52 **215**	[1017] 115 **213**	[1212] 137 **213**	[1406] 159 **211**	[1760] 199 **210**	[1946] 220 **208**	[2140] 242 **207**	[2980] 337 **196**	
	[11.9] 45	[442] 50 **277**	[991] 112 **275**	[1185] 134 **275**	[1380] 156 **273**	[1733] 196 **271**	[1946] 220 **169**	[2105] 238 **268**	[2963] 335 **256**	
	[13.2] 50	[398] 45 **308**	[973] 110 **307**	[1167] 132 **305**	[1353] 153 **303**	[1716] 194 **302**	[1910] 216 **299**	[2061] 233 **299**	[2919] 330 **287**	
Max cont	[15.8] 60	[389] 44 **370**	[937] 106 **368**	[1150] 130 **365**	[1335] 151 **364**	[1698] 192 **362**	[1893] 214 **360**	[2043] 231 **359**	[2901] 328 **347**	Max cont.
Max int.	[19.8] 75	[283] 32 **463**	[849] 96 **458**	[1052] 119 **457**	[1256] 142 **456**	[1610] 182 **453**	[1813] 205 **451**	[1963] 222 **451**		Max int.

YMP 200 [11.59 in^3/rev] 189.9 cm^3/rev.

							Max cont.	Max int.	
		[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	[2175] 15	[PSI] MPa
GPM L/ min	[2.1] 8	[646] 73 **39**	[1353] 153 **37**	[1583] 179 **36**	[1804] 204 **35**	[2264] 256 **32**	[2503] 283 **28**	[3405] 385 **12**	
	[4.0] 15	[646] 73 **74**	[1344] 152 **72**	[1592] 180 **71**	[1813] 205 **71**	[2291] 259 **70**	[2353] 266 **68**	[3449] 390 **58**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[5.3] 20	[628] 71 **99**	[1335] 151 **98**	[1574] 178 **97**	[1804] 204 **95**	[2264] 256 **94**	[2521] 285 **91**	[3449] 390 **81**	
Flow (L/min)	[7.9] 30	[601] 68 **148**	[1318] 149 **147**	[1548] 175 **146**	[1786] 202 **144**	[2246] 154 **142**	[2503] 283 **139**	[3431] 388 **128**	
	[9.2] 35	[575] 65 **173**	[1291] 146 **172**	[1530] 173 **171**	[1769] 200 **169**	[2229] 252 **168**	[2485] 281 **165**	[3414] 386 **155**	
	[11.9] 45	[557] 63 **222**	[1256] 142 **221**	[1503] 170 **220**	[1733] 196 **218**	[2184] 247 **216**	[2450] 259 **214**	[3378] 382 **203**	
	[13.2] 50	[513] 58 **247**	[1220] 138 **245**	[1468] 166 **244**	[1707] 193 **244**	[2158] 244 **242**	[2406] 272 **239**	[3343 378 **229**	
Max cont	[15.8] 60	[495] 56 **296**	[1203] 136 **294**	[1442] 163 **293**	[1689] 191 **292**	[2131] 241 **290**	[2379] 269 **287**	[3317] 375 **277**	Max cont.
Max int.	[19.8] 75	[371] 42 **370**	[1070] 121 **367**	[1327] 150 **367**	[1565] 177 **365**	[1999] 226 **364**			Max int.

YMP 250 [14.10 in^3/rev] 231 cm^3/rev.

							Max cont.	Max int.	
		[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1595] 11	[2030] 14	[PSI] MPa
GPM L/ min	[2.1] 8	[822] 93 **31**	[1725] 195 **29**	[1999] 226 **29**	[2291] 259 **27**	[2874] 325 **25**	[3157] 357 **24**		
	[4.0] 15	[814] 92 **60**	[1698] 192 **58**	[1999] 226 **57**	[2299] 260 **57**	[2874] 325 **55**	[3184] 360 **55**	[4033] 456 **46**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[5.3] 20	[796] 90 **79**	[1689] 191 **78**	[1990] 225 **77**	[2282] 258 **76**	[2848] 322 **75**	[3148] 356 **75**	[4024] 455 **65**	
Flow (L/min)	[7.9] 30	[761] 86 **119**	[1663] 188 **118**	[1955] 221 **117**	[2255] 255 **116**	[2821] 319 **114**	[3131] 354 **114**	[3997] 452 **103**	
	[9.2] 35	[725] 82 **138**	[1627] 184 **138**	[1919] 217 **137**	[2220] 251 **135**	[2804] 317 **133**	[3095] 350 **133**	[3962] 448 **124**	
	[11.9] 45	[699] 79 **179**	[1583] 179 **178**	[1893] 214 **177**	[2176] 246 **176**	[2759] 312 **173**	[3051] 345 **173**	[3909] 442 **163**	
	[13.2] 50	[654] 74 **198**	[1539] 174 **197**	[1848] 209 **197**	[2149] 243 **195**	[2706] 306 **194**	[2998] 339 **193**	[3874] 438 **185**	
Max cont	[15.8] 60	[628] 71 **237**	[1512] 171 **236**	[1822] 206 **236**	[2113] 239 **234**	[2680] 303 **232**	[2972] 336 **232**	[3829] 433 **224**	Max cont.
Max int.	[19.8] 75	[469] 53 **297**	[1353] 153 **295**	[1672] 189 **295**	[1955 221 **293**	[2582] 292 **232**	[2759] 312 **291**		Max int.

PERFORMANCE DATA

YMP 315 [19.02 in³/rev] 311.7 cm³/rev.

Flow (L/min)	GPM L/ min					Max cont.	Max int.
	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1450] 10	[1813] 12
	[2.1] 8	[1026] 116 **25**	[2149] 243 **24**	[2494] 282 **22**	[2768] 313 **16**	[3431] 388 **13**	
	[4.0] 15	[1017] 115 **47**	[2149] 243 **46**	[2512] 284 **45**	[2865] 324 **43**	[3591] 406 **41**	[4449] 503 **20**
	[5.3] 20	[1008] 114 **63**	[2140] 242 **62**	[2494] 282 **61**	[2857] 323 **58**	[3582] 405 **56**	[4466] 505 **54**
	[7.9] 30	[964] 109 **94**	[2096] 237 **93**	[2450] 277 **92**	[2821] 319 **90**	[3546] 401 **88**	[4431] 501 **77**
	[9.2] 35	[929] 105 **110**	[2052] 232 **109**	[2414] 273 **108**	[2777] 314 **106**	[3511] 397 **103**	[4395] 497 **93**
	[11.9] 45	[876] 99 **141**	[1999] 226 **141**	[2370] 268 **139**	[2733] 309 **137**	[3458] 391 **135**	[4342] 491 **124**
	[13.2] 50	[814] 92 **157**	[1928] 218 **157**	[2317] 262 **155**	[2689] 304 **154**	[3396] 384 **151**	[4298] 486 **141**
Max cont	[15.8] 60	[787] 89 **189**	[1901] 215 **188**	[2282] 258 **187**	[2644] 299 **185**	[3352] 379 **182**	[4236] 479 **171**
Max int.	[19.8] 75	[610] 69 **236**	[1716] 194 **235**	[2097] 237 **234**	[2459] 278 **232**	[3140] 355 **229**	

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMP 400 [23.57 in³/rev] 386.2 cm³/rev.

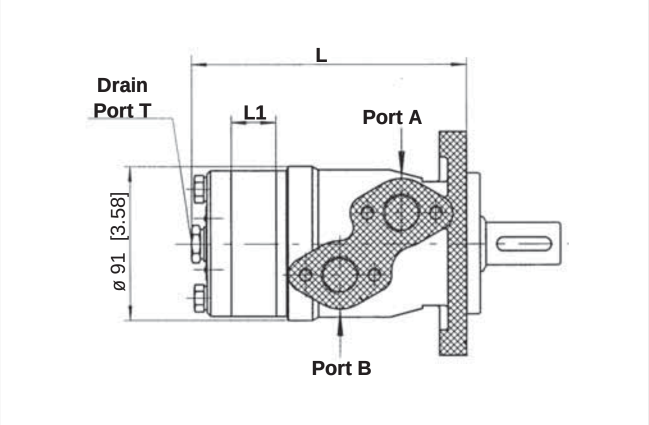
Flow (L/min)	GPM L/ min					Max cont.	Max int.
	[PSI] MPA	[435] 3	[870] 6	[1015] 7	[1160] 8	[1232,50] 8	[1812,50] 12
	[2.1] 8	[1300] 147 **20**	[2688] 304 **19**	[3131] 354 **16**			
	[4.0] 15	[1300] 147 **37**	[2724] 308 **36**	[3175] 359 **35**	[3608] 408 **33**	[3847] 435 **32**	[4705] 532 **25**
	[5.3] 20	[1273] 144 **50**	[2697] 305 **49**	[3166] 358 **47**	[3599] 407 **45**	[3847] 435 **43**	[4714] 533 **38**
	[7.9] 30	[1229] 139 **74**	[2662] 301 **73**	[3113] 352 **72**	[3555] 402 **70**	[3803] 430 **68**	[4687] 530 **62**
	[9.2] 35	[1176] 133 **86**	[2600] 294 **86**	[3051] 345 **85**	[3502] 396 **82**	[3741] 423 **80**	[4643] 525 **75**
	[11.9] 45	[1105] 125 **111**	[2538] 287 **111**	[2998] 339 **109**	[3440] 389 **106**	[3679] 416 **105**	[4572] 517 **100**
	[13.2] 50	[1035] 117 **124**	[2459] 278 **124**	[2918] 330 **122**	[3378] 382 **120**	[3591] 406 **119**	[4502] 509 **113**
Max cont	[15.8] 60	[990] 112 **149**	[2423] 274 **149**	[2883] 326 **147**	[3334] 377 **145**	[3573] 404 **144**	[4466] 505 **137**
Max int.	[19.8] 75	[778] 88 **185**	[2146] 246 **185**	[2635] 298 **185**	[3104] 351 **182**	[3325] 376 **181**	

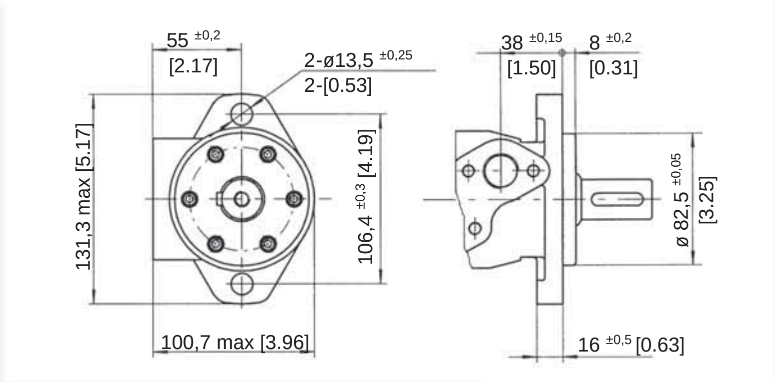
TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

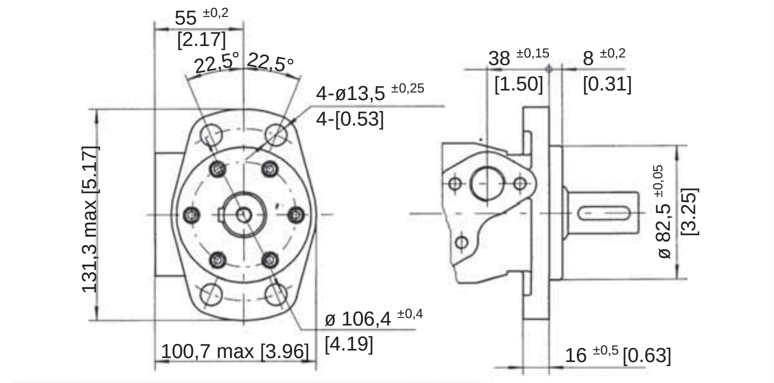
DIMENSIONS AND MOUNTING DATA



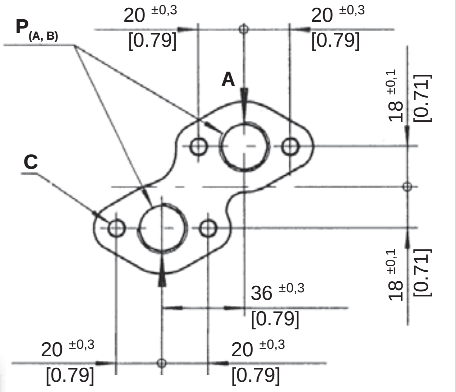


FLANGE 2 SAE-A 2 BOLT

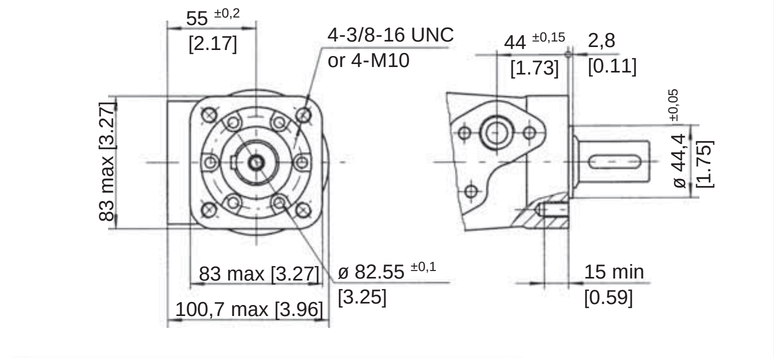
MODEL	[INCHES] L	[INCHES] L1	MILLIMETERS L	MILLIMETERS L1
YMP 50	[5.39]	[.28]	137	7
YMP 80	[5.53]	[0.41]	140.5	10.5
YMP 100	[5.63]	[0.51]	143	13
YMP 125	[5.75]	[0.63]	146	16
YMP 160	[5.94]	[0.83]	151	21
YMP 200	[6.18]	[1.02]	157	26
YMP 250	[6.38]	[1.26]	162	32
YMP 315	[6.77]	[1.65]	172	42
YMP 400	[7.17]	[2.05]	182	52



FLANGE 4 MAGNETO



PORTING



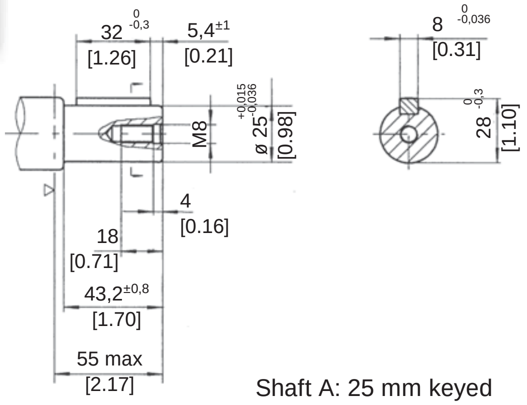
FLANGE H4/H5 4 BOLT

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	P	DEPTH	R	DEPTH
PORTS - A and B	G 1/2	15 mm	M22 X 1.5	15 mm	7/8-14 O-RING	17 mm	1/2-14NPTF	15 mm	PT(RC)1/2	15 mm
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	7/16-20UNF	12 mm	7/16-20UNF	12 mm	PT(RC)1/4	9.7 mm
BOLTS - C	4-M8	13 mm	4-M8	13 mm	4-5/16-18UNC	13 mm	4-5/16-18UNC	13 mm	4-M8	13 mm

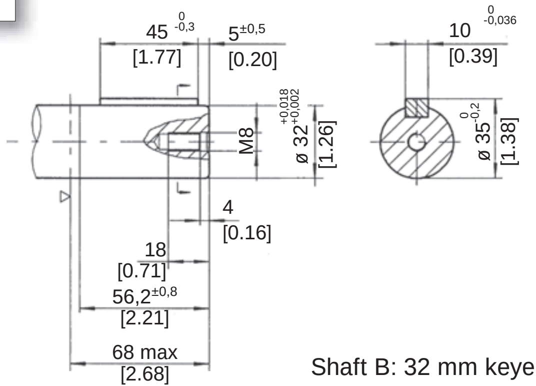
MOTOR SHAFT EXTENSIONS

A



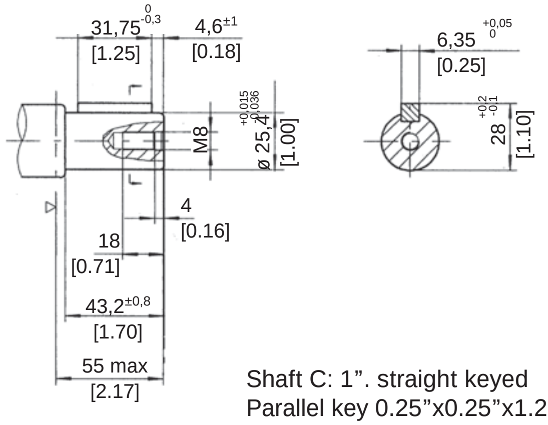
Shaft A: 25 mm keyed
Parallel key 8x7x32

B



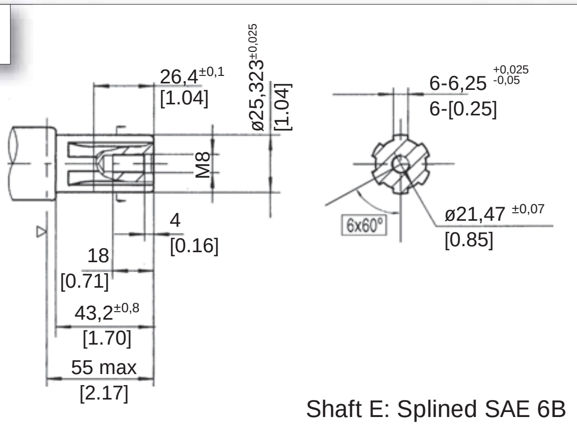
Shaft B: 32 mm keyed
Parallel key 10x8x45

C



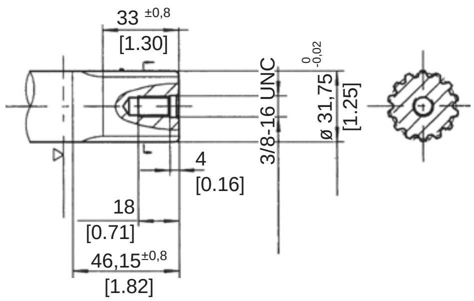
Shaft C: 1”. straight keyed
Parallel key 0.25”x0.25”x1.25”

E



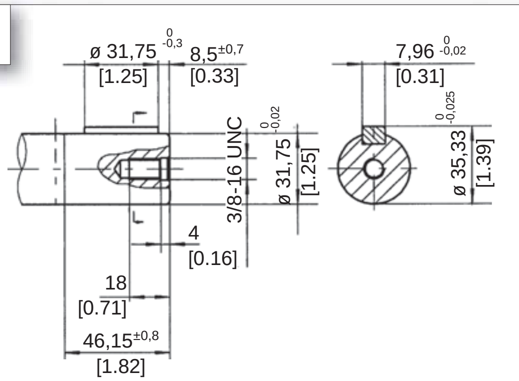
Shaft E: Splined SAE 6B

F



Shaft F: $1^{1/4}$“ 14 Splined
14-DP12/24

G

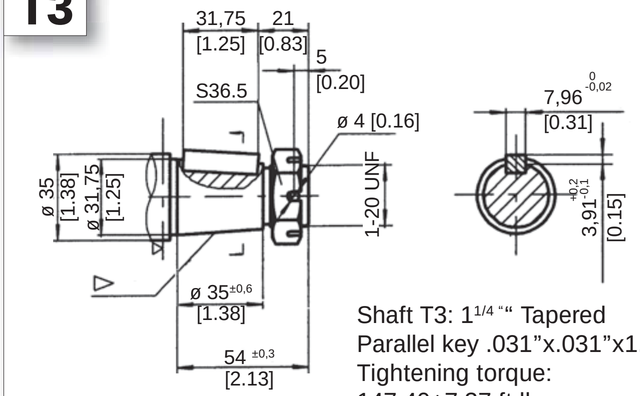


Shaft G: $1^{1/4}$“ Straight keyed
Parallel key 0.31”x0.31”x1.25”

▷ Motor Mounting Surface

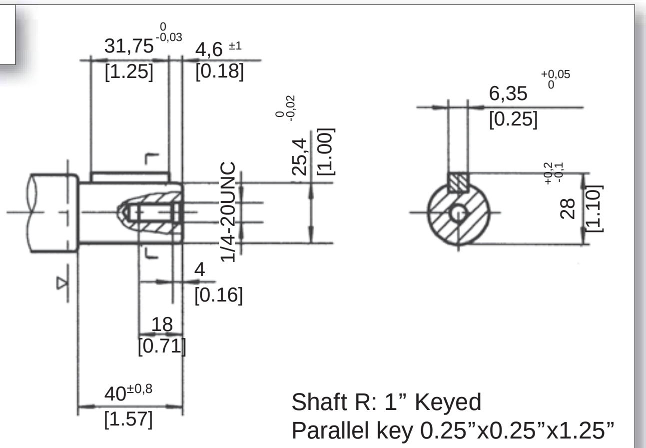
MOTOR SHAFT EXTENSIONS

T3



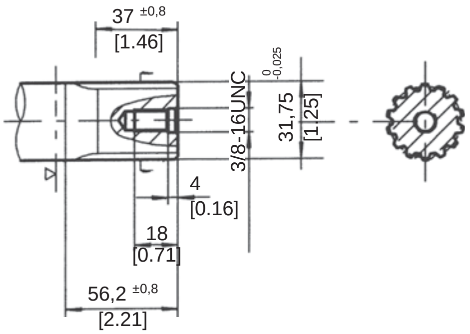
Shaft T3: $1^{1/4}$ "“ Tapered
Parallel key .031”x.031”x1.25”
Tightening torque:
147.40±7.37 ft.lb.

R



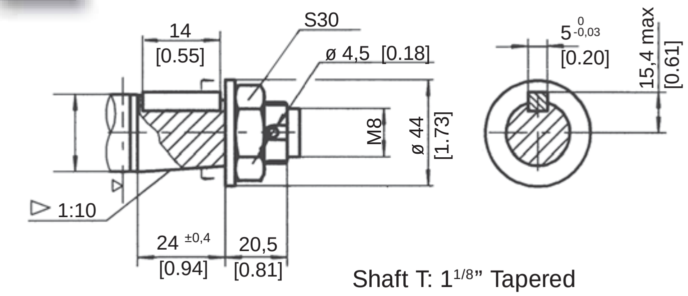
Shaft R: 1” Keyed
Parallel key 0.25”x0.25”x1.25”

FD



Shaft FD: 1 1/4”-14 Splined
14-DP12/24

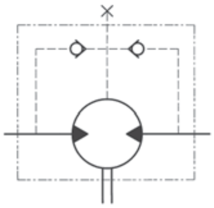
T

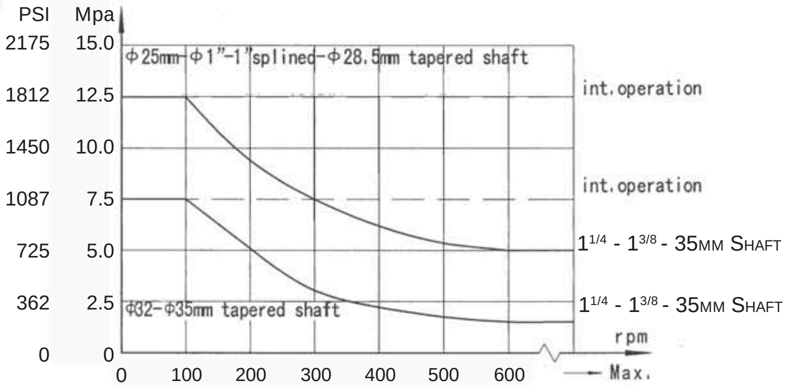


Shaft T: $1^{1/8}$” Tapered
Parallel key
Tightening torque:
147.40±7.37 ft.lb.

ADDITIONAL INFORMATION

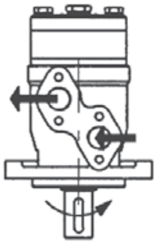
PERMISSIBLE SHAFT SEAL PRESSURE





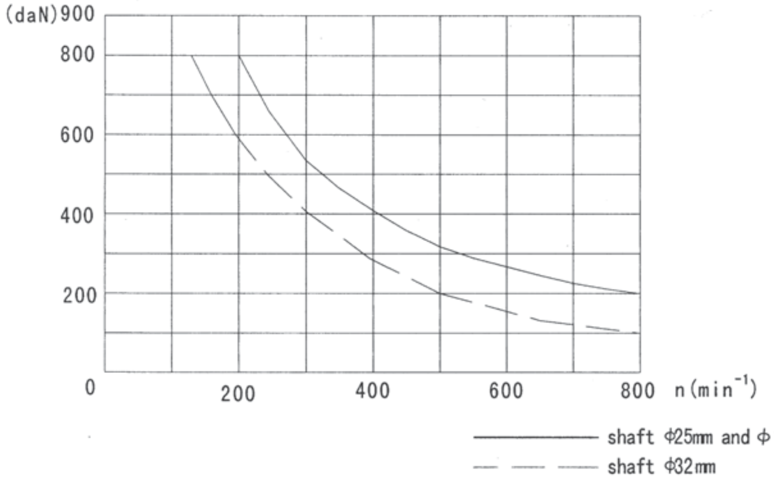
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

SHAFT ROTATION DIRECTION

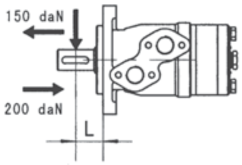


YMP

LOAD CHART RATINGS



$F_r = \frac{800}{n} \cdot \frac{2500}{95+l}$ daN



F_r =Radial Force (daN)
L =Distance (mm)
n =Speed (rpm)

Rhomb-flange L=30mm
Square-flange L=24mm

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMP							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
36	**2**	SAE - A 2 Bolt Pilot 3.25”×0.31”	**A**	Shaft 25mm Keyed Parallel key 8×7×32	**D**	Port: G 1/2 Manifold Mount Drain: G 1/4 Bolts: 4 x M8	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
50	**4**	4 Bolt Magneto Pilot 3.25”×0.31”	**B**	Shaft 32mm Keyed Parallel key 10×8×45			**R**	OPPOSITE	**NONE**	BLUE	**N**	BIG RADIAL FORCE
80	**H4**	SAE - A 4 Bolt Pilot 1.75”×0.11” 4 bolts: 3/8 - 16UNC	**C**	Shaft 1” Straight keyed Parallel key 0.25”x0.25”×1.25”	**M**	Port M22×1.5 Manifold Mount Drain: M14×1.5 Bolts: 4 x M8			**B**	BLACK	**AX**	BIG AXIAL FORCE
100	**H5**	4 Bolt Flange Pilot Ø44.4×2.8 4 x M10	**E**	Splined SAE 6B	**S**	Port: 7/8”-14 O-ring anifold Drain: 7/16”-20UNF Bolts: 4 x 5/16”-18UNC,			**S**	SILVER GRAY	**0**	NO CASE DRAIN
125			**R**	Short shaft 1” Keyed Parallel key 0.25”x0.25”×1.25”	**P**	Port: 1/2”-14 NPTF Manifold Drain: 7/16”-20UNF Bolts: 4 x 5/16”-18UNC					**FR**	FREE RUNNING
160			**F**	$1^{1/4}$” 14 Splined 14-DP12/24							**LL**	LOW LEAKAGE VALVE
200			**FD**	$1^{1/4}$” 14 Splined (long) 14-DP12/24	**R**	Port: PT(Rc)1/2” Manifold Drain: PT(Rc)1/4” Bolts: 4 x M8					**LSV**	LOW SPEED VALVE
250			**G**	$1^{1/4}$” Straight keyed Parallel key 0.31”×0.31”x1.25”							**CRS**	CORROSION RESISTANT SHAFT
315			**T**	$1^{1/8}$” Tapered Parallel key 0.20”×0.20”×0.55”							**HPS**	HIGH PRESSURE SEAL
400			**T3**	$1^{1/4}$” Tapered Parallel key 0.31”×0.31”×1.00”							**HTS**	HIGH TEMP SEAL

Ordering Code:
All options have been determined with letters, numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table, please contact us with your requirements.

YMPH

The **YMPH** series motor uses the spool valve shaft distribution design for simplicity, efficiency and compactness. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This design has identical displacement and performance of the YMP series with a few different options.

The inlet and outlet ports (A & B) are parallel with the mounting flange to meet certain application requirements. The SAE flange is available for these ports.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distribution	YMPH	[in^3./rev]	[2.18~24.41]	[PSI]	[2400]	RPM	[HP]	[14]
		cm^3/rev.	36 ~ 400	MPa	16.5	30~879	Kw	10

YMPH

QUICK REFERENCE GUIDE

YMPH SERIES QUICK REFERENCE:

Displacements				
[in³./rev]	cm³/rev.			
[2.18]	36			
[3.15]	51.7	FLOW UP TO	75 LPM	[20 GPM]
[4.74]	77.7	PRESSURE UP TO	16.5 MPa	[2392 PSI]
[5.87]	96.2	TORQUE UP TO	533 Nm	[4847 lb.-in.]
[7.19]	117.9	SPEED UP TO	975 RPM	
[9.49]	155.5			
[11.59]	189.9			
[14.10]	231			
[23.28]	311.7			
[23.57]	386.2			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedure to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20° - 60° C [68° - 180° F]

* Oil filter of 10 - 20 micron

* Oil viscosity 42 - 74 mm^2 at 40° C

* Different shafts are used when there is a radial load or not. Check data pages

* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

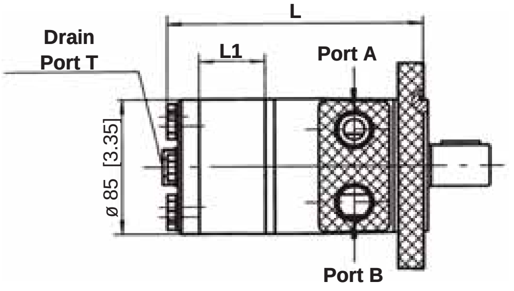
SPECIFICATION DATA

For individual motor performance chart consult equivalent YMP series data.

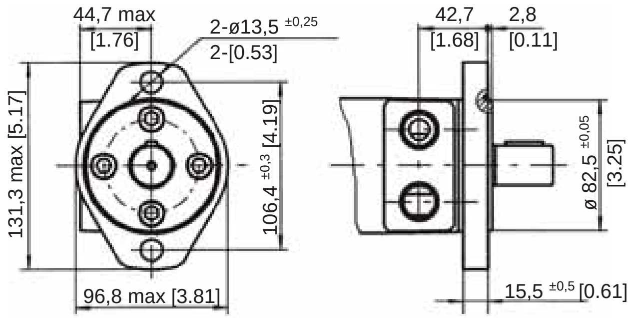
DISTRIBUTION TYPE			**YMPH 36**	**YMPH 50**	**YMPH 80**	**YMPH 100**	**YMPH 125**	**YMPH 160**	**YMPH 200**	**YMPH 250**	**YMPH 315**	**YMPH 400**
GEOMETRIC DISPLAYCEMENT		[in^3./rev.]	[2.20]	[3.15]	[4.74]	[5.87]	[7.19]	[9.49]	[11.59]	[14.10]	[19.01]	[23.57]
		cm^3/rev.	36	**51.7**	**77.7**	**96.2**	**117.9**	**155.5**	**189.9**	**231**	**311.7**	**386.2**
MAX. SPEED RPM		RATED	1050	850	650	520	390	310	260	200	156	130
		CONT.	1078	879	740	589	475	370	296	237	189	149
		INT.	**1210**	**975**	**827**	**673**	**594**	**463**	**370**	**297**	**236**	**185**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[486]	[716]	[1141]	[1424]	[1786]	[1804]	[2291]	[2874]	[3051]	[3847]
		N*M	**55**	**81**	**129**	**161**	**202**	**204**	**259**	**325**	**345**	**435**
	CONT.	[LB. IN.]	[486]	[716]	[1141]	[1424]	[1786]	[2167]	[2529]	[3184]	[3591]	[4847]
		N*M	**55**	**81**	**129**	**161**	**202**	**245**	**286**	**360**	**406**	**435**
	INT.	[LB. IN.]	[672]	[955]	[1512]	[1884]	[2370]	[3025]	[3449]	[4033]	[4466]	[4714]
		N*M	**76**	**108**	**171**	**213**	**268**	**342**	**390**	**456**	**505**	**533**
MAX. OUTPUT [HP] KW	RATED	[HP]	[8]	[9]	[12]	[12]	[11]	[9]	[9]	[9]	[7]	[8]
		KW	**6**	**7**	**8.6**	**8.6**	**8**	**6.5**	**6.9**	**6.6**	**5.5**	**5.8**
	CONT.	[HP]	[8]	[9]	[12]	[12]	[12]	[12]	[11]	[11]	[10]	[10]
		KW	**6**	**7**	**9.1**	**9**	**9.1**	**8.7**	**8.1**	**8.2**	**7.2**	**6.1**
	INT.	[HP]	[10]	[12]	[16]	[16]	[16]	[16]	[15]	[14]	[12]	[10]
		KW	**8**	**8.9**	**11.8**	**11.9**	**11.8**	**11.9**	**10.9**	**10.1**	**8.6**	**7.2**
MAX. PRES-SURE DROP [PSI] MPa	RATED	[PSI]	[1812]	[1812]	[1812]	[1812]	[1812]	[1450]	[1450]	[1450]	[1232]	[1232]
		MPa	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**10**	**10**	**10**	**8.5**	**8.5**
	CONT.	[PSI]	[1812]	[1812]	[1812]	[1812]	[1812]	[1812]	[1595]	[1595]	[1595]	[1450]
		MPa	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**11**	**11**	**11**	**10**
	INT.	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPa	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**14**	**12.5**	**10.5**
	PEAK	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPa	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**14**	**12.5**	**10.5**
MAX. FLOW [GPM] L/MIN	RATED	**[GPM]**	[10.4]	[11.8]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]
		L/MIN	**40**	**45**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
	CONT.	**[GPM]**	[10.4]	[11.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	**40**	**45**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
	INT.	**[GPM]**	[11.8]	[13.2]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**45**	**50**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
WEIGHT [LB] KG		[LB]	[12]	[12]	[13]	[13]	[13]	[14]	[14]	[15]	[15]	[16]
		KG	**5.6**	**5.6**	**5.7**	**5.9**	**6**	**6.2**	**6.4**	**6.6**	**6.9**	**75**

*	Rated speed and rated torque:	Output value of speed and torque under rated flow and rated pressure.
*	Continuous pressure:	Max. value of operating motor continuously.
*	Intermittent pressure:	Max. value of operating motor in 6 seconds per minute.
*	Peak pressure:	Max. value of operating motor in 0.6 second per minute.

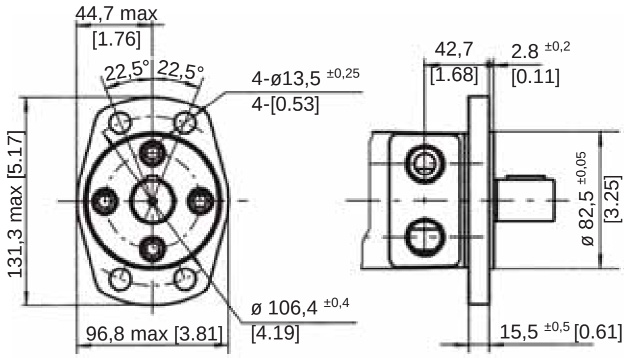
DIMENSIONS AND MOUNTING DATA



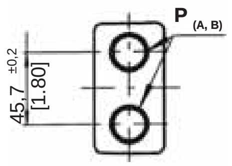
	[INCHES]		MILLIMETERS	
MODEL	L	L1	L	L1
YMPH 50	[5.39]	[.28]	141	7
YMPH 80	[5.53]	[0.41]	144.5	10.5
YMPH 100	[5.63]	[0.51]	147	13
YMPH 125	[5.75]	[0.63]	150	16
YMPH 160	[5.94]	[0.83]	155	21
YMPH 200	[6.18]	[1.02]	160	26
YMPH 250	[6.38]	[1.26]	166	32
YMPH 315	[6.77]	[1.65]	176	42
YMPH 400	[7.17]	[2.05]	186	52



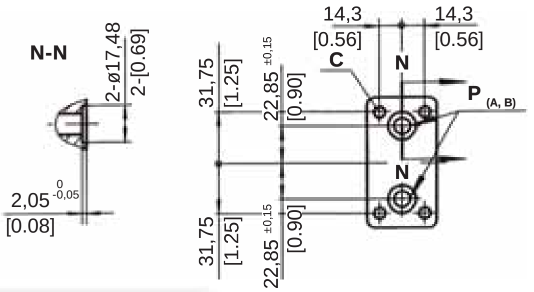
FLANGE H2 SAE-A 2 BOLT



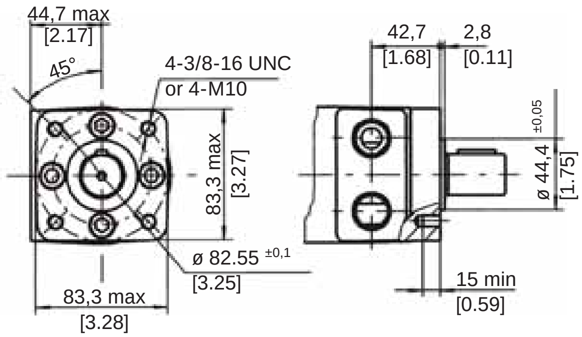
FLANGE H6 MAGNETO



PORT G-S-P-T-R



PORT B4 - B5



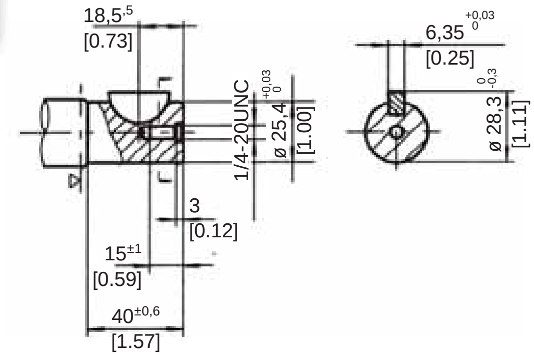
FLANGE H4/H5 4 BOLT

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	G	DEPTH	S	DEPTH	P	DEPTH	T	DEPTH	R	DEPTH	B4	DEPTH	B5	DEPTH
PORTS - A and B	G 1/2	15 mm	7/8-14 O-RING	17 mm	1/2-14NPTF	15 mm	3/4 16 O-RING	15 mm	PT(RC) 1/2	15 mm	Ø10	-	Ø10	-
TANK PORT - T	G 1/4	12 mm	7/16-20UNF	12 mm	7/16-20UNF	12 mm	7/16-20UNF	12 mm	PT(RC) 1/4	9.7 mm	7/16 20UNF	12 mm	G 1/4	12 mm
BOLTS - C	-	-	-	-	-	-	-	-	-	-	4-5/16 18UNC	13 mm	4-M8	13 mm

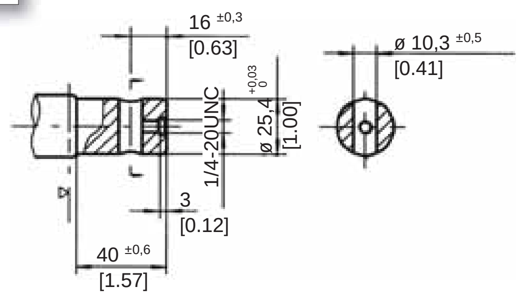
MOTOR SHAFT EXTENSIONS

K



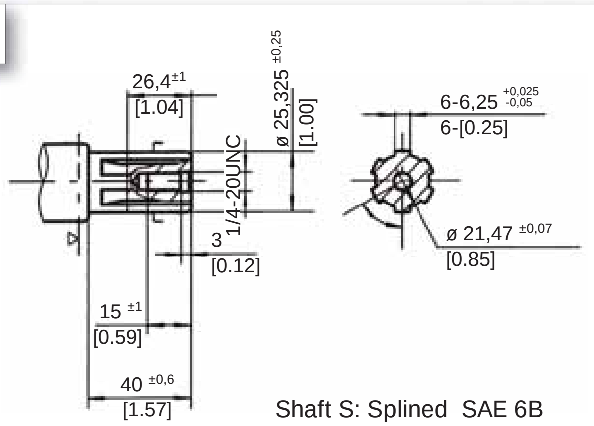
Shaft K: 1” Woodruff key
Woodruff Keyed 1” x .25”

H



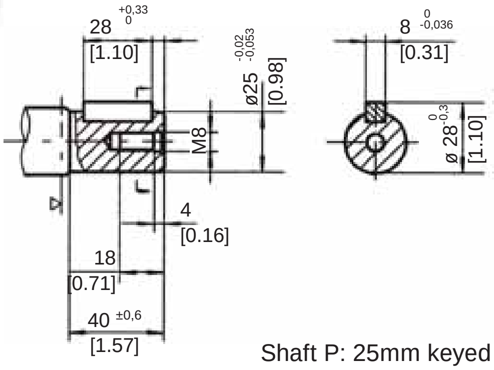
Shaft H: 1” Round Cross Hole
Cross hole .41”

S



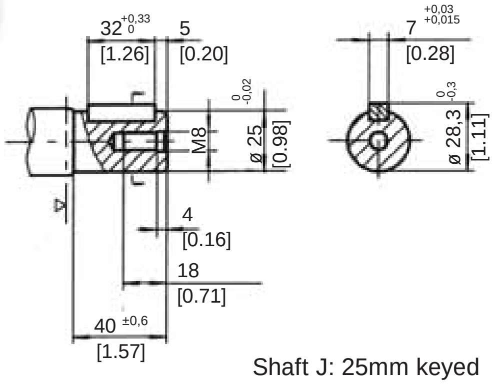
Shaft S: Splined SAE 6B

P



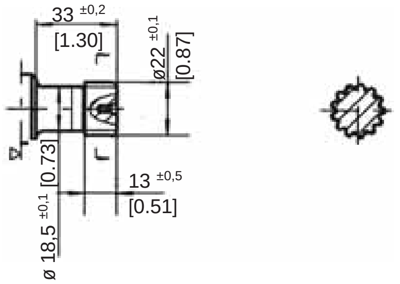
Shaft P: 25mm keyed
Parallel key 8 x 7 x 28

J



Shaft J: 25mm keyed
Parallel key 7 x 7 x 32

I

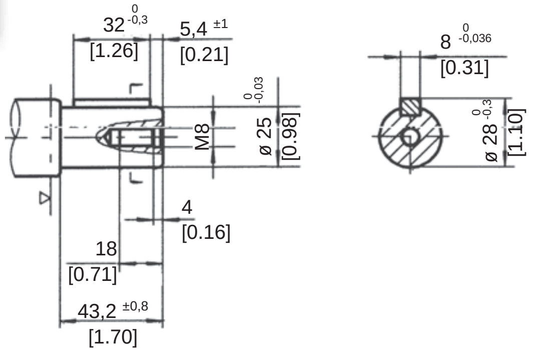


Shaft I: 7/8-13 Splined
13-DP16/32

▷ Motor Mounting Surface

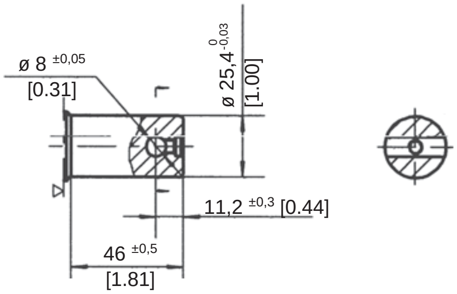
MOTOR SHAFT EXTENSIONS

A



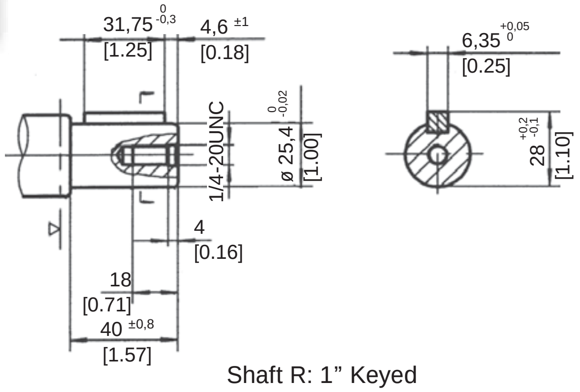
Shaft A: 25 mm Keyed
Parallel key 8x7x32

H1



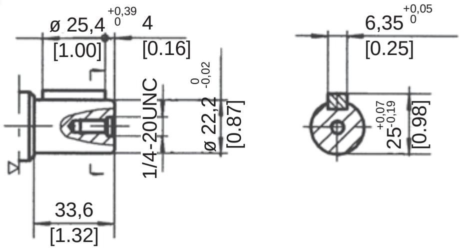
Shaft H1: 1” Round
Cross Hole .31

R



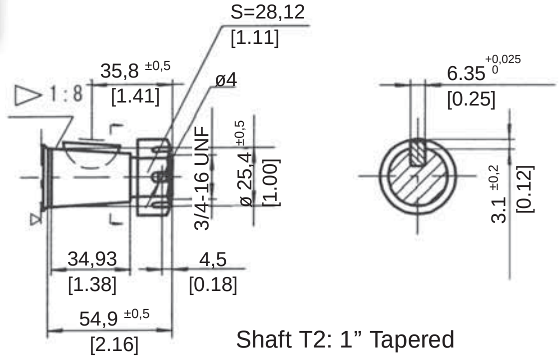
Shaft R: 1” Keyed
Parallel key .25 x .25 x 1.25

D



Shaft D: 7/8 Keyed
Parallel key .25 x .25 x 1.00

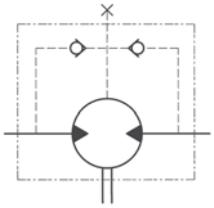
T2

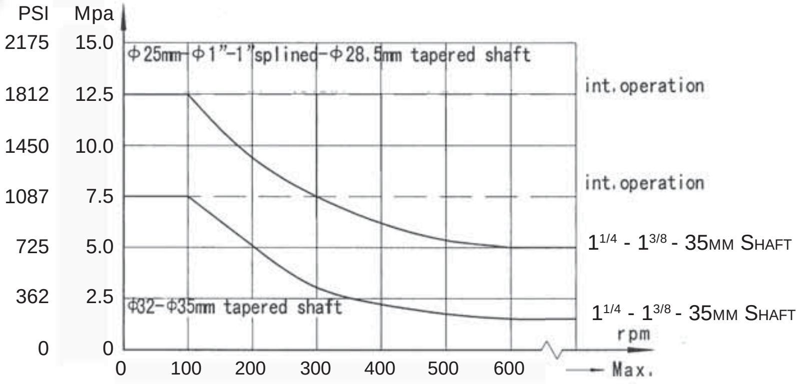


Shaft T2: 1” Tapered
Woodruff key 1.00 x .25
Tightening torque:200±10Nm

ADDITIONAL INFORMATION

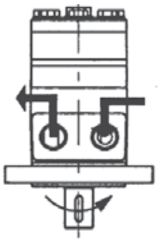
PERMISSIBLE SHAFT SEAL PRESSURE





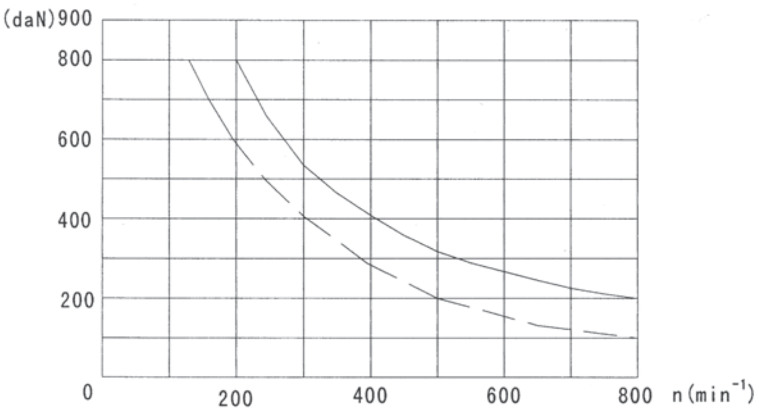
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

SHAFT ROTATION DIRECTION



YMPH

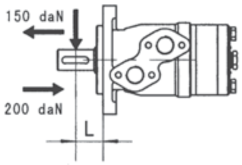
LOAD CHART RATINGS



———— shaft Φ25mm and Φ1"(Φ25.4mm)

— — — shaft Φ32mm

$$F_r = \frac{800}{n} \cdot \frac{2500}{95+l} \text{ daN}$$



F_r =Radial Force (daN)

L =Distance (mm)

n =Speed (rpm)

Rhomb-flange L=30mm

Square-flange L=24mm

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMPH							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
36	**H2**	SAE - A 2 Bolt Pilot 3.25”×0.31”	**K**	Shaft: 1” woodruff Key Wood ruff key 1”x.25	**G**	G 1/2,G 1/4	**N0NE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
50	**H6**	4 Bolt Magneto Pilot 3.25”×0.31”	**H**	Shaft:1” Round Cross Hole Cross Hole .41’	**S**	7/8-14 ORING , 7/16-20 UNF (G1/4)	**R**	REVERSE	**NONE**	BLUE	**N**	HIGH RADIAL LOAD
80	**H4**	4 Bolt Flange Pilot 1.75”×0.11” 4 bolts: 3/8 - 16UNC	**S**	Shaft: Splined SAE 6B	**P**	1/2-14NPTF, 7/16-20UNF (G1/4)			**B**	BLACK	**AX**	HIGH AXIAL LOAD
100	**H5**	4 Bolt Flange Pilot Ø44.4×2.8 4 x M10	**P**	Shaft:25mm Keyed Parallel Key 8x7x28	**T**	3/4-16 O-RING, 7/16-20 UNF			**S**	SILVER GRAY	**0**	NO CASE DRAIN
125			**J**	Shaft: 25mm Keyed Parallel Key 7x7x32	**R**	Port: PT(Rc)1/2” PT(Rc)1/4”					**FR**	FREE RUNNING
160			**I**	Shaft: 7/8-13 Splined	**B4**	10mm O-RING MANIFOLD 4X5/16-18UNC, 7/16-20UNF (G1/4)					**LL**	LOW LEAKAGE VALVE
200			**A**	Shaft 25mm Keyed Parallel key 8×7×32	**B5**	10 MM O-RING MANIFOLD 4XM8, 7/16-20 UNF (G1/4)					**LSV**	LOW SPEED VALVE
250			**H1**	Shaft: 1’ Round CrossHole Cross Hole .31							**CRS**	CORROSION RESISTANT SHAFT
315			**R**	Shaft: 1” Keyed Parallel Key .25x.25x1.25							**HPS**	HIGH PRESSURE SEAL
400			**D**	Shaft: 7/8 Keyed Parallel Key .25x.25x1.00							**HTS**	HIGH TEMP SEAL
			T2	Shaft: 1” Tapered Woodruff Key 1.00x.25								

Ordering Code:

All options have been determined with letters or numbers or combinations.All boxes must be filled with proper code.If specification is not in the table, please contact us with your specific requirements.

YMPW

The YMPW series motor uses the spool valve shaft distribution design for simplicity, effeciency and compactness. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This design has identical displacement and performance of the YMP series with a few different options.

The inlet and outlet ports (A & B) are parallel with the mounting flange to meet certain application requirements. The SAE flange is available for these ports.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distributioin	YMPW	[in^3./rev]	[3.05~24.41]	[PSI]	[2400]	RPM	[HP]	[14]
		cm^3/rev.	50 ~ 400	MPa	16.5	30~879	Kw	10

YMPW SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[3.15]	51.7	FLOW UP TO	75 LPM	[20 GPM]
[4.74]	77.7	PRESSURE UP TO	16.5 MPa	[2392 PSI]
[5.87]	96.2	TORQUE UP TO	533 Nm	[4847 lb.-in.]
[7.19]	117.9	SPEED UP TO	975 RPM	
[9.49]	155.5			
[11.59]	189.9			
[14.10]	231			
[19.01]	311.7			
[23.57]	386.2			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20° - 60° C [68° - 180° F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40° C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

YMPW

SPECIFICATION DATA

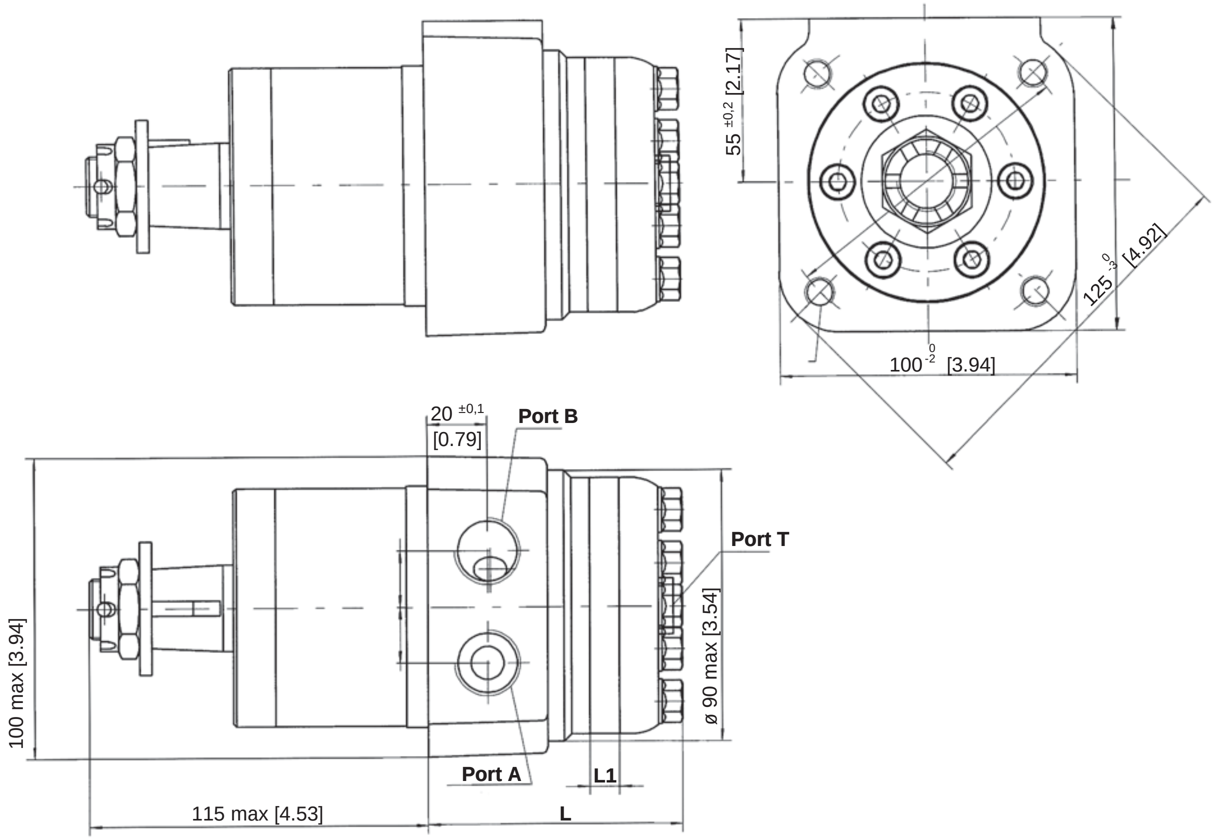
For individual motor performance chart consult equivilant YMP series data.

DISTRIBUTION TYPE			YMPW 50	YMPW 80	YMPW 100	YMPW 125	YMPW 160	YMPW 200	YMPW 250	YMPW 315	YMPW 400
GEOMETRIC DISPLACEMENT		[in³./rev.]	[3.15]	[4.74]	[5.87]	[7 . 1 9]	[9.49]	[11.59]	[14.10]	[19.01]	[23.57]
		cm³/rev.	**51.7**	**77.7**	**96.2**	**117.9**	**155.5**	**189.9**	**231**	**311.7**	**386.2**
MAX. SPEED RPM		RATED	850	650	520	390	310	260	200	156	130
		CONT.	879	740	589	475	370	296	237	189	149
		INT.	**975**	**827**	**673**	**594**	**463**	**370**	**297**	**236**	**185**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[716]	[1141]	[1424]	[1786]	[1804]	[2291]	**[2874]**	[3051]	[3847]
		N*M	**81**	**129**	**161**	**202**	**204**	**259**	**325**	**345**	**435**
	CONT.	[LB. IN.]	[716]	[1141]	[1424]	[1786]	[2167]	[2529]	[3184]	[3591]	[4847]
		N*M	**81**	**129**	**161**	**202**	**245**	**286**	**360**	**406**	**435**
	INT.	[LB. IN.]	[955]	[1512]	[1884]	[2370]	[3025]	[3449]	[4033]	[4466]	[4714]
		N*M	**108**	**171**	**213**	**268**	**342**	**390**	**456**	**505**	**533**
MAX. OUTPUT [HP] KW	RATED	[HP]	[9]	[12]	[12]	[11]	[9]	[9]	[9]	[8]	[8]
		KW	**7**	**8.6**	**8.6**	**8**	**6.5**	**6.9**	**6.6**	**5.5**	**5.8**
	CONT.	[HP]	[9]	[12]	[12]	[12]	[12]	[11]	[11]	[10]	[10]
		KW	**7**	**9.1**	**9**	**9.1**	**8.7**	**8.1**	**8.2**	**7.2**	**6.1**
	INT.	[HP]	[12]	[16]	[16]	[16]	[16]	[15]	[14]	[12]	[10]
		KW	**8.9**	**11.8**	**11.9**	**11.8**	**11.9**	**10.9**	**10.1**	**8.6**	**7.2**
MAX. PRES-SURE DROP [PSI] MPA	RATED	[PSI]	[1812]	[1812]	[1812]	[1812]	[1450]	[1450]	[1450]	[1232]	[1232]
		MPA	**12.5**	**12.5**	**12.5**	**12.5**	**10**	**10**	**10**	**8.5**	**8.5**
	CONT.	[PSI]	[1812]	[1812]	[1812]	[1812]	[1812]	[1595]	[1595]	[1595]	[1450]
		MPA	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**11**	**11**	**11**	**10**
	INT.	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPA	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**14**	**12.5**	**10.5**
	PEAK	[PSI]	[2392]	[2392]	[2392]	[2392]	[2392]	[2392]	[2030]	[1812]	[1522]
		MPA	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**16.5**	**14**	**12.5**	**10.5**
MAX. FLOW [GPM] L/MIN	RATED	**[GPM]**	[11.8]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]	[14.5]
		L/MIN	**45**	**55**	**55**	**55**	**55**	**55**	**55**	**55**	**55**
	CONT.	**[GPM]**	[11.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	**45**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
	INT.	**[GPM]**	[13.2]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**50**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
WEIGHT [LB] KG		[LB]	[12]	[13]	[13]	[13]	[14]	[14]	[15]	[15]	[16]
		KG	**5.6**	**5.7**	**5.9**	**6**	**75**	**75**	**75**	**6.9**	**75**

*	Rated speed and rated torque:	Output value of speed and torque under rated flow and rated pressure.
*	Continuous pressure:	Max. value of operating motor continuously.
*	Intermittent pressure:	Max. value of operating motor in 6 seconds per minute.
*	Peak pressure:	Max. value of operating motor in 0.6 second per minute.

YMPW

DIMENSIONS AND MOUNTING DATA



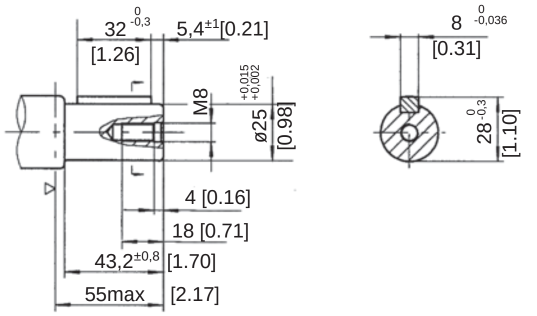
	[INCHES]		MILLIMETERS	
MODEL	**L**	**L1**	**L**	**L1**
YMPW 50	[3.19]	[.28]	81	7
YMPW 80	[3.33]	[0.41]	84.5	10.5
YMPW 100	[3.43]	[0.51]	87	13
YMPW 125	[3.54]	[0.63]	90	16
YMPW 160	[3.74]	[0.83]	95	21
YMPW 200	[3.94]	[1.02]	100	26
YMPW 250	[4.17]	[1.26]	106	32
YMPW 315	[4.57]	[1.65]	116	42
YMPW 400	[4.96]	[2.05]	126	52

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	G	DEPTH	S	DEPTH
PORTS A and B	G 1/2	15 mm	7/8-14 O-RING	17 mm
TANK PORT - T	G 1/4	12 mm	7/16 20UNF	12 mm

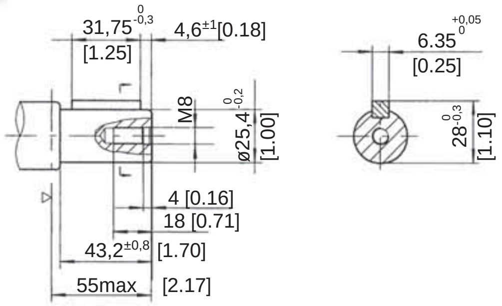
MOTOR SHAFT EXTENSIONS

A



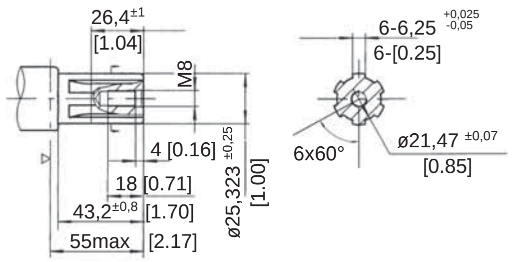
Shaft A: 25mm Keyed
Parallel Key 8x7x32

C



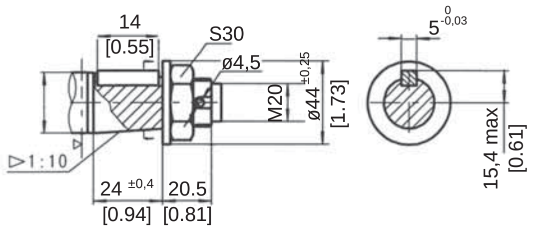
Shaft C: 1” Keyed
Parallel Key .25x.25x1.25

E



Shaft E: Splined SAE 6B

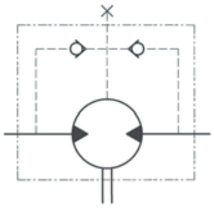
T

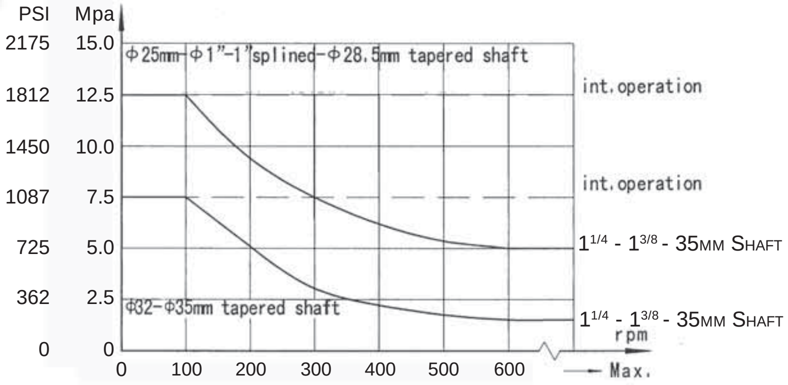


Shaft T: 1.125” Tapered
Parallel Key B5X5X14

ADDITIONAL INFORMATION

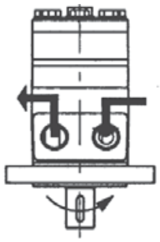
PERMISSIBLE SHAFT SEAL PRESSURE





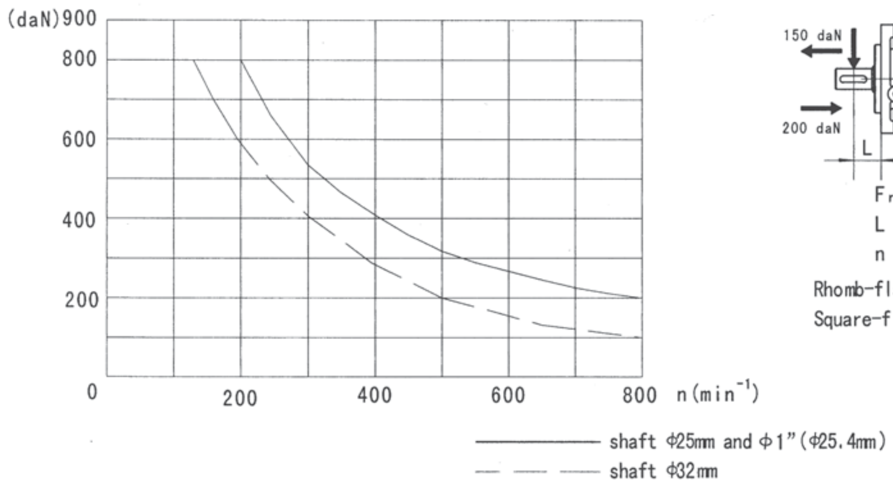
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

SHAFT ROTATION DIRECTION

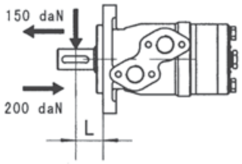


YMPW

LOAD CHART RATINGS



$$F_r = \frac{800}{n} \cdot \frac{2500}{95+l} \text{ daN}$$



F_r =Radial Force (daN)
L =Distance (mm)
n =Speed (rpm)

Rhomb-flange L=30mm
Square-flange L=24mm

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMPW							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
50	**OMIT**	Wheel Flange Pilot 80mmx7.5 4- m10 bolt holes	**A**	Shaft: 25mm Keyed Parallel Key 8x7x32	**G**	G 1/2,G 1/4	**N0NE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
80			**C**	Shaft: 1” Keyed Parallel Key .25x.25x1.25							**N**	HIGH RADIAL LOAD
100			**E**	Shaft: 1” SAE 6B Splined	**S**	7/8-14 ORING , 7/16-20 UNF (G1/4)	**R**	REVERSE	**NONE**	BLUE	**AX**	HIGH AXIAL LOAD
125			**T**	Shaft: 1.125 Tapered Parallel Key B5x5x14							**0**	NO CASE DRAIN
160									**B**	BLACK	**FR**	FREE RUNNING
200											**LL**	LOW LEAKAGE VALVE
250									**S**	SILVER GRAY		
											LSV	LOW SPEED VALVE
315												
400												
											CRS	CORROSION RESISTANT SHAFT
											HPS	HIGH PRESSURE SEAL
											HTS	HIGH TEMP SEAL

Ordering code:

All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table, please contact us with your specific requirements.

YMR

The **YMR** series motor uses the **spool valve** shaft distribution design for simplicity, efficiency and compactness. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This series uses the more advanced “**ROLLER**” gear type. It is manufactured with the most advanced technology and equipment to improve effiency, smoothness, lower leakage and better overall performance.

These motors are very compact, economical, and powerful without the need of a reducer to deliver high torque.

The large number of shaft, flange, port and special options make this a very flexible motor useful for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distribution	YMR	[in^3./rev]	[3.05 ~ 22.88]	[PSI]	[2900]	RPM	[HP]	[20]
		cm^3/rev.	50 ~ 375	MPa	20	30 ~ 970	Kw	15

QUICK REFERENCE GUIDE

YMR SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[3.13]	51.3	FLOW UP TO	75 LPM	[20 GPM]
[4.92]	80.6	PRESSURE UP TO	20 MPa	[2900 PSI]
[6.15]	100.8	TORQUE UP TO	548 Nm	[4846 lb.-in.]
[7.62]	124.9	POWER UP TO	17 Kw	[23 HP]
[9.59]	157.2	SPEED UP TO	970 RPM	
[12.16]	199.2			
[15.38]	252			
[19.19]	314.5			
[22.58]	370			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]

* Oil filter of 10 - 20 micron

* Oil viscosity 42 - 74 mm^2 at 40^o C

* Different shafts are used when there is a radial load or not. Check data pages

* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YMR 50	YMR 80	YMR 100	YMR 125	YMR 160	YMR 200	YMR 250	YMR 315	YMR 375
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[3.13]	[4.92]	[6.15]	[7.62]	[9.59]	[12.16]	[15.38]	[19.19]	[22.58]
		cm^3/rev.	**51.3**	**80.6**	**100.8**	**124.9**	**157.2**	**199.2**	**252**	**314.5**	**370**
MAX. SPEED RPM		RATED	755	750	600	475	375	300	240	190	160
		CONT.	**970**	**940**	**750**	**600**	**470**	**375**	**300**	**240**	**200**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[884]	[1415]	[1769]	[2211]	[2830]	[2919]	[3113]	[3184]	[3714]
		N*M	**100**	**160**	**200**	**250**	**320**	**330**	**352**	**360**	**420**
	CONT.	[LB. IN.]	[884]	[1680]	[2123]	[2582]	[3210]	[3166]	[3113]	[3184]	[3714]
		N*M	**100**	**190**	**240**	**292**	**363**	**358**	**352**	**360**	**420**
	INT.	[LB. IN.]	[1114]	[1946]	[2476]	[3007]	[3803]	[3962]	[4157]	[4157]	[4847]
		N*M	**126**	**220**	**280**	**340**	**430**	**448**	**470**	**470**	**548**
MAX. OUTPUT [HP] KW	RATED	[HP]	[10]	[17]	[17]	[16]	[17]	[14]	[12]	[9]	[9]
		KW	**7.7**	**12.3**	**12.3**	**12.0**	**12.3**	**10**	**9**	**7**	**6.5**
	CONT.	[HP]	[10]	[20]	[20]	[19]	[19]	[15]	[12]	[9]	[12]
		KW	**7.7**	**15**	**15**	**14**	**14**	**11**	**9**	**7**	**8.6**
	INT.	[HP]	[13]	[23]	[23]	[22]	[22]	[19]	[16]	[12]	[16]
		KW	**9.7**	**17**	**17**	**16**	**16**	**14**	**12**	**9**	**12**
MAX. PRESSURE DROP [PSI] MPA	RATED	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[1740]	[1595]	[1232]	[1232]
		MPA	**14**	**14**	**14**	**14**	**14**	**12**	**11**	**8.5**	**8.5**
	CONT.	[PSI]	[2030]	[2537]	[2537]	[2537]	[2392]	[1885]	[1595]	[1232]	[1232]
		MPA	**14**	**17.5**	**17.5**	**17.5**	**16.5**	**13**	**11**	**8.5**	**8.5**
	INT.	[PSI]	[2537]	[2900]	[2900]	[2900]	[2900]	[2537]	[2030]	[1667]	[1667]
		MPA	**17.5**	**20**	**20**	**20**	**20**	**17.5**	**14**	**11.5**	**11.5**
MAX. FLOW [GPM] L/MIN	CONT.	[GPM]	[10.6]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	**40**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
	INT.	[GPM]	[13.2]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**50**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
WEIGHT [LB] KG		[LB]	[15]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]
		KG	**6.7**	**6.9**	**6.9**	**7.2**	**7.5**	**8**	**8.5**	**9**	**9.3**

PERFORMANCE DATA

YMR 50 [3.13 in^3/rev] 51.3 cm^3/rev.

							Max cont.		Max int.	
		[725] 5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[2320] 16	[2537] 17.5	[PSI] MPA
GPM L/ min	[1.3] 5	[310] 35 **95**	[398] 45 **84**	[539] 61 **76**	[593] 67 **73**	[681] 77 **69**	[778] 88 **46**			
	[2.6] 10	[318] 36 **184**	[407] 46 **173**	[548] 62 **165**	[610] 69 **162**	[708] 80 **150**	[840] 95 **130**	[955] 108 **111**	[1061] 120 **84**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[3.9] 15	[310] 35 **283**	[433] 49 **277**	[557] 63 **269**	[646] 73 **261**	[778] 88 **250**	[884] 100 **230**	[964.] 109 **211**	[1088] 123 **185**	
Flow (L/min)	[5.3] 20	[305] 34.5 **377**	[416] 47 **375**	[539] 61 **365**	[610] 69 **361**	[734] 83 **346**	[849] 96 **330**	[964] 109 **308**	[1114] 126 **276**	
	[6.6] 25	[301] 34 **476**	[398] 45 **468**	[539] 61 **460**	[610] 69 **453**	[716] 81 **438**	[849] 96 **423**	[964] 109 **395**	[1114] 126 **361**	
	[7.9] 30	[292] 33 **576**	[389] 44 **569**	[531] 60 **561**	[593] 67 **554**	[708] 80 **542**	[840] 95 **531**	[955] 108 **500**	[1114] 126 **465**	
	[9.2] 35	[274] 31 **669**	[371] 42 **665**	[522] 59 **657**	[584] 66 **654**	[708] 80 **638**	[822] 93 **623**	[946] 107 **598**	[1097] 124 **561**	
Max cont	[10.6] 40	[265] 30 **760**	[363] 41 **758**	[513] 58 **753**	[584] 66 **750**	[699] 79 **738**	[814] 92 **724**	[937] 106 **700**	[1079] 122 **670**	Max cont.
Max int.	[11.9] 45	[261] 29.5 **856**	[354] 40 **856**	[504] 57 **850**	[575] 65 **845**	[690] 78 **835**	[796] 90 **815**	[929] 105 **799**	[1070] 121 **780**	Max int.

YMR 80 [4.92 in^3/rev] 80.6 cm^3/rev.

							Max cont.		Max int.	
		[725] 5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[2320] 16	[2537] 17.5	[PSI] MPA
GPM L/ min	[2.6] 10	[486] 55 **115**	[681] 77 **109**	[867] 98 **106**	[946] 107 **101**	[1150] 130 **91**	[1318] 149 **75**	[1503] 170 **53**	[1592] 180 **45**	
	[5.3] 20	[442] 50 **239**	[722] 81.6 **235**	[929] 105 **227**	[1044] 118 **224**	[1167] 132 **209**	[1415] 160 **196**	[1574] 178 **172**	[1671] 189 **160**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[7.9] 30	[425] 48 **364**	[654] 74 **360**	[858] 97 **357**	[1008] 114 **345**	[1159] 131 **332**	[1327] 150 **321**	[1584] 179 **300**	[1680] 190 **284**	
Flow (L/min)	[10.6] 40	[398] 45 **488**	[628] 71 **483**	[840] 95 **475**	[929] 105 **472**	[1132] 128 **460**	[1318] 149 **447**	[1565] 177 **420**	[1663] 188 **408**	
	[13.2] 50	[371] 42 **619**	[619] 70 **615**	[796] 90 **607**	[867] 98 **598**	[1106] 125 **593**	[1300] 147 **568**	[1512] 171 **547**	[1654] 187 **535**	
	[15.8] 60	[336] 38 **740**	[557] 63 **725**	[752] 85 **721**	[840] 95 **715**	[1044] 118 **707**	[1256] 142 **688**	[1495] 169 **667**	[1636] 185 **657**	
Max cont	[18.5] 70	[318] 36 **860**	[513] 58 **853**	[708] 80 **839**	[787] 89 **837**	[991] 112 **823**	[1229] 139 **811**	[1450] 164 **790**	[1583] 179 **776**	Max cont.
Max int.	[19.8] 75	[256] 29 **925**	[495] 56 **915**	[681] 77 **910**	[751] 85 **899**	[973] 110 **888**	[1176] 133 **871**	[1424] 161 **853**	[1565] 177 **837**	Max int.

YMR 100 [6.15 in^3/rev] 100.8 cm^3/rev

							Max cont.		Max int.	
		[725] 5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[2320] 16	[2537] 17.5	[PSI] MPA
GPM L/ min	[2.6] 10	[619] 70 **99**	[884] 100 **95**	[1079] 122 **87**	[1220] 138 **84**	[1406] 159 **74**	[1610] 182 **63**	[1857] 210 **52**	[1963] 222 **44**	
	[5.3] 20	[601] 68 **199**	[840] 95 **194**	[1088] 123 **188**	[1265] 143 **182**	[1459] 165 **175**	[1769] 200 **162**	[1955] 221 **150**	[2105] 238 **138**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[7.9] 30	[548] 62 299	[831] 94 294	[1070] 121 288	[1238] 140 284	[1450] 164 278	[1716] 194 263	[1946] 220 249	[2123] 240 236	
Flow (L/min)	[10.6] 40	[522] 59 **400**	[778] 88 **398**	[1052] 119 **387**	[1185] 134 **385**	[1424] 161 **380**	[1698] 192 **366**	[1928] 218 **350**	[2105] 238 **336**	
	[13.2] 50	[486] 55 **498**	[734] 83 **496**	[1035] 117 **488**	[1106] 125 **484**	[1389] 157 **475**	[1636] 185 **464**	[1919] 217 **450**	[2078] 235 **436**	
	[15.8] 60	[425] 48 **599**	[699] 79 **595**	[973] 110 **587**	[1052] 119 **585**	[1344] 152 **579**	[1592] 180 **569**	[1893 214 **552**	[2061] 233 **538**	
Max cont	[18.5] 70	[380] 43 699	[619] 70 693	[884] 100 687	[991] 112 683	[1256] 142 679	[1503] 170 668	[1778] 201 648	[2025] 229 636	Max cont.
Max int.	[19.8] 75	[345] 39 **748**	[557] 63 **741**	[858] 97 **737**	[929] 105 **735**	[1238] 140 **720**	[1477] 167 **713**	[1742] 197 **697**	[2008] 227 **686**	Max int.

YMR 125 [7.62 in^3/rev] 124.9 cm^3/rev.

							Max cont.		Max int.	
		[725] 5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[2320] 16	[2537] 17.5	[PSI] MPA
GPM L/ min	[2.6] 10	[796] 90 **73**	[1079] 122 **71**	[1415] 160 **66**	[1530] 173 **63**	[1813] 205 **55**	[2096] 237 **42**	[2282] 258 **23**	[2388] 270 **14**	
	[5.3] 20	[752] 85 **154**	[1044] 118 **152**	[1046] 159 **150**	[1521] 172 **145**	[1840] 208 **138**	[2211] 250 **123**	[2459] 278 **109**	[2582] 292 **91**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[7.9] 30	[725] 82 **237**	[946] 107 **236**	[1397] 158 **233**	[1450] 164 **226**	[1822] 206 **219**	[2131] 241 **207**	[2450] 277 **192**	[2574] 291 **170**	
Flow (L/min)	[10.6] 40	[699] 79 **315**	[929] 105 **313**	[1327] 150 **309**	[1424] 161 **307**	[1804] 204 **302**	[2105] 238 **297**	[2432] 275 **272**	[2556] 289 **254**	
	[13.2] 50	[663] 75 **398**	[849] 96 **397**	[1282] 145 **395**	[1415] 160 **391**	[1751] 198 **381**	[2087] 236 **368**	[2317] 262 **353**	[2494] 282 **337**	
	[15.8] 60	[548] 62 **475**	[840] 95 **473**	[1229] 139 **471**	[1397] 158 **470**	[1618] 183 **463**	[1963] 222 **450**	[2246] 254 **427**	[2467] 279 **416**	
Max cont	[18.5] 70	[522] 59 **554**	[734] 83 **553**	[1106] 125 **551**	[1327] 150 **550**	[1574] 178 **546**	[1875] 212 **538**	[2211] 250 **514**	[2317] 262 **500**	Max cont.
Max int.	[19.8] 75	[495] 56 **598**	[708] 80 **597**	[1079] 122 **593**	[1282] 145 **590**	[1521] 172 **586**	[1813] 205 **577**	[2167] 245 **551**	[2308] 261 **537**	Max int.

PERFORMANCE DATA

YMR 160 [9.59 in³/rev] 157.2 cm³/rev.

Flow (L/min) GPM L/min	[725] 5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	Max cont. [2030] 14	[2320] 16	Max int. [2537] 17.5	[PSI] MPA
[2.6] 10	[1017] 115 **58**	[1415] 160 **55**	[1822] 203 **52**	[1946] 220 **50**	[2299] 260 **44**	[2653] 300 **38**	[3007] 340 **34**	[3202] 362 **26**	
[5.3] 20	[1026] 116 **119**	[1415] 160 **115**	[1813] 205 **111**	[2034] 230 **108**	[2344] 265 **103**	[2830] 320 **95**	[3140] 355 **84**	[3361] 380 **76**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[929] 105 **184**	[1397] 158 **181**	[1786] 202 **177**	[1955] 221 **172**	[2308] 261 **165**	[2697] 305 **153**	[3042] 344 **134**	[3343] 378 **130**	
[10.6] 40	[884] 100 **246**	[1282] 145 **244**	[1733] 196 **239**	[1928] 218 **237**	[2273] 257 **230**	[2644] 299 **218**	[3007] 340 **199**	[3308] 374 **184**	
[13.2] 50	[796] 90 **307**	[1238] 140 **305**	[1680] 190 **302**	[1848] 209 **300**	[2211] 250 **292**	[2609] 295 **280**	[2972] 336 **262**	[3237] 366 **244**	
[15.8] 60	[743] 84 **370**	[1203] 136 **368**	[1592] 180 **364**	[1760] 199 **362**	[2123] 240 **355**	[2529] 286 **342**	[2919] 330 **334**	[3184] 360 **304**	
Max cont [18.5] 70	[575] 65 **435**	[1061] 120 **434**	[1450] 164 **430**	[1592] 180 **427**	[1972] 223 **416**	[2476] 280 **405**	[2830] 320 **335**	[3095] 350 **366**	Max cont.
Max int. [19.8] 75	[522] 59 **465**	[1026] 116 **462**	[1397] 158 **458**	[1548] 175 **456**	[1946] 220 **447**	[2406] 272 **433**	[2777] 314 **416**	[3025] 342 **395**	Max int.

YMR 200 [9.59 in³/rev] 157.2 cm³/rev.

Flow (L/min) GPM L/min	[725] 5	[1015] 7	[1305] 9	[1508] 10.5	[1740] 12	Max cont [2030] 14	Max int. [2537] 17.5	[PSI] MPA
[2.6] 10	[1309] 148 **49**	[1813] 205 **47**	[2255] 255 **45**	[2565] 290 **43**	[2892] 327 **40**	[3272] 370 **30**	[3909] 442 **24**	
[5.3] 20	[1238] 140 **99**	[1786] 202 **97**	[2211] 250 **93**	[2857] 323 **90**	[2919] 330 **86**	[3635] 411 **78**	[3962] 448 **65**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[1150] 130 **149**	[1707] 193 **146**	[2131] 241 **140**	[2715] 307 **136**	[2874] 325 **131**	[3334] 377 **122**	[3936] 445 **105**	
[10.6] 40	{1105] 125 **200**	[1645] 186 **197**	[2052] 232 **192**	[2697] 305 **188**	[2768] 313 **181**	[3449] 390 **170**	[3856] 436 **149**	
[13.2] 50	[1061] 120 **250**	[1565] 177 **247**	[1990] 225 **242**	[2609] 295 **238**	[2697] 305 **231**	[3378] 382 **218**	[3776] 427 **193**	
[15.8] 60	[973] 110 **300**	[1468] 166 **298**	[1954] 221 **291**	[2521] 285 **287**	[2582] 292 **282**	[3290] 372 **268**	[3706] 419 **236**	
Max cont [18.5] 70	[867] 98 **350**	[1327] 150 **347**	[1813] 205 **342**	[2158] 244 **338**	[2459] 278 **331**	[2927] 331 **318**	[3626] 410 **282**	Max cont.
Max int. [19.8] 75	[752] 85 **375**	[1247] 141 **372**	[1760] 199 **366**	[2078] 235 **362**	[2370] 268 **357**	[2857] 323 **343**	[3538] 400 **310**	Max int.

YMR 250 [15.38 in³/rev] 252 cm³/rev.

Flow (L/min) GPM L/min	[435] 3	[725] 5	[1015] 7	[1160] 8	[1450] 10	Max cont. [1595] 11	[2030] 14	Max int. [2537] 17.5	[PSI] MPA
[2.6] 10	[1017] 115 **40**	[1415] 180 **38**	[2220] 251 **37**	[2609] 295 **35**	[3095] 350 **32**	[3361] 380 **30**	[4157] 470 **22**	[4732] 535 **16**	
[5.3] 20	[973] 110 **79**	[1574] 178 **78**	[2229] 252 **75**	[2600] 294 **74**	[3113] 352 **70**	[3405] 385 **68**	[4157] 470 **57**	[4847] 548 **48**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[884] 100 **120**	[1503] 170 **119**	[2193] 248 **117**	[2521] 285 **116**	[3078] 348 **110**	[3370] 381 **107**	[4148] 469 **95**	[4820] 545 **79**	
[10.6] 40	[805] 91 **158**	[1406] 159 **157**	[2052] 232 **156**	[2370] 268 **154**	[2936] 332 **151**	[3237] 366 **148**	[4068] 460 **130**	[4687] 530 **110**	
[13.2] 50	[716] 81 **200**	[1309] 148 **198**	[1910] 216 **196**	[2229] 252 **195**	[2830] 320 **163**	[3113] 352 **160**	[4006] 453 **152**	[4608] 521 **147**	
[15.8] 60	[663] 75 **241**	[1167] 132 **240**	[1778] 201 **239**	[2078] 235 **237**	[2697] 305 **232**	[3007] 340 **228**	[3829] 433 **210**	[4466] 505 **180**	
Max cont [18.5] 70	[442] 50 **280**	[1035] 117 **279**	[1671] 189 **277**	[1946] 220 **276**	[2565] 290 **271**	[2830] 320 **268**	[3644] 412 **250**	[4378] 495 **215**	Max cont.
Max int. [19.8] 75	[371] 42 300	[929] 105 299	[1592] 180 298	[1866] 211 297	[2485] 281 295	[2742] 310 289	[3582] 405 272	[4298] 486 239	Max int.

YMR 315 [19.19 in³/rev] 314.5 cm³/rev.

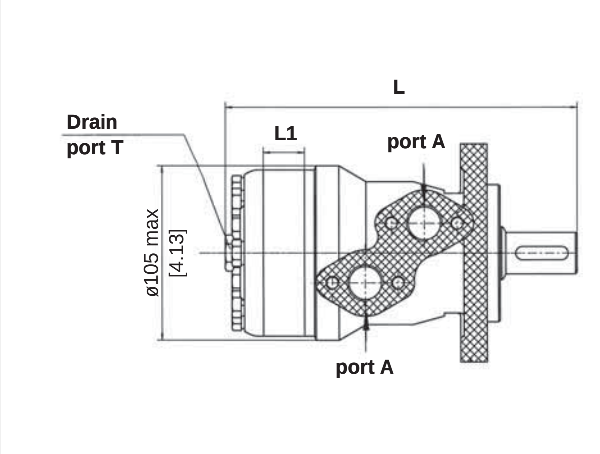
Flow (L/min) GPM L/min	[435] 3	[725] 5	[942] 6,5	[1160] 8	Max cont. [1305] 9	[1885] 13	Max int. [1957] 13,5	[PSI] MPA
[2.6] 10	[1194] 135 **31**	[1901] 215 **29**	[2467] 279 **28**	[3033] 343 **27**	[3387] 383 **27**	[4555] 515 **24**	[4864] 550 **22**	
[5.3] 20	[1176] 133 **62**	[1910] 216 **61**	[2556] 289 **60**	[3086] 349 **58**	[3361] 380 **57**	[4493] 508 **52**	[4882] 552 **50**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[1105] 125 **95**	[1813] 205 **92**	[2432] 275 **91**	[3016] 341 **90**	[3316] 375 **88**	[4369] 494 **81**	[4802] 543 **79**	
[10.6] 40	[999] 113 **123**	[1724] 195 **121**	[2361] 267 **120**	[2963] 335 **118**	[3246] 367 **117**	[4289] 485 **106**	[4652] 526 **104**	
[13.2] 50	[814] 92 **155**	[1503] 170 **154**	[2237] 253 **152**	[2839] 321 **149**	[3113] 352 **147**	[4192] 474 **137**	[4519] 511 **133**	
[15.8] 60	[707] 80 **190**	[1415] 160 **187**	[2043] 231 **193**	[2697] 305 **179**	[2954] 334 **176**	[4050] 458 **163**	[4351] 492 **157**	
Max cont [18.5] 70	[504] 57 **222**	[1203] 136 **220**	[1901] 215 **217**	[2520] 285 **212**	[2830] 320 **208**	[3927] 444 **192**	[4245] 480 **185**	Max cont.
Max int. [19.8] 75	[486] 55 **235**	[1097] 124 **234**	[1813] 205 **231**	[2379] 269 **227**	[2724] 308 **225**	[3776] 427 **408**	[4148] 469 **201**	Max int.

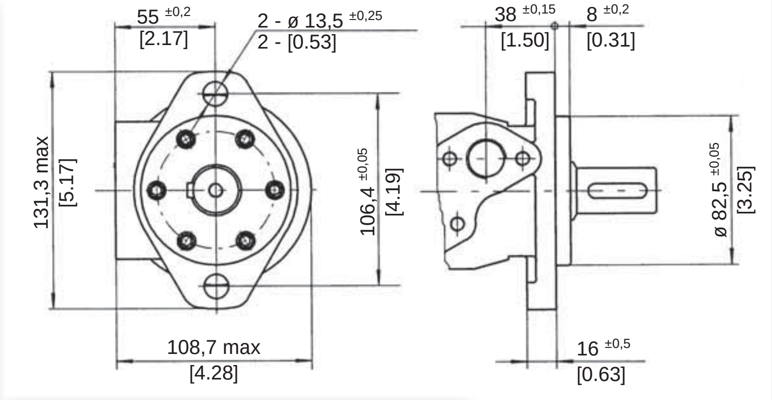
PERFORMANCE DATA

YMR 375 [22.58 in^3/rev] 370 cm^3/rev.

							Max cont.		Max int.	
			[435] 3	[725] 5	[942] 6.5	[1160] 8	[1305] 9	[1885] 13	[1957] 13.5	[PSI] MPA
Flow (L/min)	GPM L/ min	[2.6] 10	[1415] 160 **26**	[2388] 270 **25**	[3007] 340 **24**	[3714] 420 **22**	[4157] 470 **21**	[4864] 550 **19**	[5395] 610 **17**	
		[5.3] 20	[1406] 159 **53**	[2299] 260 **52**	[3007] 340 **51**	[3626] 410 **49**	[4157] 470 **47**	[4776] 540 **42**	[5351] 605 **37**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
		[7.9] 30	[1327] 150 **79**	[1990] 225 **78**	[2918] 330 **77**	[3538] 400 **75**	[3980] 450 **73**	[4687] 530 **67**	[5306] 600 **60**	
		[10.6] 40	[1194] 135 **106**	[2123] 240 **105**	[2742] 310 **104**	[3317] 375 **102**	[3803] 430 **99**	[4599] 520 **93**	[5218] 590 **85**	
		[13.2] 50	[1061] 120 **134**	[2034] 230 **132**	[2609] 295 **131**	[3184] 360 **129**	[3714] 420 **126**	[4466] 505 **120**	[5041] 570 **110**	
		[15.8] 60	[867] 98 **159**	[1857] 210 **158**	[2432] 275 **157**	[3007] 340 **155**	[3449] 390 **153**	[4334] 490 **147**	[4864] 550 **135**	
	Max cont	[18.5] 70	[663] 75 **187**	[1548] 175 **186**	[2211] 250 **185**	[2830] 320 **183**	[3272] 370 **180**	[4112] 465 **175**	[4687] 530 **160**	Max cont.
	Max int.	[19.8] 75	[575] 65 **200**	[1415] 160 **199**	[2034] 230 **198**	[2742] 310 **195**	[3184] 360 **192**	[3980] 450 **187**	[4555] 515 **178**	Max int.

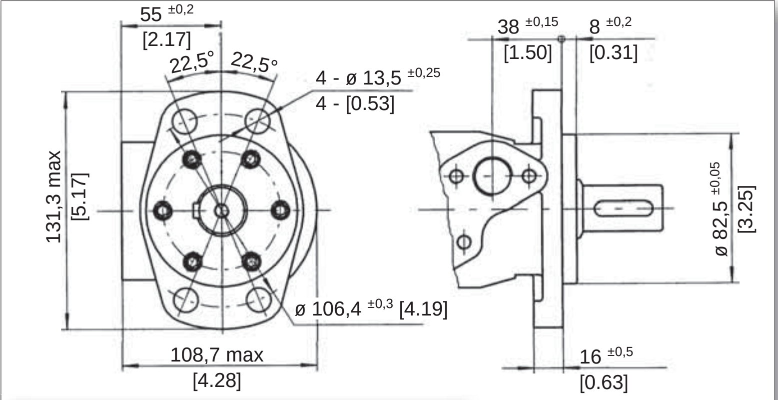
DIMENSIONS AND MOUNTING DATA



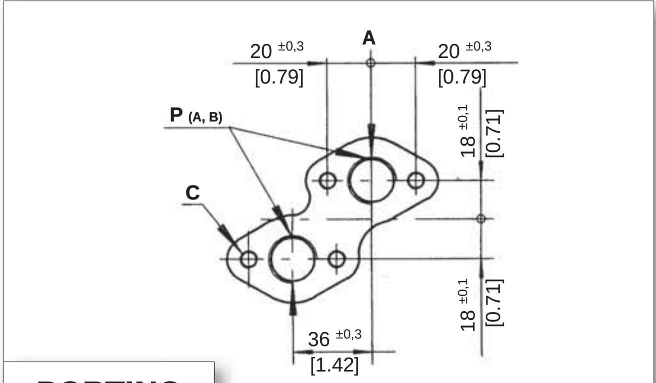


FLANGE 2 SAE-A 2 BOLT

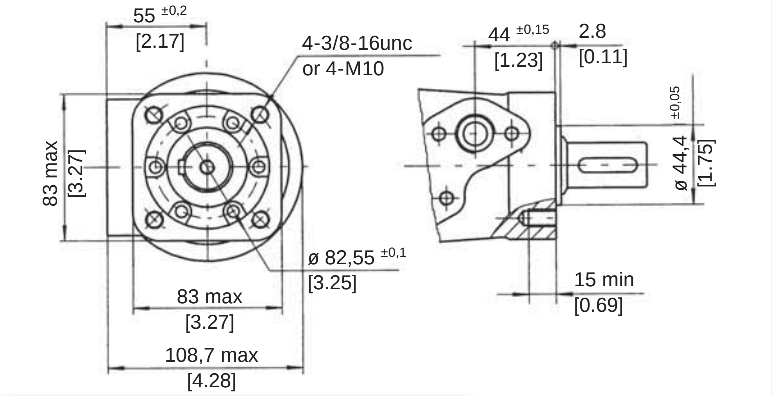
MODEL	[INCHES]		MILLIMETERS	
	L	L1	L	L1
YMR 50	[5.51]	[0.39]	140	10
YMR 80	[5.75]	[0.63]	146	16
YMR 100	[5.91]	[0.79]	150	20
YMR 125	[6.10]	[0.98]	155	25
YMR 160	[6.36]	[1.24]	161.5	31.5
YMR 200	[6.69]	[1.57]	170	40
YMR 250	[7.09]	[1.97]	180	50
YMR 315	[7.56]	[2.44]	192	62
YMR 375	[8.03]	[2.91]	204	74



FLANGE 4 MAGNETO



PORTING D,M,S,P,R



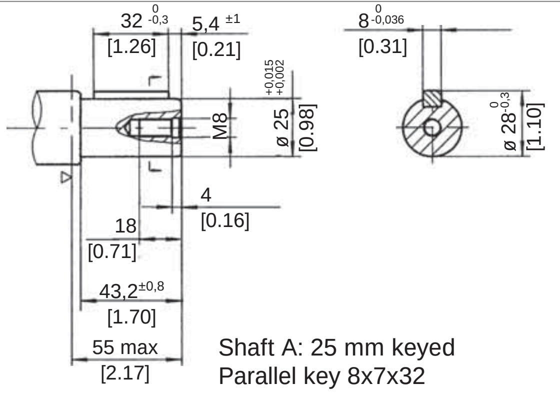
FLANGE H4/H5 4 BOLT

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	P	DEPTH	R	DEPTH
PORTS - A and B	G 1/2	15 mm	M22 X 1.5	15 mm	7/8-14 O-RING	17 mm	1/2-14NPTF	15 mm	PT(RC)1/2	15 mm
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	7/16-20UNF	12 mm	7/16-20UNF	12 mm	PT(RC)1/4	9.7 mm
BOLTS - C	4-M8	13 mm	4-M8	13 mm	4-5/16-18UNC	13 mm	4-5/16-18UNC	13 mm	4-M8	13 mm

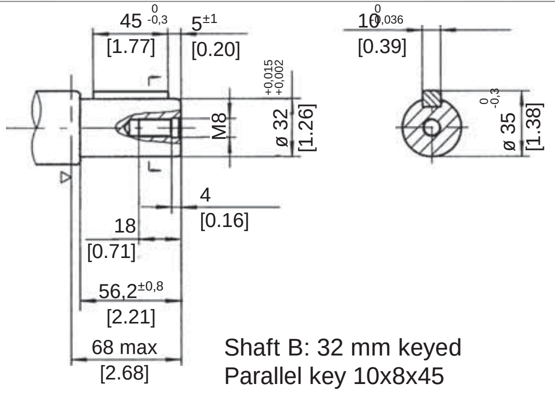
MOTOR SHAFT EXTENSIONS

A



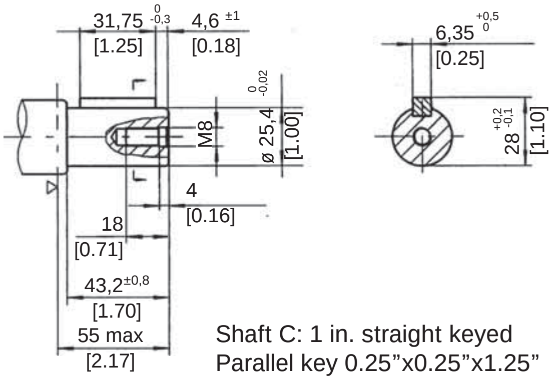
Shaft A: 25 mm keyed
Parallel key 8x7x32

B



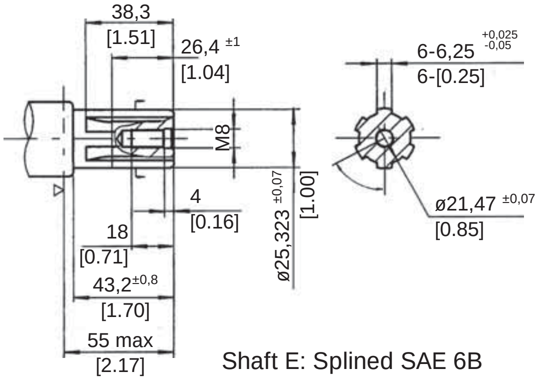
Shaft B: 32 mm keyed
Parallel key 10x8x45

C



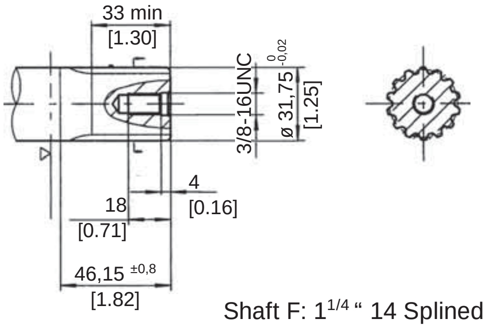
Shaft C: 1 in. straight keyed
Parallel key 0.25”x0.25”x1.25”

E



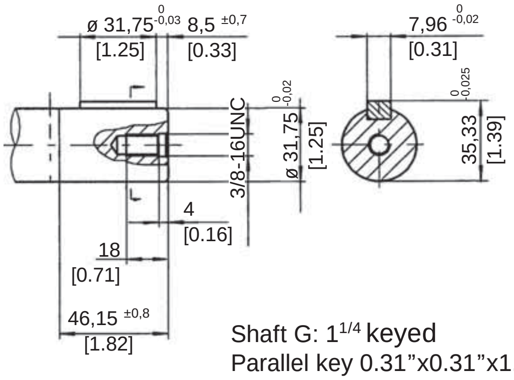
Shaft E: Splined SAE 6B

F



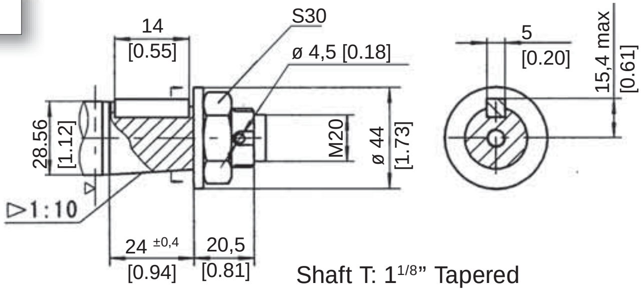
Shaft F: 1$^{1/4}$“ 14 Splined
14-DP12/24

G



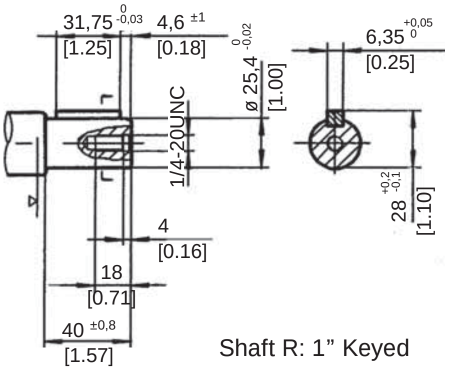
Shaft G: 1$^{1/4}$ keyed
Parallel key 0.31”x0.31”x1.25”

T



Shaft T: 1$^{1/8}$” Tapered
Parallel Key B5X5X14
Tightening torque:
100+10NM

R

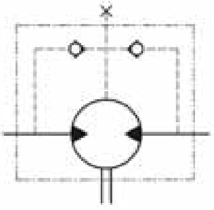


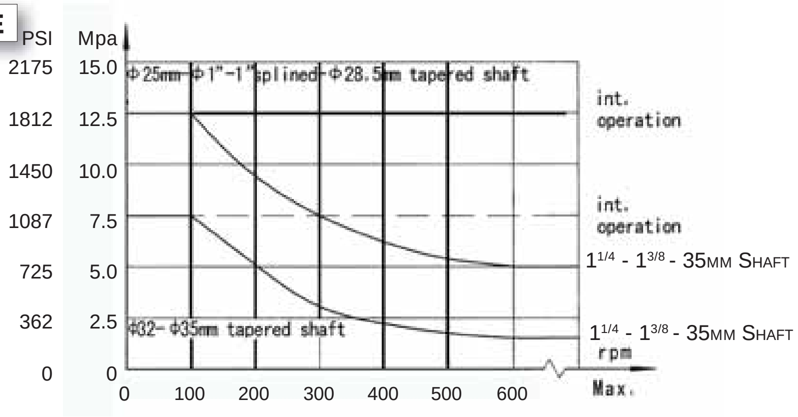
Shaft R: 1” Keyed
Parallel key 0.25”x0.25”x1.25”

▷ Motor Mounting Surface

ADDITIONAL INFORMATION

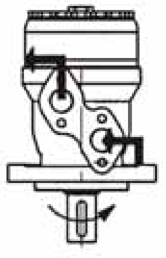
PERMISSIBLE SHAFT SEAL PRESSURE





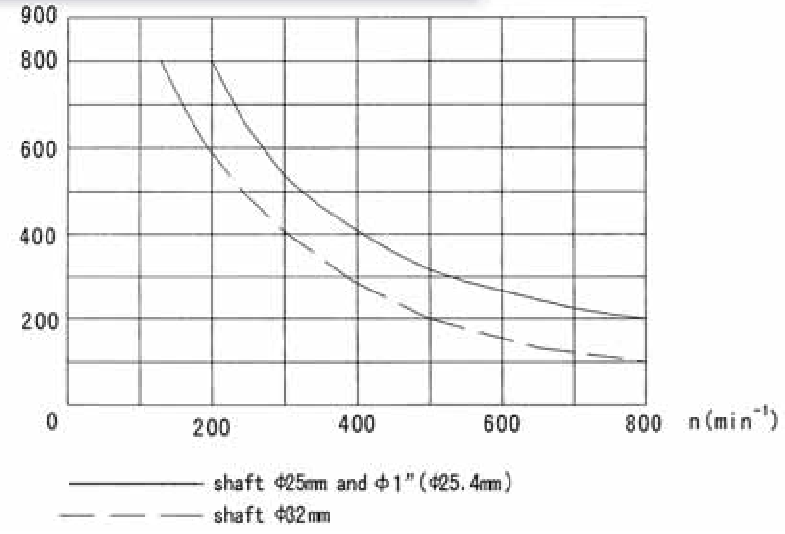
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

SHAFT ROTATION DIRECTION

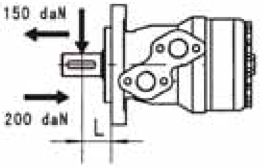


YMR

STATUS OF THE SHAFT'S RADIAL FORCE



$$F_r = \frac{800}{n} \cdot \frac{2500}{95+l} \text{ daN}$$



F_r =Radial Force (daN)
L =Distance (mm)
n =Speed (rpm)

Rhomb-flange L=30mm
Square-flange L=24mm

212

ORDER INFORMATION

	1	2	3	4	5	6	7
YMR							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
50	**2**	SAE - A 2 Bolt Pilot .25”×0.31”	**A**	Shaft 25mm Keyed Parallel key 8×7×32	**D**	G1/2 Manifold Mount 4×M8, G1/4	**N0NE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
80	**4**	4 Bolt Magneto Pilot .25”×0.31”	**B**	Shaft 32mm Keyed Parallel key 10×8×45	**M**	M22×1.5 Manifold Mount 4×M8, M14×1.5	**R**	OPPOSITE	**NONE**	BLUE	**N**	BIG RADIAL FORCE
100	**H4**	4 Bolt Flange Pilot 1.75”×0.11” 4 bolts: 3/8 - 16UNC	**C**	Shaft 1” keyed Parallel key 25”x0.25”×1.25”	**S**	7/8-14 O-ring manifold 4x5/16-18UNC, 7/16-20UNF			**B**	BLACK	**AX**	BIG AXIAL FORCE
125	**H5**	4 Bolt Flange Pilot Ø44.4×2.8 4 x M10	**E**	Splined SAE 6B	**P**	1/2-14 NPTF Manifold 4x5/16-18UNC, 7/16-20UNF			**S**	SILVER GRAY	**0**	NO CASE DRAIN
160			**R**	Short shaft 1” Keyed Parallel key 25”x0.25”×1.25”	**R**	PT(Rc)1/2 Manifold 4xM8, PT(Rc)1/4					**FR**	FREE RUNNING
200			**F**	$1^{1/4}$” 14 Splined 14-DP12/24							**LL**	LOW LEAKAGE VALVE
250			**FD**	Long - $1^{1/4}$” 14 Splined 14-DP12/24							**LSV**	LOW SPEED VALVE
315			**G**	$1^{1/4}$” keyed Parallel key 31”×0.31”x1.25”							**CRS**	CORROSION RESISTANT SHAFT
375			**T**	$1^{1/8}$” Tapered Parallel key B5X5X14							**HPS**	HIGH PRESSURE SEAL
											HTS	HIGH TEMP SEAL

Ordering Code:
All options have been determined with letters,numbers or combinations. All boxes must be filled with proper codes.If specification is not in the table,please contact us with your requirements.

YMRS

The **YMRS** series motor uses the **spool valve** shaft distribution design for simplicity, efficiency and compactness. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This series uses the more advanced “**ROLLER**” gear type. It is manufactured with the most advanced technology and equipment to improve efficiency, smoothness, lower leakage and better overall performance.

This design has identical displacements and perfomance of the YMR series with a few different options.

These motors are very compact, economical, and powerful without the need of a reducer to deliver high torque.

The large number of shaft, flange, port and special options make this a very flexible motor useful for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Axial Distribution	YMRS	[in^3./rev]	[3.05 ~ 22.88]	[PSI]	[2900]	RPM	[HP]	[20]
		cm^3/rev.	50 ~ 375	MPa	20	30 ~ 970	Kw	17

YMRS SERIES QUICK REFERENCE:

Displacements				
[in³./rev]	cm³/rev.			
[3.13]	51.3	FLOW UP TO	75 LPM	[20 GPM]
[4.92]	80.6	PRESSURE UP TO	20 MPa	[2900 PSI]
[6.15]	100.8	TORQUE UP TO	548 Nm	[4846 in.-lb.]
[7.62]	124.9	POWER UP TO	17 Kw	[23 HP]
[9.59]	157.2	SPEED UP TO	970 RPM	
[12.16]	199.2			
[15.38]	252			
[19.19]	314.5			
[22.58]	370			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environment and applications.

APPLICATION GUIDELINES:

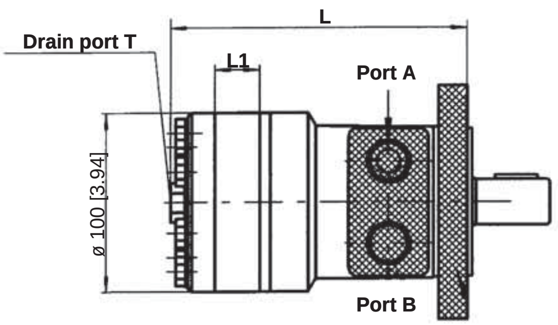
For optimum results the following working conditions are recommended:
- Oil temperature should be between 20° - 60° C [68° - 180° F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40° C
- Different shafts are used when there is a radial load or not. Check data pages
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

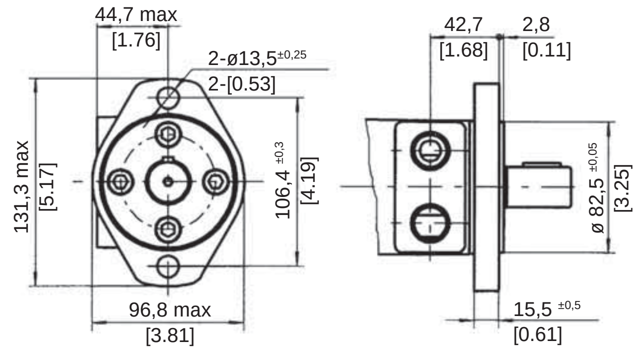
SPECIFICATION DATA

For individual motor performance chart consult equivilant YMR series data

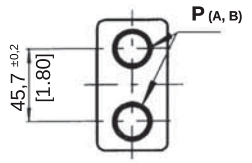
DISTRIBUTION TYPE			**YMRS 50**	**YMRS 80**	**YMRS 100**	**YMRS 125**	**YMRS 160**	**YMRS 200**	**YMRS 250**	**YMRS 315**	**YMRS 375**
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[3.13]	[4.92]	[6.15]	[7.62]	[9.59]	[12.16]	[15.38]	[19.19]	[22.58]
		cm^3/rev.	**51.3**	**80.6**	**100.8**	**124.9**	**157.2**	**199.2**	**252**	**314.5**	**370**
MAX. SPEED RPM		RATED	755	750	600	475	375	300	240	190	160
		CONT.	**970**	**940**	**750**	**600**	**470**	**375**	**300**	**240**	**200**
MAX. TORQUE [LB.IN.] N*M	RATED	[LB.IN.]	[884]	[1415]	[1769]	[2211]	[2830]	[2919]	[3113]	[3184]	[3714]
		N*M	**100**	**160**	**200**	**250**	**320**	**330**	**352**	**360**	**420**
	CONT.	[LB.IN.]	[884]	[1680]	[2123]	[2582]	[3210]	[3166]	[3113]	[3184]	[3714]
		N*M	**100**	**190**	**240**	**292**	**363**	**358**	**352**	**360**	**420**
	INT.	[LB.IN.]	[1114]	[1946]	[2476]	[3007]	[3803]	[3962]	[4157]	[4157]	[4847]
		N*M	**126**	**220**	**280**	**340**	**430**	**448**	**470**	**470**	**548**
MAX. OUTPUT [HP] KW	RATED	[HP]	[10]	[17]	[17]	[16]	[17]	[14]	[12]	[9]	[9]
		KW	**7.7**	**12.3**	**12.3**	**12.0**	**12.3**	**10**	**9**	**7**	**6.5**
	CONT.	[HP]	[10]	[20]	[20]	[19]	[19]	[15]	[12]	[9]	[12]
		KW	**7.7**	**15**	**15**	**14**	**14**	**11**	**9**	**7**	**8.6**
	INT.	[HP]	[13]	[23]	[23]	[22]	[22]	[19]	[16]	[12]	[16]
		KW	**9.7**	**17**	**17**	**16**	**16**	**14**	**12**	**9**	**12**
MAX. PRESSURE DROP [PSI] MPA	RATED	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[1740]	[1595]	[1232]	[1232]
		MPA	**14**	**14**	**14**	**14**	**14**	**12**	**11**	**8.5**	**8.5**
	CONT.	[PSI]	[2030]	[2537]	[2537]	[2537]	[2392]	[1885]	[1595]	[1232]	[1232]
		MPA	**14**	**17.5**	**17.5**	**17.5**	**16.5**	**13**	**11**	**8.5**	**8.5**
	INT.	[PSI]	[2538]	[2900]	[2900]	[2900]	[2900]	[2537]	[2030]	[1667]	[1667]
		MPA	**17.5**	**20**	**20**	**20**	**20**	**17.5**	**14**	**11.5**	**11.5**
MAX. FLOW [GPM] L/MIN	CONT.	[GPM]	[10.6]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	**40**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
	INT.	[GPM]	[13.2]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**50**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
WEIGHT [LB] KG		[LB]	[15]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]
		KG	**6.7**	**6.9**	**6.9**	**7.2**	**7.5**	**8**	**8.5**	**9**	**9.3**

DIMENSIONS AND MOUNTING DATA

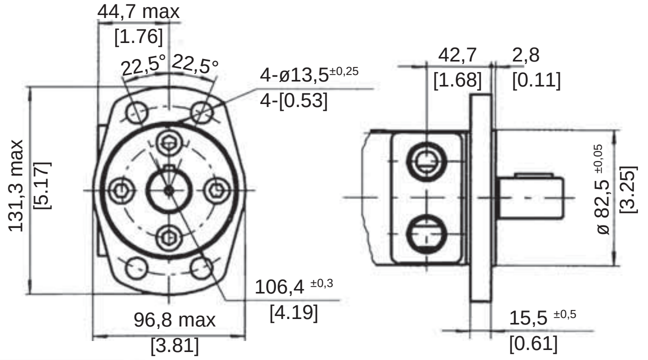




FLANGE H2



PORT G-S-P-R M1-M2-M3



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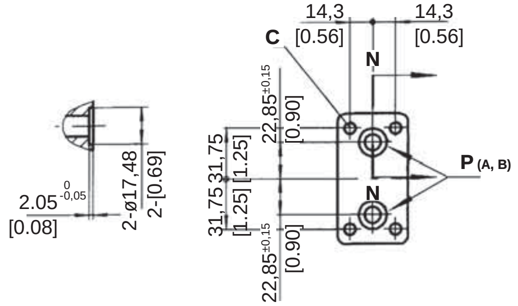
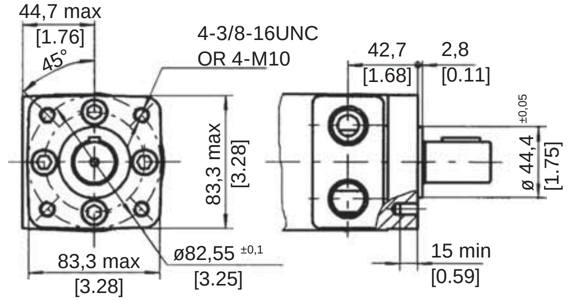


PORT B4 -B5



FLANGE H4/H5

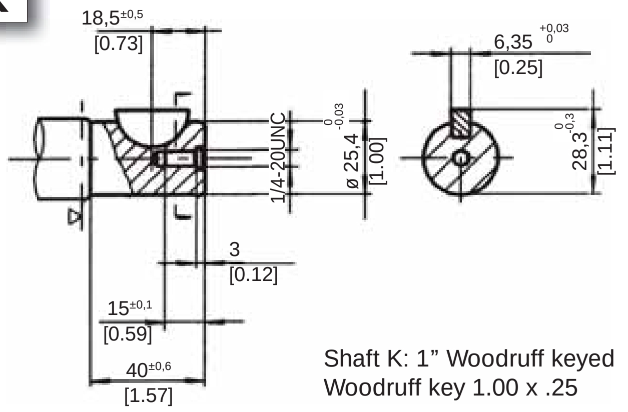
	[INCHES]		MILLIMETERS	
MODEL	**L**	**L1**	**L**	**L1**
YMRS 50	[5.67]	[0.39]	144	10
YMRS 80	[5.91]	[0.63]	150	16
YMRS 100	[6.06]	[0.79]	154	20
YMRS 125	[6.26]	[0.98]	159	25
YMRS 160	[6.12]	[1.24]	155.5	31.5
YMRS 200	[6.85]	[1.57]	174	40
YMRS 250	[7.24]	[1.97]	184	50
YMRS 315	[7.72]	[2.44]	196	62
YMRS 375	[8.19]	[2.91]	208	74

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	G	DEPTH	S	DEPTH	P	DEPTH	R	DEPTH	M1	DEPTH	M2	DEPTH	M3	DEPTH	B4	DEPTH	B5	DEPTH
PORTS A and B	G 1/2	15 mm	7/8-14 O-RING	17 mm	1/2 14NPTF	15 mm	PT(RC) 1/2	15 mm	M18 X 1.5	15 mm	M20 X 1.5	15 mm	M22 X 1.5	15 mm	Ø10	-	Ø10	-
TANK PORT T	G 1/4	12 mm	7/16 20UNF	12 mm	7/16 20UNF	12 mm	PT(RC) 1/4	9.7 mm	M10 X 1	12 mm	M10 X 1	12 mm	M10 X 1	12 mm	7/16 20UNF	12 mm	G1/4	12 mm
BOLTS - C	-	-	-	-	-	-	-	-	-	-					4-5/16 18UNC	13 mm	4-M8	13 mm

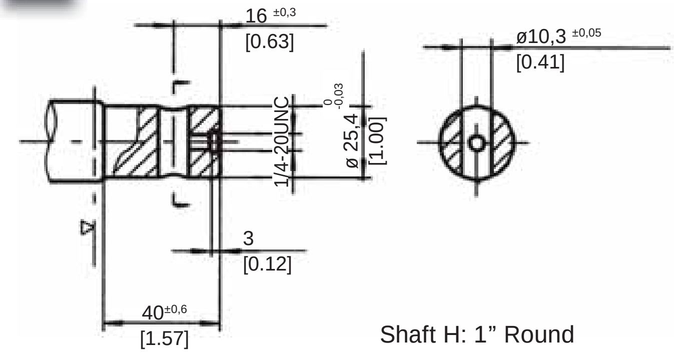
MOTOR SHAFT EXTENSIONS

K



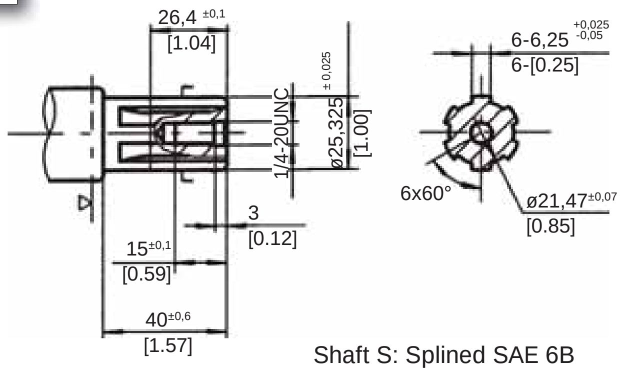
Shaft K: 1” Woodruff keyed
Woodruff key 1.00 x .25

H



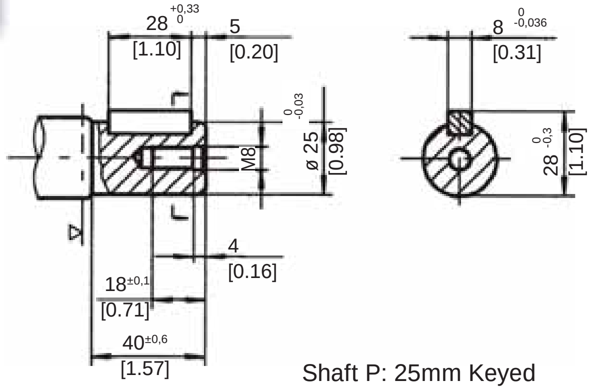
Shaft H: 1” Round
Cross Hole .41

S



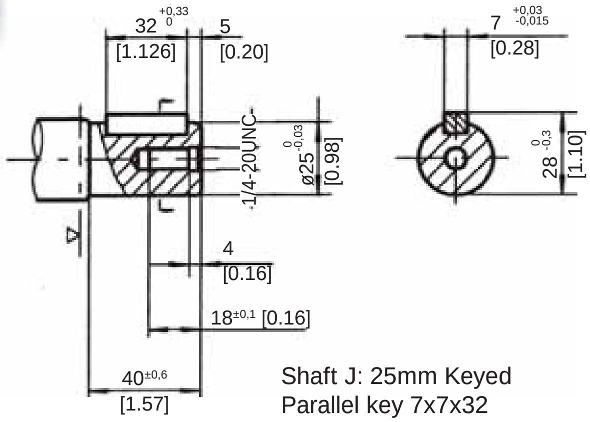
Shaft S: Splined SAE 6B

P



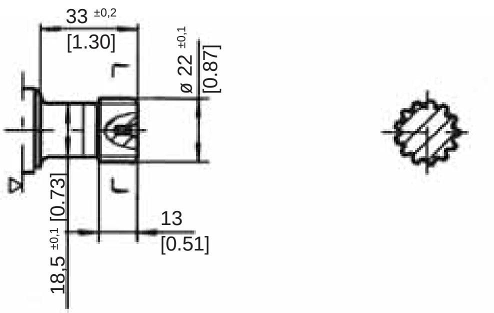
Shaft P: 25mm Keyed
Parallel key 8x7x28

J



Shaft J: 25mm Keyed
Parallel key 7x7x32

I

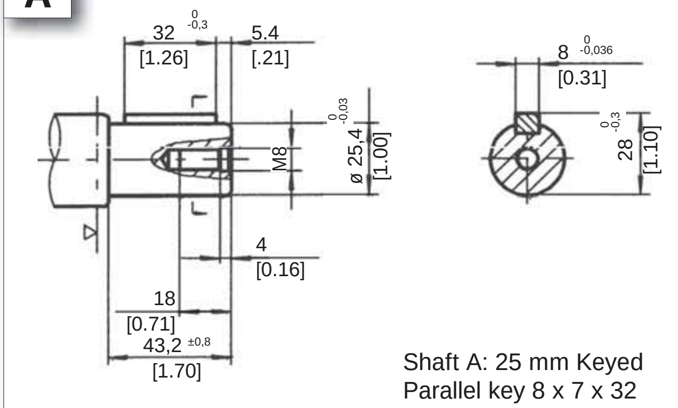


Shaft I: 7/8-13 Splined
13-DP 16/32

▷ Motor Mounting Surface

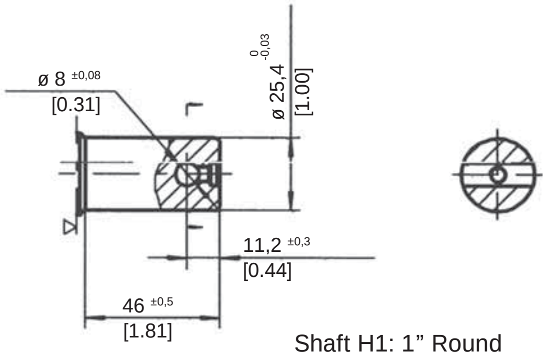
MOTOR SHAFT EXTENSIONS

A



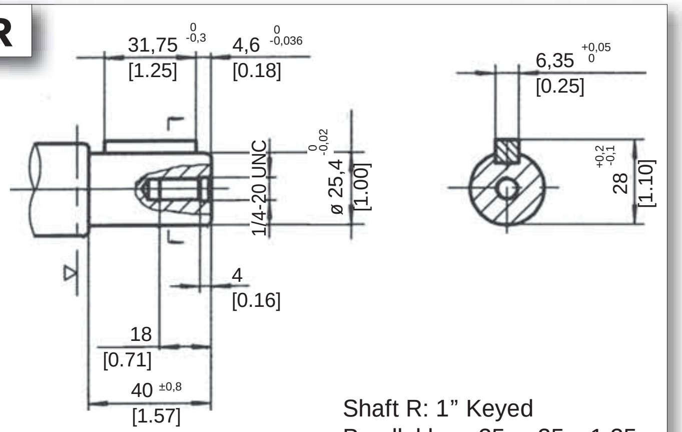
Shaft A: 25 mm Keyed
Parallel key 8 x 7 x 32

H1



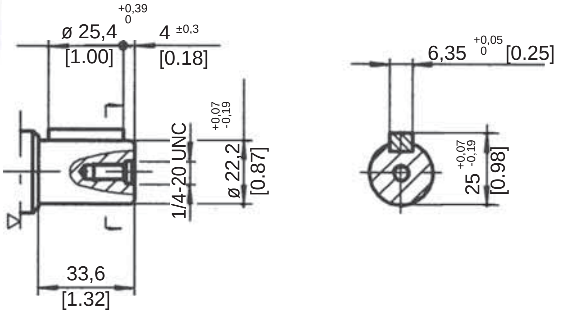
Shaft H1: 1” Round
Cross Hole .31

R



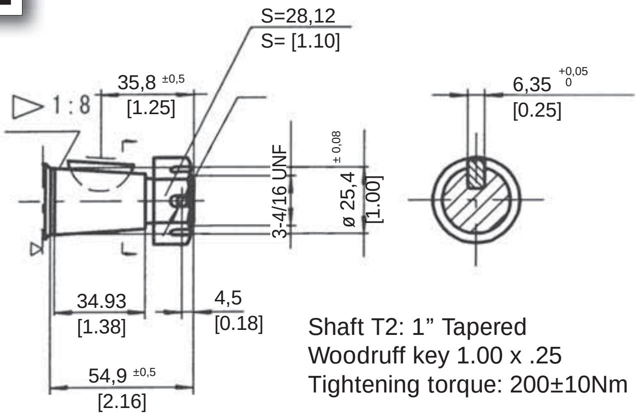
Shaft R: 1” Keyed
Parallel key .25 x .25 x 1.25

D



Shaft D: 7/8 Keyed
Parallel key .25 x .25 x 1.00

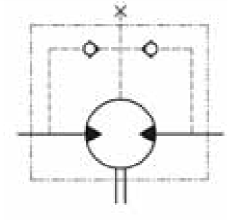
T2

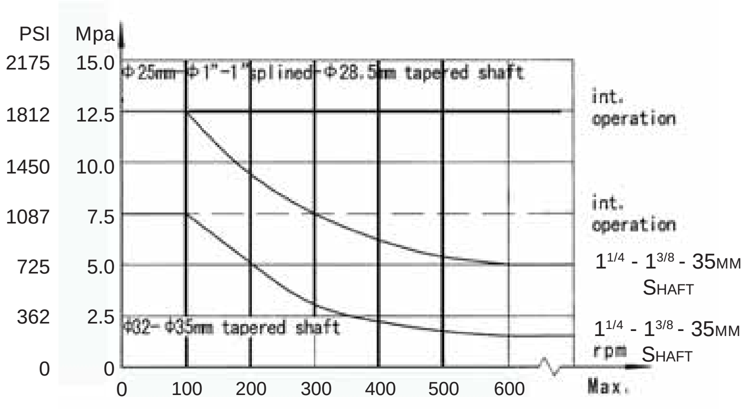


Shaft T2: 1” Tapered
Woodruff key 1.00 x .25
Tightening torque: 200±10Nm

ADDITIONAL INFORMATION

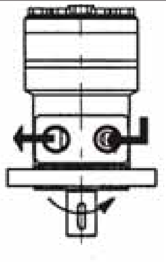
PERMISSIBLE SHAFT SEAL PRESSURE





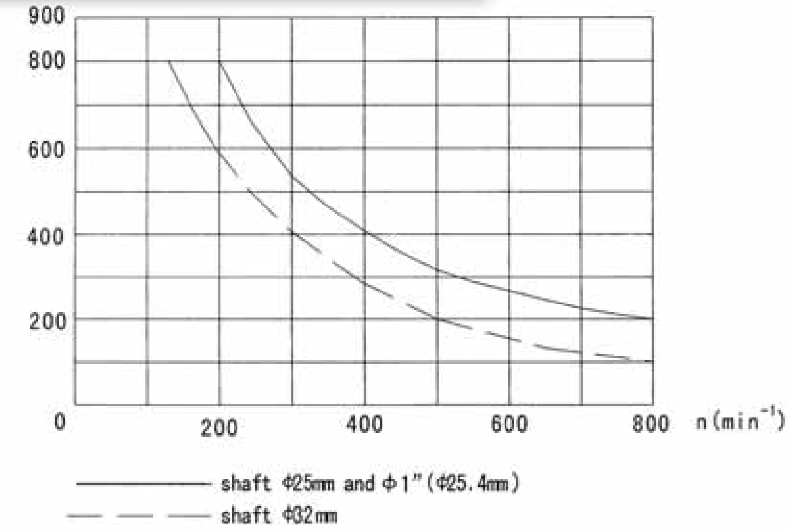
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

SHAFT ROTATION DIRECTION

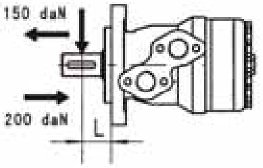


YMRS

STATUS OF THE SHAFT'S RADIAL FORCE



$$F_r = \frac{800}{n} \cdot \frac{2500}{95+l} \text{ daN}$$



F_r =Radial Force (daN)
L =Distance (mm)
n =Speed (rpm)

Rhomb-flange L=30mm
Square-flange L=24mm

ORDER INFORMATION

	1	2	3	4	5	6	7
YMRS							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
50	**H2**	SAE - A 2 Bolt Pilot .25”×0.31”	**K**	Shaft K: 1” Woodruff keyed • Woodruff key 1.00 x .25	**G**	G1/2, G1/4	**N0NE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
80	**H6**	4 Bolt Magneto Pilot .25”×0.31”	**H**	Shaft H: 1” Round Cross Hole .41	**S**	7/8-14 O-RING 7/16-20 UNF (G1/4)	**R**	OPPOSITE	**NONE**	BLUE	**N**	BIG RADIAL FORCE
100	**H4**	4 Bolt Flange Pilot .75”×0.11” 4 bolts: 3/8 - 16UNC	**S**	Shaft S: Splined SAE 6B	**P**	1/2NPTF, 7/16-20 UNF (G1/4)			**B**	BLACK	**AX**	BIG AXIAL FORCE
125	**H5**	4 Bolt Flange Pilot Ø44.4×2.8 4 x M10	**P**	Shaft P: 25mm Keyed Parallel key 8x7x28	**R**	PT(Rc)1/2 , PT(Rc)1/4			**S**	SILVER GRAY	**0**	NO CASE DRAIN
160			**J**	Shaft J: 25mm Keyed Parallel key 7x7x32	**M1**	M18 X 1.5, M10 X 1					**FR**	FREE RUNNING
200			**I**	Shaft I: 7/8 -13 Splined 13-DP16/32	**M2**	M20 X 1.5, M10 X 1					**LL**	LOW LEAKAGE VALVE
250			**A**	Shaft A: 25mm Keyed Parallel key 8x7x32	**M3**	M22 X 1.5, M10 X 1					**LSV**	LOW SPEED VALVE
315			**H1**	Shaft H1: 1” Round Cross Hole .31	**B4**	Ø10 O-ring manifold 4 x 5/16-18 7/16-20UNF (G 1/4)					**CRS**	CORROSION RESISTANT SHAFT
375			**R**	Shaft R: 1” Keyed Parallel Key .25x.25x1.25	**B5**	Ø10 O-ring manifold 4 x M8, 7/16-20UNF (G 1/4)					**HPS**	HIGH PRESSURE SEAL
			D	Shaft D: 7/8 Keyed Parallel key .25x.25x1.00							**HTS**	HIGH TEMP SEAL
			T2	Shaft T2: 1” Tapered Woodruff key 1.00x.25 Tightening torque: 200±10Nm								

Note: All options have been designated with a letter, number, or a combination. All boxes must be filled with the corresponding code. If your specification is not in the opeions list please contact us with your requirements.

YMH

YMH series motor uses the **spool valve** shaft distribution design for simplicity, efficiency and compactness. This design integrates the distribution and hydraulic bearing design with the motor shaft.

This series uses the more advanced **“ROLLER”** gear type. It is manufactured with the most advanced technology and equipment to improve efficiency, smoothness, lower leakage and better overall performance.

These motors are very compact, economical, and powerful without the need of a reducer to deliver high torque.

The large number of shaft, flange, port and special options make this a very flexible motor useful for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Spool Valve Distribution	YMP	[in^3./rev]	[12.21~30.52]	[PSI]	[2900]	RPM	[HP]	[23]
		cm^3/rev.	200 ~ 500	MPA	20	30~430	Kw	17

QUICK REFERENCE GUIDE

YMH SERIES QUICK REFERENCE:

Displacements				
[in^{3}./rev]	cm^{3}/rev.			
[12.4]	203.2	FLOW UP TO	90 LPM	[23.78 GPM]
[15.61]	255.9	PRESSURE UP TO	20 MPa	[2900 PSI
[19.29]	316.1	TORQUE UP TO	533 Nm	[4713lb.-in.]
[24.80]	406.0	POWER UP TO	17 Kw	[21.6 HP]
[29.85]	489.2	SPEED UP TO	439 RPM	

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^{o} - 60^{o} C [68^{o} - 180^{o} F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^{2} at 40^{o} C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			**YMH 200**	**YMH 250**	**YMH 315**	**YMH 400**	**YMH 500**
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[12.40]	[15.62]	[19.29]	[24.80]	[29.86]
		cm^3/rev.	**203.2**	**255.9**	**316.1**	**406.4**	**489.2**
MAX. SPEED RPM		RATED	263	209	169	131	109
		CONT.	366	290	236	183	155
		INT.	**439**	**348**	**282**	**220**	**166**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[2636]	[3317]	[4015]	[4219]	[4059]
		N*M	**298**	**375**	**454**	**477**	**459**
	CONT.	[LB. IN.]	[4510]	[5492]	[6545]	[7641]	[7066]
		N*M	**510**	**621**	**740**	**864**	**799**
	INT.	[LB. IN.]	[5121]	[6208]	[7314]	[8738]	[8588]
		N*M	**579**	**702**	**827**	**988**	**971**
	PEAK	[LB. IN.]	[5757]	[6987]	[8225]	[9658]	[9658]
		N*M	**651**	**790**	**930**	**1092**	**1092**
MAX. OUTPUT [HP] KW	RATED	[HP]	[11]	[11]	[11]	[9]	[7]
		KW	**8.2**	**8.2**	**8.2**	**6.6**	**5.2**
	CONT.	[HP]	[15]	[12]	[13]	[10]	[9]
		KW	**11.2**	**9.2**	**9.8**	**7.4**	**6.5**
	INT.	[HP]	[23]	[20]	[17]	[17]	[15]
		KW	**17**	**15**	**13**	**13**	**11**
MAX. PRESSURE DROP [PSI] MPA	RATED	[PSI]	[1813]	[1813]	[1813]	[1450]	[1160]
		MPA	**12.5**	**12.5**	**12.5**	**10**	**8**
	CONT.	[PSI]	[2538]	[2538]	[2538]	[2248]	[1813]
		MPA	**17.5**	**17.5**	**17.5**	**15.5**	**12.5**
	INT.	[PSI]	[2900]	[2900]	[2900]	[2755]	[2320]
		MPA	**20**	**20**	**20**	**19**	**16**
	PEAK	[PSI]	[3263]	[3263]	[3263]	[3045]	[2610]
		MPA	**22.5**	**22.5**	**22.5**	**21**	**18**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[15.8]	[15.8]	[15.8]	[15.8]	[15.8]
		L/MIN	**60**	**60**	**60**	**60**	**60**
	CONT.	[GPM]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**75**	**75**	**75**	**75**	**75**
	INT.	[GPM]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]
		L/MIN	**90**	**90**	**90**	**90**	**90**
WEIGHT [LB] KG		[LB]	[23]	[24]	[25]	[27]	[29]
		KG	10.5	11	11.5	12.3	13

PERFORMANCE DATA

YMH 200 [12.40 in^3/rev] 203.2 cm^3/rev.

Flow (L/min)

					Max cont.	Max int.	
GPM L/ min	[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[2900] 20	[PSI] MPa
[1.3] 5	[867] 98 **25**	[1716] 194 **25**	[2512] 284 **22**				
[2.6] 10	[893] 101 **43**	[1804] 204 **41**	[2662] 301 **36**	[3458] 391 **29**	[4263] 482 **14**		
[5.3] 20	[876] 99 **100**	[1778] 201 **97**	[2689] 304 **93**	[3555] 402 **85**	[4502] 509 **69**	[5094] 576 **56**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[858] 97 **145**	[1742] 197 **143**	[2653] 300 **139**	[3555] 402 **130**	[4510] 510 **114**	[5121] 579 **101**	
[10.6] 40	[796] 90 **200**	[1680] 190 **200**	[2582] 292 **200**	[3529] 399 **188**	[4484] 507 **168**	[5112] 578 **153**	
[13.2] 50	[725] 82 **248**	[1618] 183 **246**	[2512] 284 **244**	[3467] 392 **235**	[4422] 500 **213**	[5050] 571 **199**	
[15.9] 60	[646] 73 **292**	[1539] 174 **290**	[2423] 274 **287**	[3396] 384 **279**	[4360] 493 **260**	[4979] 563 **244**	
[18.5] 70	[557] 63 **352**	[1442] 163 **350**	[2335] 264 **349**	[3308] 374 **338**	[4254] 481 **318**	[4900] 554 **301**	
Max cont [19.8] 75	[522] 59 **366**	[1389] 157 **365**	[2291] 259 **363**	[3237] 366 **355**	[4201] 475 **335**	[4838] 547 **319**	
[21.1] 80	[469] 53 **381**	[1327] 150 **381**	[2238] 253 **380**	[3166] 358 **371**	[4121] 466 **352**	[4758] 538 **338**	Max cont.
Max int. [23.8] 90	[345] 39 **443**	[1238] 140 **437**	[2131] 241 **434**	[3078] 348 **426**	[4033] 456 **407**	[4652] 526 **392**	Max int.

YMH 250 [15.61 in^3/rev] 255.9 cm^3/rev.

Flow (L/min)

						Max cont.	Max int.	
GPM L/ min	[507] 3.5	[1015] 7	[1305] 9	[1740] 12	[2102] 14.5	[2537] 17.5	[2900] 20	[PSI] MPa
[1.3] 5	[1070] 121 **19**	[2176] 246 **19**	[2812] 318 **18**	[3520] 398 **14**				
[2.6] 10	[1150] 130 **34**	[2282] 258 **33**	[2927] 331 **31**	[3759] 425 **29**	[4555] 515 **23**	[5262] 595 **12**		
[5.3] 20	[1150] 130 **78**	[2282] 258 **77**	[2936] 332 **76**	[3821] 432 **73**	[4599] 520 **65**	[5492] 621 **53**	[6208] 702 **42**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[1079] 122 **115**	[2220] 251 **113**	[2892] 327 **111**	[3794] 429 **105**	[4599] 520 **96**	[5492] 621 **84**	[6191] 700 **75**	
[10.6] 40	[1017] 115 **157**	[2123] 240 **157**	[2857] 323 **156**	[3732] 422 **150**	[4537] 513 **139**	[5448] 616 **127**	[6173] 698 **114**	
[13.2] 50	[929] 105 **196**	[2052] 232 **195**	[2777] 314 **192**	[3635] 411 **185**	[4466] 505 **173**	[5359] 606 **159**	[6076] 687 **147**	
[15.9] 60	[831] 94 **232**	[1946] 220 **230**	[2671] 302 **226**	[3546] 401 **218**	[4387] 496 **206**	[5271] 596 **192**	[5979] 676 **180**	
[18.5] 70	[720] 81.4 **274**	[1848] 209 **274**	[2547] 288 **274**	[3440] 389 **266**	[4281] 484 **252**	[5147] 582 **238**	[5890] 666 **222**	
Max cont [19.8] 75	[637] 72 **290**	[1795] 203 **289**	[2476] 280 **287**	[3370] 381 **279**	[4201] 475 **266**	[5076] 574 **251**	[5828] 659 **236**	
[21.1] 80	[584] 66 **303**	[1716] 194 **302**	[2414] 273 **298**	[3281] 371 **290**	[4130] 467 **279**	[5006] 566 **264**	[5757] 651 **249**	Max cont.
Max int. [23.8] 90	[433] 49 **348**	[1574] 178 **347**	[2264] 256 **345**	[3140] 355 **337**	[4006] 453 **325**	[4882] 552 **309**	[5607] 634 **292**	Max int.

YMH 315 [19.29 in^3/rev] 316.1 cm^3/rev.

Flow (L/min)

						Max cont.	Max int.	
GPM L/ min	[507] 3.5	[1087] 7.5	[1450] 10	[1957] 13.5	[2247] 15.5	[2537] 17.5	[2900] 20	[PSI] MPa
[1.3] 5	[1371] 155 **16**	[2874] 325 **13**						
[2.6] 10	[1442] 163 **27**	[3025] 342 **24**	[4015] 454 **18**	[4917] 556 **14**				
[5.3] 20	[1495] 169 **63**	[3087] 349 **61**	[4048] 469 **55**	[5147] 582 **48**	[5872] 664 **40**	[6483] 733 **32**	[7155] 809 **19**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[1459] 165 **93**	[3042] 344 **89**	[4157] 470 **82**	[5130] 580 **77**	[5917] 669 **67**	[6545] 740 **59**	[7287] 824 **46**	
[10.6] 40	[1362] 154 **126**	[2980] 337 **126**	[4112] 465 **119**	[5103] 577 **111**	[5864] 663 **99**	[6518] 737 **88**	[7314] 827 **73**	
[13.2] 50	[1247] 141 **159**	[2874] 325 **155**	[4024] 455 **148**	[5023] 568 **139**	[5802] 656 **126**	[6438] 728 **115**	[7287] 824 **98**	
[15.9] 60	[1070] 121 **187**	[2759] 312 **186**	[3891] 440 **179**	[4908] 555 **169**	[5687] 643 **154**	[6323] 715 **143**	[7181] 812 **124**	
[18.5] 70	[911] 103 **222**	[2636] 298 **222**	[3759] 425 **215**	[4785] 541 **205**	[5581] 631 **187**	[6217] 703 **176**	[7075] 800 **157**	
Max cont [19.8] 75	[831] 94 **236**	[2538] 287 **233**	[3688] 417 **224**	[4678] 529 **215**	[5510] 623 **196**	[6155] 696 **184**	[7004] 792 **166**	
[21.1] 80	[725] 82 **246**	[2450] 277 **244**	[3591] 406 **236**	[4581] 518 **228**	[5404] 611 **210**	[6085] 688 **197**	[6934] 784 **174**	Max cont.
Max int. [23.8] 90	[548] 62 **282**	[2264] 256 **280**	[3414] 386 **275**	[4387] 496 **266**	[5245] 593 **248**	[5917] 669 **234**	[6783] 767 **209**	Max int.

YMH 400 [24.80 in^3/rev] 406.40 cm^3/rev.

Flow (L/min)

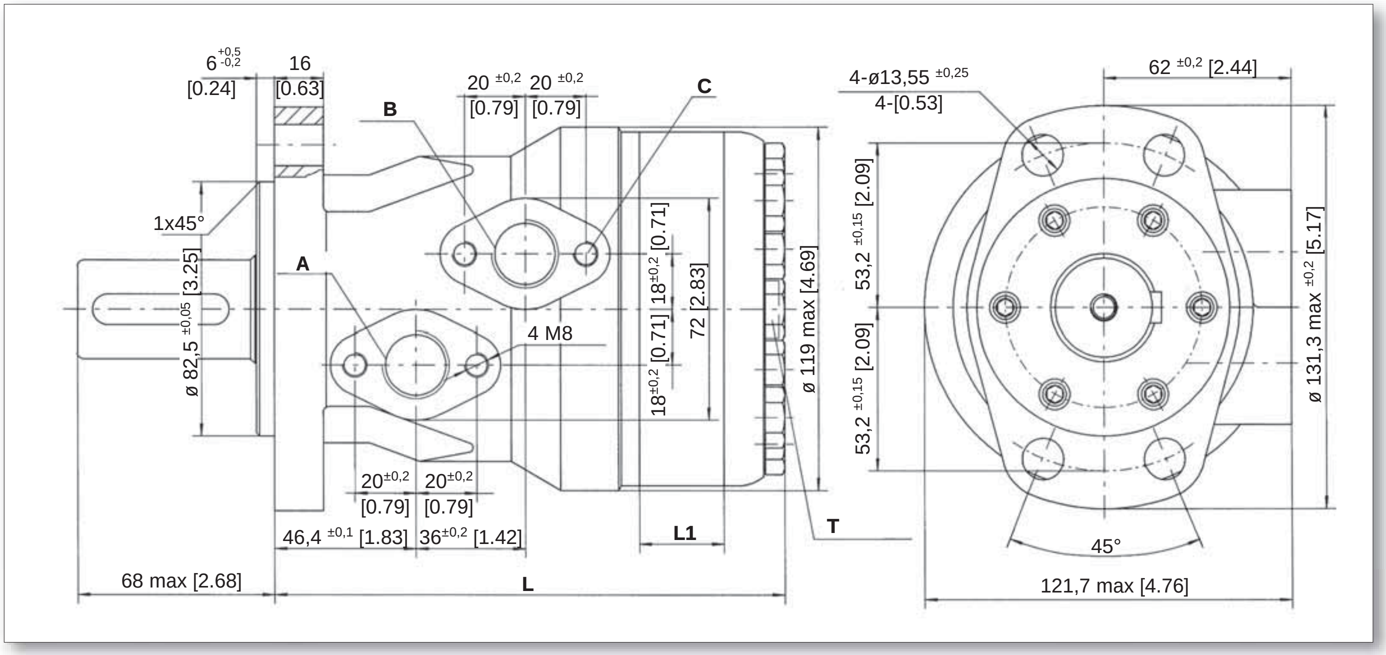
					Max cont.	Max int.	
GPM L/ min	[507] 3.5	[870] 6	[1522] 10.5	[1812] 12.5	[2247] 15.5	[2755] 19	[PSI] MPa
[1.3] 5	[1733] 196 **13**	[3078] 348 **13**	[4564] 516 **10**				
[2.6] 10	[1813] 205 **22**	[3210] 363 **21**	[4829] 546 **21**	[6209] 702 **17**	[7597] 859 **11**		
[5.3] 20	[1848] 209 **50**	[3237] 366 **49**	[4802] 543 **46**	[6262] 708 **41**	[7730] 874 **36**	[8738] 988 **31**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
[7.9] 30	[1778] 201 **73**	[3157] 357 **72**	[4793] 542 **70**	[6244] 706 **63**	[7641] 864 **56**	[8703] 984 **51**	
[10.6] 40	[1725] 195 **99**	[3060] 346 **98**	[4705] 532 **96**	[6200] 701 **86**	[7588] 858 **77**	[8605] 973 **71**	
[13.2] 50	[1530] 173 **123**	[2936] 332 **122**	[4581] 518 **118**	[6076] 687 **107**	[7500] 848 **97**	[8473] 958 **90**	
[15.9] 60	[1362] 154 **146**	[2821] 319 **144**	[4431] 501 **141**	[5908] 668 **128**	[7368] 833 **115**	[8349] 944 **106**	
[18.5] 70	[1221] 138 **174**	[2697] 305 **173**	[4245] 480 **169**	[5740] 649 **156**	[7199] 814 **141**	[8181] 925 **130**	
Max cont [19.8] 75	[1132] 128 **183**	[2600] 294 **181**	[4121] 466 **177**	[5634] 637 **163**	[7093] 802 **149**	[8057] 911 **138**	
[21.1] 80	[999] 113 **192**	[2450] 277 **191**	[3989] 451 **188**	[5492] 621 **174**	[6951] 786 **158**	[7951] 899 **144**	Max cont.
Max int. [23.8] 90	[796] 90 **220**	[2264] 256 **220**	[3829] 433 **215**	[5262] 595 **202**	[6783] 767 **183**	[7792] 881 **165**	Max int.

PERFORMANCE DATA

YMH 500 [29.85 in^3/rev] 489.2 cm^3/rev.

		362 2.5	725 5	1232 8.5	1450 10	Max cont. 1812 12.5	Max int. 2320 16	[PSI] MPA
GPM L/ min	[1.3] 5	[1459] 165 **11**	[2804] 317 **11**	[4564] 516 **8**				
	[2.6] 10	[1574] 178 **20**	[2963] 335 **19**	[4908] 555 **17**	[5917] 669 **15**	[6996] 791 **13**	[8570] 969 **9**	
	[5.3] 20	[1565] 177 **42**	[2927] 331 **42**	[4944] 559 **41**	[5952] 673 **38**	[7066] 799 **36**	[8738] 988 **29**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[7.9] 30	[1521] 172 **64**	[2830] 320 **63**	[4891] 553 **61**	[5864] 663 **57**	[7004] 792 **53**	[8694] 983 **47**	
Flow (L/min)	[10.6] 40	[1442] 163 **85**	[2733] 309 **85**	[4785] 541 **83**	[5784] 654 **79**	[6925] 783 **75**	[8588] 971 **67**	
	[13.2] 50	[1291] 146 **103**	[2618] 296 **103**	[4625] 523 **103**	[5616] 635 **97**	[6792] 768 **93**	[8437] 954 **85**	
	[15.9] 60	[1070] 121 **124**	[2432] 275 **124**	[4440] 502 **123**	[5430] 614 **117**	[6606] 747 **113**	[8260] 934 **103**	
	[18.5] 70	[858] 97 **148**	[2264] 256 **148**	[4263] 482 **148**	[5280] 597 **140**	[6447] 729 **134**	[8110] 917 **122**	
Max cont	[19.8] 75	[699] 79 **155**	[2123] 240 **155**	[4148] 469 **155**	[5147] 582 **152**	[6315] 714 **144**	[7977] 902 **130**	
	[21.1] 80	[531] 60 **166**	[1999] 226 **166**	[4006] 453 **166**	[5041] 570 **159**	[6200] 701 **153**	[7818] 884 **139**	Max cont.
Max int.	[23.8] 90	[301] 34 **166**	[1778] 201 **165**	[3723] 421 **164**	[4864] 550 **157**	[5952] 673 **156**	[7685] 869 **155**	Max int.

MOUNTING DATA



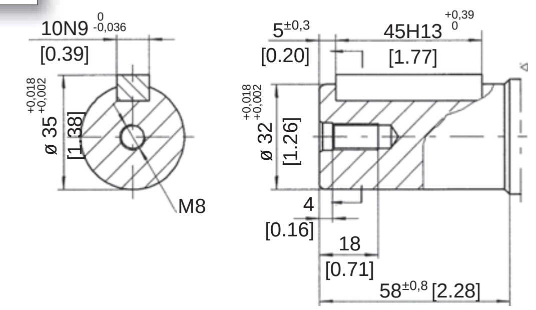
	[INCHES]		MILLIMETERS	
MODEL	**L**	**L1**	**L**	**L1**
YMH 200	[6.61]	[1.06]	168	27
YMH 250	[6.89]	[1.34]	175	34
YMH 315	[7.24]	[1.65]	184	42
YMH 400	[7.68]	[2.13]	195	54
YMH 500	[8.11]	[2.56]	206	65

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	P	DEPTH	R	DEPTH
PORTS - A and B	G 1/2	15 mm	M22 X 1.5	15 mm	7/8-14 O-RING	15 mm	1/2-14NPTF	15 mm	PT(RC)1/2	15 mm
TANK PORT - T	G 1/4	12 mm	M14 X 1.5	12 mm	7/16-20 UNF	12 mm	7/16-20 UNF	12 mm	PT(RC)1/4	1/4
BOLTS - C	4-M8	13 mm	4-M8	13 mm	4-M8	13 mm	4-M8	13 mm	4-M8	13 mm

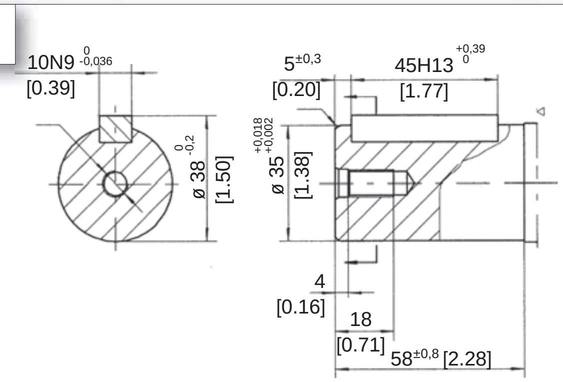
MOTOR SHAFT EXTENSIONS

B



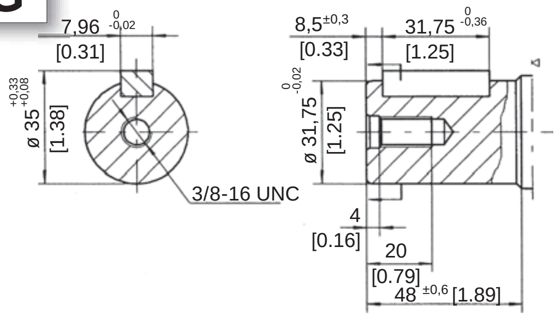
Shaft B: 32 mm keyed
Parallel key 10x8x45

M



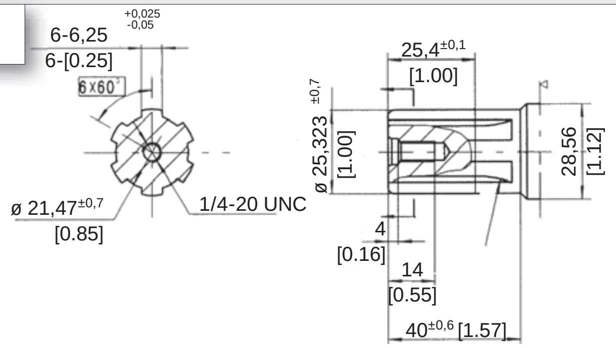
Shaft M: 35mm Keyed
Parallel key 10x8x45

G



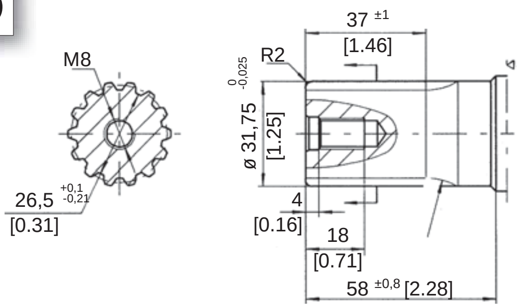
Shaft G: 1 1/4 Keyed
Parallel key .31x.31x1.25

S



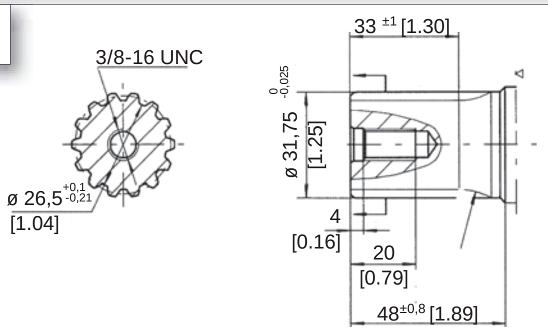
Shaft S: Splined SAE 6B

FD



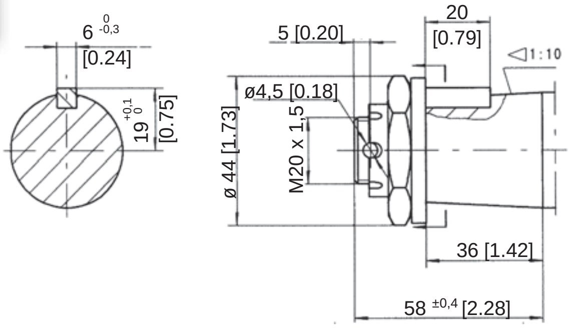
Shaft FD: 1 1/4 14 Splined
Long DP 12/24

F



Shaft F: 1 1/4 14 Splined
DP 12/24

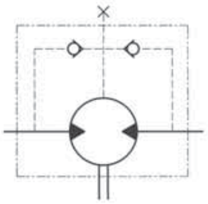
T1

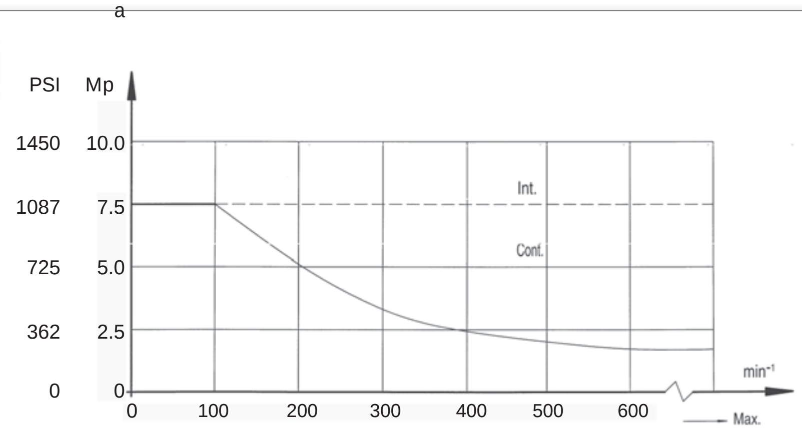


Shaft T1: 35mm Tapered • Parallel key B6x6x20
Tightening torque: 200±10Nxm

ADDITIONAL INFORMATION

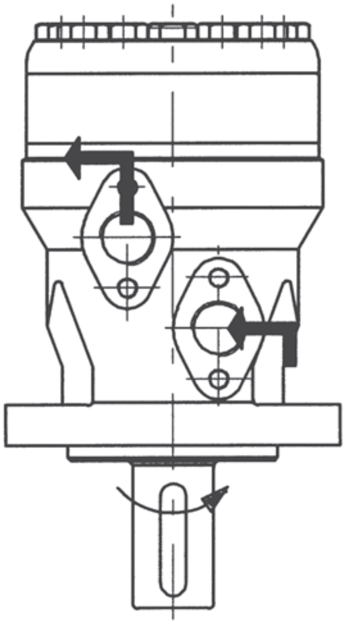
PERMISSIBLE SHAFT SEAL PRESSURE





IN APPLICATIONS WITHOUT A DRAIN LINE,THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. APPLICATIONS USING A DRAIN LINE ,THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN THE DRAIN LINE.

SHAFT ROTATION DIRECTION



ORDERING INFORMATION

	1	2	3	4	5	6	7	8
YMH								

1	2		3		4		5		6		7	
DISP.	FLANGE		OUTPUT SHAFT		PORT AND DRAIN PORT		ROTATION DIRECTION		PAINT		SPECIAL OPTIONS	
200	4	MAGNETO 3.25 PILOT	B	Shaft: 32mm Keyed parllel key 10x8x45	D	G1/2 Manifold mount 4 X M8 G1/4	NONE	STANDARD	OO	NO PAINT	NONE	STANDARD
250			M	Shaft: 35 Keyed parllel key 10x8x45	S	7/8-14 O-ring Manifold mount 4 X M8 7/16-20 UNF	R	OPPOSITE	NONE	BLUE	O	NO CASE DRAIN
315			F	Shaft: 11/4 14 splined 14-DP12/24	M	M22 X 1.5 Manifold mount 4 x M8, M14 x 1.5			B	BLACK	FR	FREE RUNNING
400			FD	Long Shaft: 11/4 14splined 14-DP12/24	P	1/2-14 NPTF Manifold 4xM8, 7/16-20UNF			S	SILVER GRAY	LL	LOW LEACKAGE VALVE
500			G	Shaft: 11/4 Keyed parallel key .31x.31x11/4	R	PT(Rc)1/2 Manifold mount 4 x M8 ,PT(Rc)1/4					CRS	CORROSION RESISTANT SHAFT
			T1	35mm tapered parllel key B6x6x20							HPS	HIGH PRESSURE SEAL
			S	Shaft: Splined SAE 6B							HTS	HIGH TEMP SEAL

Ordering Code:
All options have been determined with letters, numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table, please contact us with your requirements.

YMSY

The **YMSY** series motors adapts an advanced **GEROLOR** gear set designed with disc distribution flow and high pressure.

This motor series uses the **“ROLOR”** gear type manufactured with most advanced technology and quality available to provide low pressure start up, smooth reliable operation and high efficiency.

The output shaft tapered roller bearings allow for high axial and radial forces.

Advanced design in disc distribution flow,which can automatically compensate in operating with high volume efficiency and long life.

The YMSY series has the same dimensions and mounting data as the YMS series.This series is rated **10-20%** higher for higher torque and higher pressure applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMSY	[in^3./rev]	[4.88 ~ 22.88]	[PSI]	[3263]	RPM	[HP]	[32]
		cm^3/rev.	80 ~ 415	MPA	22.5	30 ~ 800	Kw	24

QUICK REFERENCE GUIDE

Displacements				
[in³./rev]	cm³/rev.			
[4.92]	80.6			
[6.15]	100.8			
[7.63]	125			
[9.40]	154	FLOW UP TO	90 LPM	[23.78 GPM]
[11.84]	194	PRESSURE UP TO	22.5 MPA	[3262 PSI]
[14.83]	243	TORQUE UP TO	1100 NM	[9728 LB. IN.]
[18.97]	311	SPEED UP TO	470 RPM	
[24.4]	394			
[28.98]	475			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedure to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

- Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40^o C
- Different shafts are used when there is a radial load or not. Check data pages
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

YMSY

SPECIFICATION DATA

DISTRIBUTION TYPE			YMSY 80	YMSY 100	YMSY 125	YMSY 160	YMSY 200	YMSY 250	YMSY 315	YMSY 400	YMSY 475
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[4.92]	[6.15]	[7.63]	[9.40]	[11.84]	[14.83]	[18.97]	[24.04]	[28.98]
		cm^3/rev.	80.6	100.8	125	154	194	243	311	394	475
MAX. SPEED RPM		RATED	675	540	432	337	270	216	171	135	110
		CONT.	800	748	600	470	375	300	240	185	155
		INT	988	900	720	560	450	360	280	225	185
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[1548]	[1946]	[2414]	[3936]	[4466]	[5483]	[6191]	[6766]	[6898]
		N*M	**175**	**220**	**273**	**445**	**505**	**620**	**700**	**765**	**780**
	CONT.	[LB. IN.]	[1990]	[2565]	[3228]	[4289]	[5183]	[6262]	[7783]	[7783]	[8048]
		N*M	**225**	**290**	**365**	**485**	**586**	**708**	**880**	**880**	**910**
	INT.	[LB. IN.]	[2211]	[2830]	[3538]	[4776]	[5704]	[7128]	[8490]	[8490]	[8490]
		N*M	**250**	**320**	**400**	**540**	**645**	**806**	**960**	**960**	**960**
MAX. OUTPUT [HP] KW	RATED	[HP]	[16]	[17]	[17]	[17]	[17]	[17]	[15]	[13]	[12]
		KW	**12**	**12.4**	**12.4**	**12.4**	**12.4**	**12.4**	**11.2**	**9.6**	**8.6**
	CONT.	[HP]	[21]	[24]	[24]	[24]	[24]	[24]	[23]	[15]	[12]
		KW	**16**	**18**	**18**	**18.1**	**18.1**	**18**	**17**	**11**	**9**
	INT.	[HP]	[27]	[29]	[31]	[34]	[32]	[32]	[27]	[16]	[15]
		KW	**20**	**22**	**23**	**25**	**24**	**23.8**	**20.2**	**12**	**11**
MAX. PRESSURE DROP [PSI] MPA	RATED	[PSI]	[2320]	[2320]	[2320]	[2755]	[2755]	[2610]	[2320]	[2030]	[1740]
		MPA	**16**	**16**	**16**	**19**	**19**	**18**	**16**	**14**	**12**
	CONT.	[PSI]	[2913]	[2913]	[2913]	[3045]	[3045]	[2900]	[2900]	[2320]	[2030]
		MPA	**20.5**	**20.5**	**20.5**	**21**	**21**	**20**	**20**	**16**	**14**
	INT.	[PSI]	[3263]	[3263]	[3263]	[3263]	[3263]	[3263]	[3263]	[2538]	[2175]
		MPA	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**17.5**	**15**
	PEAK	[PSI]	[4278]	[4278]	[4278]	[3263]	[3263]	[3263]	[3263]	[2900]	[2538]
		MPA	**29.5**	**29.5**	**29.5**	**22.5**	**22.5**	**22.5**	**22.5**	**20**	**17.5**
MAX. FLOW [GPM] L/MIN	CONT.	[GPM]	[17.17]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**65**	**75**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
	INT.	[GPM]	[21.14]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]
		L/MIN	**80**	**90**	**90**	**90**	**90**	**90**	**90**	**90**	**90**
MAX. INLET PRESSURE [PSI] MPA	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPA	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPA	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	INT.	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPA	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[22]	[22.4]	[23]	[24]	[24]	[26]	[27]	[29]	[31]
		KG	**9.8**	**10**	**10.3**	**10.7**	**11.1**	**11.6**	**12.3**	**13.2**	**14.3**

- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Continuous pressure: Max. value of operating motor continuously.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YMSY 80 [4.92 in^3/rev] 80.6 cm^3/rev.

							Max cont.	Max int.	
		[508]	[1015]	[1523]	[2030]	[2538]	[3045]	[3263]	[PSI]
		3.5	7	10.5	14	17.5	20.5	22.5	MPa
GPM	[3.9]	[310]	[708]	[1061]	[1397]	[1725]	[2016]	[2202]	
L/ min		35	80	120	158	195	228	249	
	15	**180**	**174**	**168**	**164**	**158**	**151**	**143**	
	[7.9]	[310]	[708]	[1061]	[1397]	[1725]	[2016]	[2202]	TORQUE [LB-IN]
		35	80	120	158	195	232	260	TORQUE (N•M)
	30	**362**	**352**	**346**	**338**	**330**	**322**	**310**	SPEED (RPM)
Flow (L/min)	[10.6]	[310]	[699]	[1057]	[1311]	[1707]	[2008]	[2211]	
		35	79	119	155	193	227	250	
	40	**487**	**480**	**468**	**457**	**446**	**438**	**425**	
	[13.2]	[265]	[681]	[1035]	[1353]	[1698]	[1981]	[2193]	
		30	77	117	153	192	224	248	
	50	**612**	**603**	**592**	**581**	**572**	**558**	**542**	
	[15.9]	[248]	[681]	[1035]	[1353]	[1698]	[1981]	[2149]	
		28	77	117	153	192	224	243	
	60	**735**	**726**	**718**	**703**	**687**	**673**	**646**	
Max cont	[17.17]	[230]	[663]	[1026]	[1335]	[1663]	[1919]	[2087]	
		26	75	116	151	188	217	236	Max cont.
	65	**794**	**786**	**773**	**760**	**744**	**722**	**706**	
Max int.	[21.19]	[212]	[637]	[964]	[1256]	[1557]	[1823]	[2009]	
		24	72	109	142	176	206	227	Max int.
	80	**981**	**968**	**955**	**925**	**893**	**870**	**832**	

YMSY 100 [6.15 in^3/rev] 100.8 cm^3/rev.

							Max cont.	Max int.	
		[508]	[1015]	[1523]	[2030]	[2538]	[3045]	[3263]	[PSI]
		3.5	7	10.5	14	17.5	20.5	22.5	MPa
GPM	[3.9]	[425]	[840]	[1327]	[1769]	[2211]	[2494]	[2742]	
L/ min		48	95	150	200	250	282	310	
	15	**146**	**144**	**139**	**135**	**130**	**120**	**105**	
	[7.9]	[398]	[831]	[1291]	[1751]	[2211]	[2565]	[2804]	TORQUE [LB-IN]
		45	94	146	198	250	290	317	TORQUE (N•M)
	30	**291**	**289**	**278**	**274**	**269**	**258**	**242**	SPEED (RPM)
Flow (L/min)	[10.6]	[380]	[787]	[1256]	[1733]	[2193]	[2517]	[2795]	
		43	89	142	196	248	288	316	
	40	**387**	**384**	**374**	**359**	**350**	**335**	**320**	
	[13.2]	[354]	[778]	[1194]	[1716]	[2184]	[2529]	[2786]	
		40	88	135	194	247	286	315	
	50	**486**	**483**	**473**	**462**	**450**	**430**	**420**	
	[15.9]	[327]	[778]	[1167	[1636]	[2158]	[2563]	[2759]	
		37	88	132	185	244	283	312	
	60	**588**	**584**	**574**	**562**	**550**	**538**	**520**	
Max cont	[19.8]	[310]	[708]	[1150]	[1592]	[2123]	[2467]	[2742]	
		35	80	130	180	240	279	310	Max cont.
	75	**740**	**735**	**720**	**705**	**696**	**676**	**653**	
Max int.	[23.8]	[245]	[663]	[1047]	[1503]	[2087]	[2397]	[2684]	
		30	75	124	170	236	271	303	Max int.
	90	**850**	**840**	**810**	**787**	**770**	**750**	**747**	

YMSY 125 [1.63 in^3/rev] 125 cm^3/rev.

							Max cont.	Max int.	
		[508]	[1015]	[1523]	[2030]	[2538]	[3045]	[3263]	[PSI]
		3.5	7	10.5	14	17.5	20.5	22.5	MPa
GPM	[3.9]	[486]	[1061]	[1557]	[2167]	[2733]	[3051]	[3317]	
L/ min		55	120	176	245	309	345	375	
	15	**115**	**113**	**110**	**104**	**98**	**90**	**84**	
	[7.9]	[486]	[1061]	[1548]	[2241]	[2786]	[3219]	[3573]	TORQUE [LB-IN]
		55	120	175	250	315	364	404	TORQUE (N•M)
	30	**231**	**228**	**225**	**214**	**202**	**188**	**172**	SPEED (RPM)
Flow (L/min)	[10.6]	[469]	[1044]	[1574]	[2211]	[2786]	[3219]	[3564]	
		53	118	178	250	315	364	403	
	40	**312**	**309**	**290**	**289**	**278**	**262**	**235**	
	[13.2]	[442]	[1017]	[1557]	[2193]	[2784]	[3201]	[3511]	
		50	115	176	248	315	362	397	
	50	**391**	**386**	**378**	**365**	**352**	**339**	**308**	
	[15.9]	[398]	[999]	[1512]	[2131]	[2729]	[3166]	[3511]	
		45	113	171	241	308	358	397	
	60	**469**	**461**	**450**	**437**	**425**	**400**	**372**	
Max cont	[19.8]	[398]	[913]	[1477]	[2123]	[2706]	[3113]	[3440]	
		45	110	167	240	306	352	389	Max cont.
	75	**588**	**574**	**560**	**544**	**526**	**505**	**481**	
Max int.	[23.8]	[354]	[929]	[1433]	[2096]	[2662]	[3033]	[3343]	
		40	105	162	237	301	343	378	Max int.
	90	**710**	**696**	**680**	**661**	**646**	**628**	**610**	

YMSY 160 [9.4 in^3/rev] 154 cm^3/rev.

							Max cont.	Max int.	
		[508]	[1015]	[1523]	[2030]	[2538]	[3045]	[3263]	[PSI]
		3.5	7	10.5	14	17.5	21	22.5	MPa
GPM	[3.9]	[619]	[1256]	[1901]	[2636]	[3290]	[3847]	[4210]	
L/ min		70	142	215	298	372	435	476	
	15	**93**	**91**	**89**	**85**	**80**	**76**	**58**	
	[7.9]	[646]	[1335]	[1990]	[2759]	[3378]	[4033]	[4351]	TORQUE [LB-IN]
		73	151	225	312	382	456	492	TORQUE (N•M)
	30	**189**	**187**	**181**	**176**	**170**	**162**	**153**	SPEED (RPM)
Flow (L/min)	[10.6]	[663]	[1344]	[2016]	[2777]	[3387]	[4015]	[4316]	
		75	152	228	314	383	454	488	
	40	**252**	**250**	**246**	**239**	**234**	**228**	**212**	
	[13.2]	[619]	[1309]	[1990]	[2697]	[3290]	[3936]	[4245]	
		70	148	225	305	372	445	480	
	50	**313**	**310**	**306**	**298**	**293**	**285**	**272**	
	[15.9]	[601]	[1265]	[1928]	[2618]	[3272]	[3909]	[4245]	
		68	143	218	296	370	442	480	
	60	**378**	**376**	**370**	**362**	**353**	**346**	**332**	
Max cont	[19.8]	[548]	[1238]	[1866]	[2574]	[3228]	[3883]	[4201]	
		62	140	211	291	365	439	475	Max cont.
	75	**475**	**469**	**461**	**450**	**441**	**432**	**414**	
Max int.	[23.8]	[522]	[1159]	[1786]	[2529]	[3157]	[3759]	[4068]	
		59	131	202	286	357	425	460	Max int.
	90	**567**	**561**	**554**	**543**	**532**	**520**	**509**	

PERFORMANCE DATA

YMSY 200 [11.8 in^3/rev] 194 cm^3/rev.

							Max cont.	Max int.	
		[508] 3.5	[1015] 7	[1523] 10.5	[2030] 14	[2538] 17.5	[3045] 21	[3263] 22.5	[PSI] MPa
GPM L/ min	[3.9] 15	[769] 87 **74**	[1583] 179 **73**	[2414] 273 **71**	[3281] 371 **68**	[4166] 471 **64**	[4970] 562 **60**	[5395] 610 **48**	
	[7.9] 30	[805] 91 **150**	[1680] 190 **148**	[2547] 288 **143**	[3414] 386 **140**	[4325] 489 **134**	[5059] 572 **128**	[5466] 618 **119**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[831] 94 **198**	[1707] 193 **195**	[2618] 296 **192**	[3485] 394 **188**	[4404] 498 **183**	[5165] 584 **178**	[5704] 645 **167**	
	[13.2] 50	[796] 90 **248**	[1689] 191 **246**	[2582] 292 **241**	[3440] 389 **236**	[4360] 493 **230**	[5130] 580 **223**	[5607] 634 **212**	
	[15.9] 60	[752] 85 **300**	[1636] 185 **295**	[2467] 279 **288**	[3378] 382 **281**	[4272] 483 **273**	[5085] 575 **263**	[5501] 622 **251**	
Max cont	[19.8] 75	[690] 78 **374**	[1557] 176 **370**	[2397] 271 **364**	[3272] 370 **360**	[4174] 472 **352**	[4961] 561 **340**	[5395] 610 **331**	Max cont.
Max int.	[23.8] 90	[601] 68 **443**	[1442] 163 **440**	[2344] 265 **435**	[3193] 361 **428**	[4033] 456 **424**	[4820] 545 **413**	[5298] 599 **400**	Max int.

YMSY 250 [14.8 in^3/rev] 243 cm^3/rev.

							Max cont.	Max int.	
		[508] 3.5	[1015] 7	[1523] 10.5	[2030] 14	[2537] 17.5	[2900] 20	[3262] 22.5	[PSI] MPa
GPM L/ min	[3.9] 15	[773] 110 **59**	[2043] 231 **58**	[3104] 351 **56**	[4086] 462 **53**	[5174] 585 **50**	[6023] 681 **46**	[6881] 778 **35**	
	[7.9] 30	[1026] 116 **119**	[2087] 236 **117**	[3175] 359 **114**	[4201] 475 **108**	[5280] 597 **102**	[6191] 700 **92**	[6987] 790 **80**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1044] 118 **162**	[2131] 241 **159**	[3210] 363 **156**	[4245] 480 **150**	[5298] 599 **143**	[6244] 706 **134**	[7040] 796 **121**	
	[13.2] 50	[982] 111 **203**	[2069] 234 **201**	[3113] 352 **197**	[4174] 472 **191**	[5227] 591 **182**	[6129] 693 **173**	[6969] 788 **158**	
	[15.9] 60	[937] 106 **244**	[1981] 224 **242**	[3051] 345 **237**	[4086] 462 **230**	[5147] 582 **220**	[6058] 685 **208**	[6828] 772 **194**	
Max cont	[19.8] 75	[893] 101 **303**	[1893] 214 **299**	[3007] 340 **294**	[4015] 454 **285**	[5041] 570 **272**	[5925] 670 **260**	[6721] 760 **244**	Max cont.
Max int.	[23.8] 90	[822] 93 **363**	[1848] 209 **359**	[2963] 335 **354**	[3953] 447 **348**	[4944] 559 **340**	[5811] 657 **328**	[6624] 749 **303**	Max int.

YMSY 315 [18.9 in^3/rev] 311 cm^3/rev.

							Max cont.	Max int.	
		[508] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[2900] 20	[3262] 22.5	[PSI] MPa
GPM L/ min	[3.9] 15	[1309] 148 **48**	[2689] 304 **47**	[4033] 456 **45**	[5421] 613 **43**	[6739] 762 **41**	[7774] 879 **39**	[8649] 978 **27**	
	[7.9] 30	[1371] 155 **95**	[2777] 314 **93**	[4112] 465 **91**	[5616] 635 **89**	[6881] 778 **86**	[7818] 884 **82**	[8738] 988 **67**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1415] 160 **127**	[2839] 321 **125**	[4236] 479 **121**	[5749] 650 **117**	[7040] 796 **115**	[8013] 906 **109**	[8817] 997 **91**	
	[13.2] 50	[1371] 155 **159**	[2777] 314 **157**	[4112] 465 **153**	[5642] 638 **149**	[6898] 780 **145**	[7836] 886 **142**	[8738] 988 **128**	
	[15.9] 60	[1535] 151 **187**	[2706] 306 **185**	[4006] 453 **181**	[5483] 620 **176**	[6766] 765 **169**	[7836] 886 **157**	[8632] 976 **143**	
Max cont	[19.8] 75	[1291] 146 **238**	[2653] 300 **236**	[3936] 445 **232**	[5421] 613 **227**	[6677] 755 **224**	[7739] 875 **220**	[8543] 966 **196**	Max cont.
Max int.	[23.8] 90	[1194] 135 **286**	[2512] 284 **283**	[3856] 436 **278**	[5315] 601 **272**	[6545] 740 **265**	[7632] 863 **257**	[8419] 952 **232**	Max int.

YMSY 400 [24.0 in^3/rev] 394 cm^3/rev.

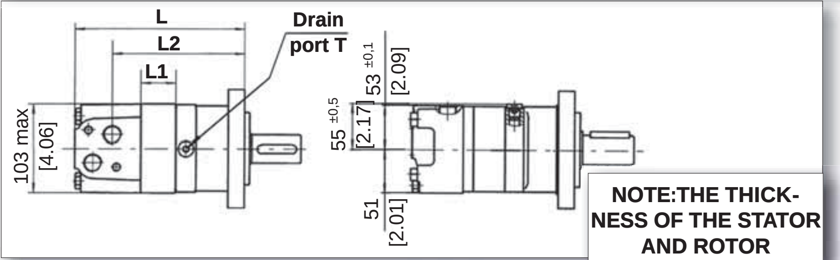
						Max cont.	Max int.	
		[508] 3.5	[1015] 7	[1523] 10.5	[2030] 14	[2320] 16	[2538] 17.5	[PSI] MPa
GPM L/ min	[3.9] 15	[1645] 186 **37**	[3352] 379 **36**	[5112] 578 **35**	[6889] 779 **33**	[7924] 896 **31**	[8720] 986 **29**	
	[7.9] 30	[1680] 190 **75**	[3431] 388 **73**	[5218] 590 **71**	[6996] 791 **68**	[8004] 905 **65**	[8764] 991 **61**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1725] 195 **99**	[3485] 394 **97**	[5271] 596 **95**	[7049] 797 **93**	[8066] 912 **90**	[8826] 998 **85**	
	[13.2] 50	[1689] 191 **125**	[3431] 388 **123**	[5191] 587 **118**	[6943] 785 **114**	[7995] 904 **109**	[8694] 983 **102**	
	[15.9] 60	[1645] 186 **149**	[3431] 388 **146**	[5191] 587 **142**	[6943] 785 **137**	[7995] 904 **131**	[8694] 983 **122**	
Max cont	[19.8] 75	[1601] 181 **187**	[3290] 372 **183**	[5094] 576 **177**	[6810] 770 **171**	[7880] 891 **164**	[8605] 973 **153**	Max cont.
Max int.	[23.8] 90	[1557] 176 **226**	[3246] 367 **221**	[5050] 571 **214**	[6775] 766 **208**	[7809] 883 **199**	[8534] 965 **183**	Max int.

PERFORMANCE DATA

YMSY 475 [28.9 in³/rev] 475 cm³/rev.

					Max cont.	Max int.	
		[508] 3.5	[1015] 7	[1523] 10.5	[2030] 14	[2538] 17.5	[PSI] MPA
GPM L/ min	[3.9] 15	[1928] 218 **30**	[3883] 439 **29**	[5843] 661 **28**	[7889] 892 **27**	[8800] 995 **25**	
	[7.9] 30	[1972] 223 **61**	[3980] 450 **60**	[5979] 676 **58**	[8048] 910 **56**	[8862] 1002 **53**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[2016] 228 **82**	[4077] 461 **80**	[6094] 689 **77**	[8198] 927 **74**	[8994] 1017 **68**	
	[13.2] 50	[1981] 224 **103**	[4033] 456 **101**	[6032] 682 **97**	[8136] 920 **92**	[8915] 1008 **86**	
	[15.9] 60	[1946] 220 **123**	[3989] 451 **121**	[5987] 677 **118**	[8075] 913 **112**	[8826] 998 **105**	
Max cont	[19.8] 75	[1875] 212 **155**	[3918] 443 **153**	[5872] 664 **147**	[7968] 901 **140**	[8667] 980 **132**	Max cont.
Max int.	[23.8] 90	[1733] 196 **186**	[3723] 421 **184**	[5687] 643 **178**	[7756] 877 **170**	[8481] 959 **157**	Max int.

MOUNTING DATA

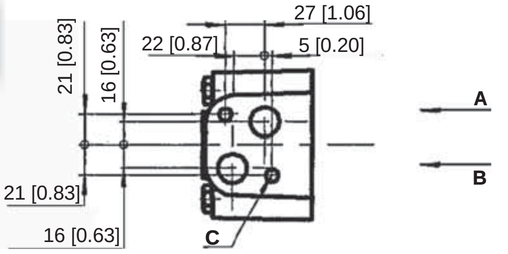


NOTE:THE THICKNESS OF THE STATOR AND ROTOR IS THE DIMENSION OF L1 PLUS 3MM

	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	L	L1	L2
YMSY 80	[6.69]	[0.63]	[4.98]	170	16	126.5
YMSY 100	[6.85]	[0.79]	[5.14]	174	20	130.5
YMSY 125	[7.05]	[0.98]	[5.33]	179	25	135.5
YMSY 160	[7.15]	[1.09]	[5.43]	181.5	27.5	137.7
YMSY 200	[7.44]	[1.39]	[5.72]	189	35.1	145.2
YMSY 250	[7.92]	[1.85]	[6.19]	201	47	157.2
YMSY 315	[8.39]	[2.33]	[6.67]	213	59	169.2
YMSY 400	[25.4]	[2.72]	[7.07]	223	69	179.5
YMSY 475	[9.33]	[3.27]	[7.22]	237	83	183.5

	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	L	L1	L2
YMSY 80 W	[5.22]	[0.63]	[3.50]	132.5	16	89
YMSY 100 W	[5.37]	[0.79]	[3.66]	136.5	20	93
YMSY 125 W	[5.57]	[0.98]	[3.86]	141.5	25	98
YMSY 160 W	[5.67]	[1.08]	[3.96]	143.9	27.5	100.5
YMSY 200 W	[5.96]	[1.38]	[4.25]	151.4	35.1	108
YMSY 250 W	[6.43]	[1.85]	[4.72]	163.4	47	120
YMSY 315 W	[6.91]	[2.32]	[5.20]	175.4	59	132
YMSY 400 W	[7.30]	[2.72]	[5.59]	185.5	69	142
YMSY 475 W	[7.85]	[3.27]	[6.14]	199.5	83	156

D-M-S-P PORTING

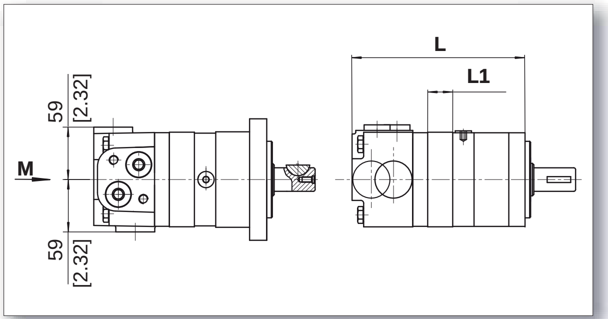


PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D depth	M depth	S depth	P depth
PORTS - A AND B	G 1/2 18 mm	M 22 x 1.5 18 mm	7/8-14 O-ring 18 mm	1/2-14 NPT 15 mm
TANK PORT - T	G 1/4 12 mm	M 14 x 1.5 12 mm	7/16-20UNF 12 mm	7/16-20 UNF 12 mm
BOLTS-C	2-M10 13 mm	2-M10 13 mm	2-3/8-16 unc 13 mm	2-3/8-16 unc 13 mm

YMSY

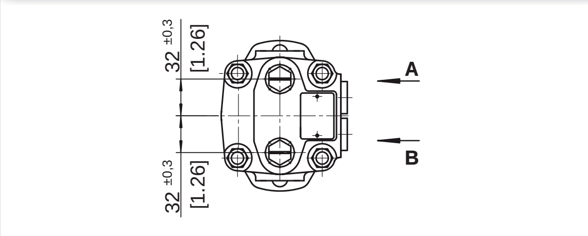
MOUNTING DATA



	[INCHES]		MILLIMETERS	
MODEL	L	L1	L	L1
YMSY 80	[6.93]	[0.63]	176	16
YMSY 100	[7.09]	[0.79]	180	20
YMSY 125	[7.28]	[0.98]	185	25
YMSY 160	[7.36]	[1.06]	187	27
YMSY 200	[7.64]	[1.34]	194	34
YMSY 250	[7.95]	[1.65]	202	42
YMSY 315	[8.43]	[2.13]	214	54
YMSY 400	[9.02]	[2.72]	229	69
YMSY 475	[9.57]	[3.27]	243	83

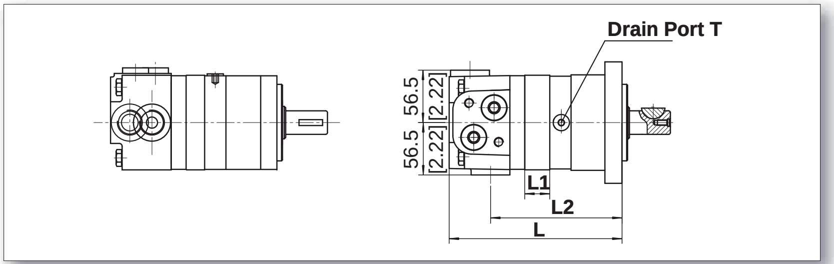
	[INCHES]		MILLIMETERS	
MODEL	L	L1	L	L1
YMSY 80 WE	[5.83]	[0.63]	148	16
YMSY 100 WE	[5.98]	[0.79]	152	20
YMSY 125 WE	[6.18]	[0.98]	157	25
YMSY 160 WE	[6.26]	[1.06]	159	27
YMSY 200 WE	[6.54]	[1.34]	166	34
YMSY 250 WE	[6.85]	[1.65]	174	42
YMSY 315 WE	[7.32]	[2.13]	186	54
YMSY 400 WE	[7.91]	[2.72]	201	69
YMSY 475 WE	[8.46]	[3.27]	215	83

PORTING END PORTS



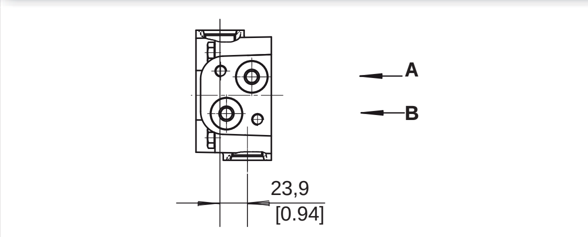
PORT & DRAIN PORT ORDERING CODES

ORDER CODE	EE-D depth	EE-M2 depth	EE-S2 depth
PORTS - A AND B	G 1/2 18 mm	M22x1.5 - 18 mm	7/8-14 O-ring 18 mm
TANK PORT - T	G 1/4 12 mm	M14x1.5 - 12 mm	7/16-20 UNF 12 mm



	[INCHES]			MILLIMETERS		
MODEL	L	L1	L2	L	L1	L2
YMSY 80	[6.93]	[0.63]	[5.12]	176	16	130
YMSY 100	[7.09]	[0.79]	[5.28]	180	20	134
YMSY 125	[7.28]	[0.98]	[5.47]	185	25	139
YMSY 160	[7.36]	[1.06]	[5.55]	187	27	141
YMSY 200	[7.64]	[1.34]	[5.83]	194	34	148
YMSY 250	[7.95]	[1.65]	[6.14]	202	42	156
YMSY 315	[8.43]	[2.13]	[6.61]	214	54	168
YMSY 400	[9.02]	[2.72]	[7.20]	229	69	183
YMSY 475	[9.57]	[3.27]	[7.76]	243	83	197

ED PORTING 180° PORTS



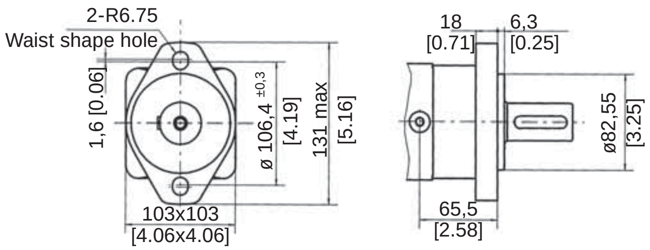
PORT & DRAIN PORT ORDERING CODES

ORDER CODE	ED depth
PORTS - A AND B	1-1/16-12 UN O-ring 18 mm
T	7/16-20 UNF 12 mm

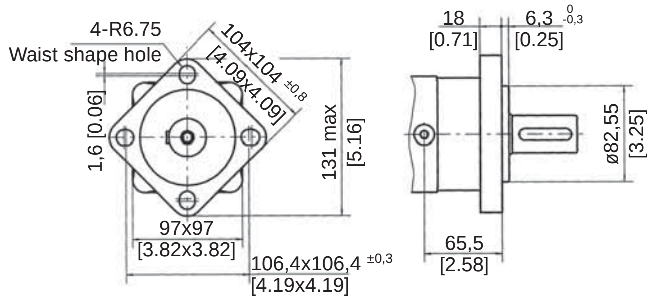
	[INCHES]			MILLIMETERS		
MODEL	L	L1	L2	L	L1	L2
YMSY 80	[5.83]	[0.63]	[4.02]	148	16	102
YMSY 100	[5.98]	[0.79]	[4.17]	152	20	106
YMSY 125	[6.18]	[0.98]	[4.37]	157	25	111
YMSY 160	[6.26]	[1.06]	[4.45]	159	27	113
YMSY 200	[6.54]	[1.34]	[4.69]	166	34	119
YMSY 250	[7.01]	[1.65]	[5.00]	178	42	127
YMSY 315	[7.48]	[2.13]	[5.47]	190	54	139
YMSY 400	[8.07]	[2.72]	[6.06]	205	69	154
YMSY 475	[8.62]	[3.27]	[6.61]	219	83	168

YMSY

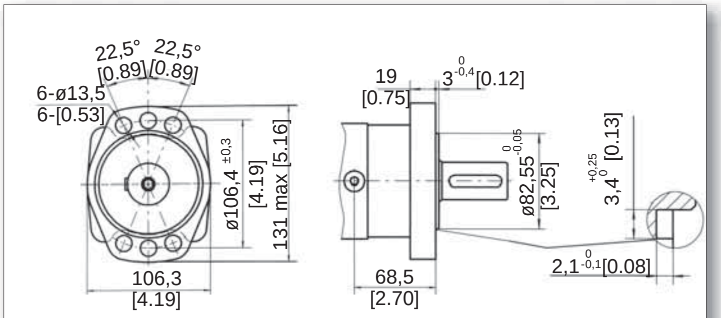
MOUNTING DATA



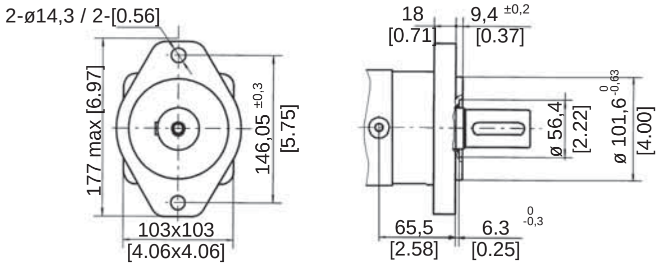
FLANGE E2



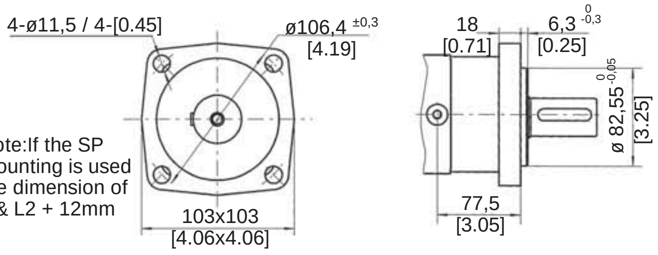
FLANGE E4



FLANGE F6

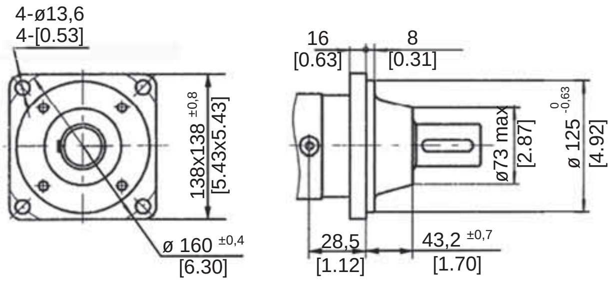


FLANGE E2B



Note:If the SP
mounting is used
the dimension of
L & L2 + 12mm

FLANGE SP

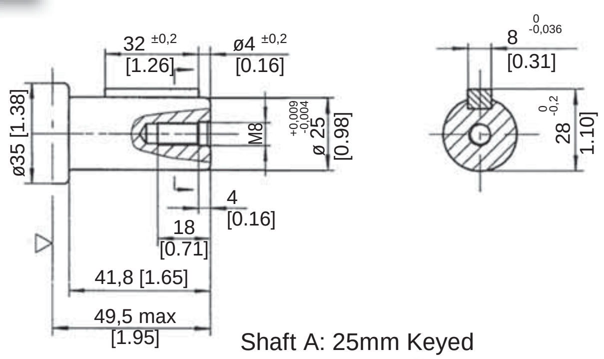


FLANGE W

YMSY

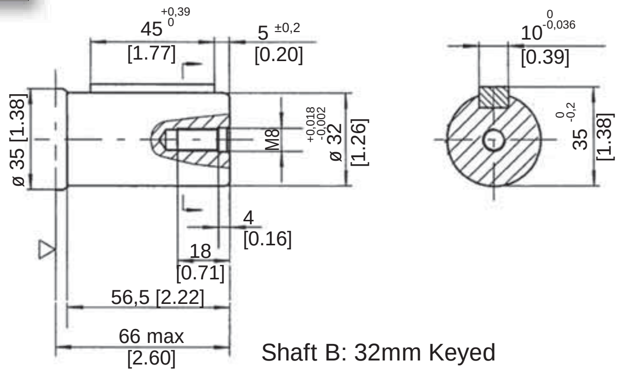
MOTOR SHAFT EXTENSIONS

A



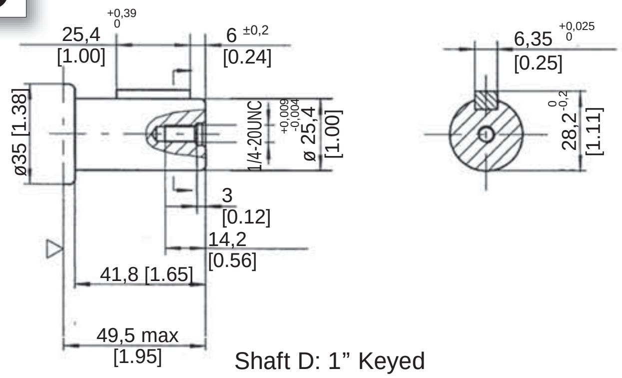
Shaft A: 25mm Keyed
Parallel key 8x7x32

B



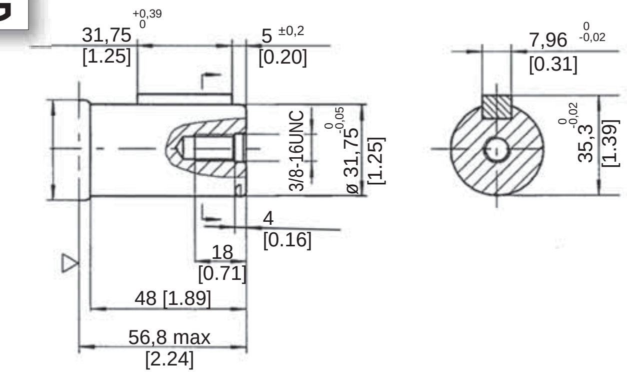
Shaft B: 32mm Keyed
Parallel key 10x8x45

D



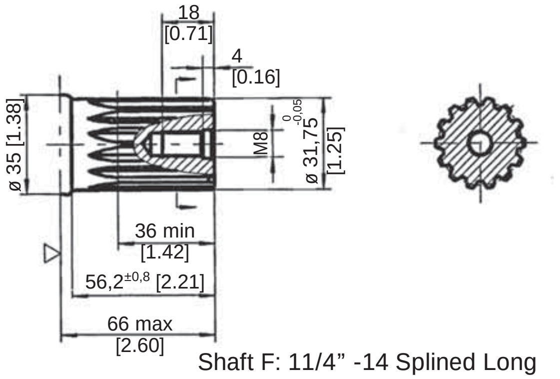
Shaft D: 1” Keyed
Parallel key .25x.25x1.0

G



Shaft G: 11/4” Keyed
Parallel key .31x.31x1.25

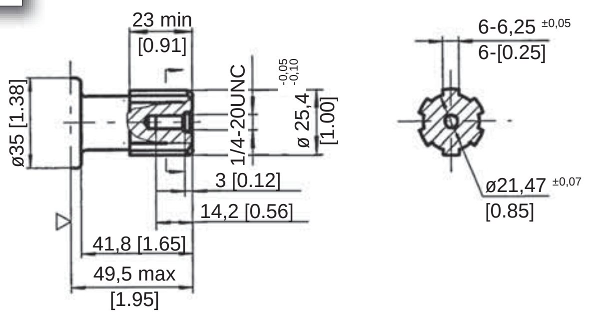
FD



Shaft F: 11/4” -14 Splined Long
14-DP12/24

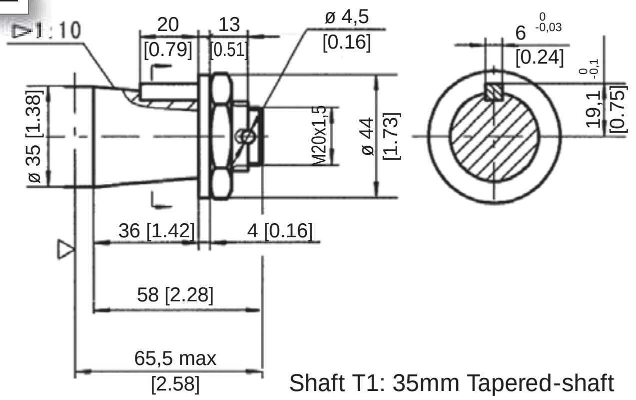
MOTOR SHAFT EXTENSIONS

S1



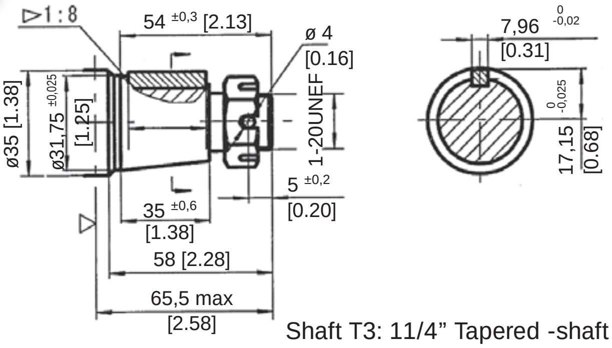
Shaft S1: Splined SAE 6B

T1



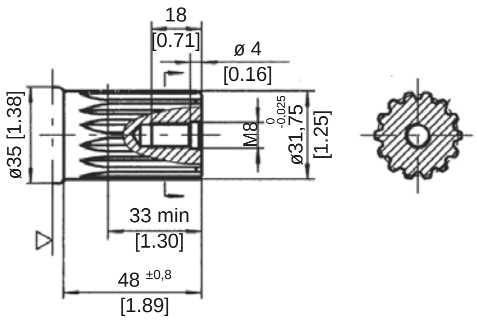
Shaft T1: 35mm Tapered-shaft
Parallel key B6x6x20

T3



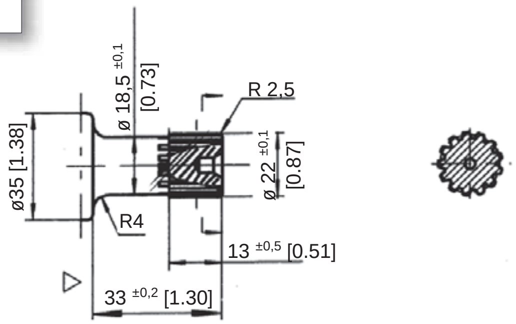
Shaft T3: 11/4” Tapered -shaft
Parallel key .31x.31x11/4
Tightening torque:200±10Nm

F



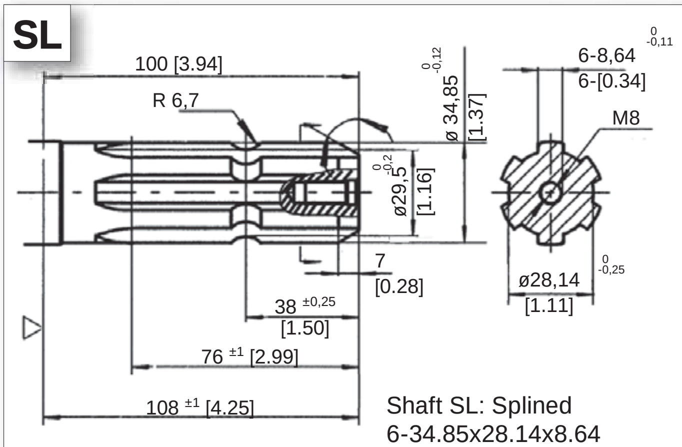
Shaft F : 11/4” 14 Splined Take out
14-DP12/24

I



Shaft I: 7/8” 13 Splined
13-DP16/32

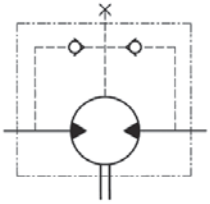
SL

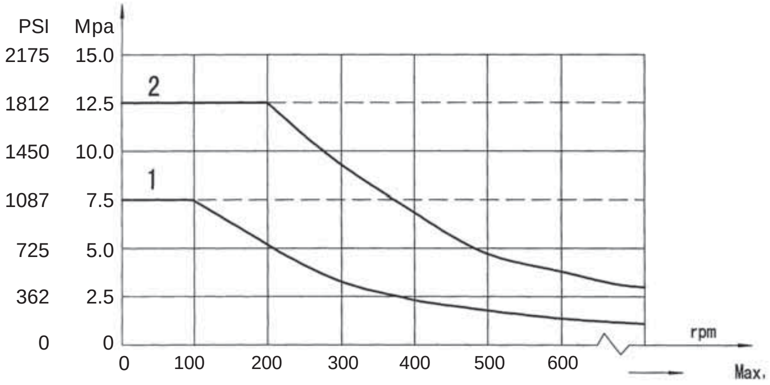


Shaft SL: Splined
6-34.85x28.14x8.64

ADDITIONAL DATA

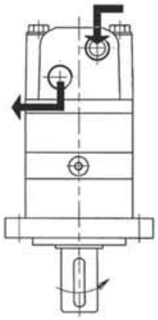
PERMISSIBLE SHAFT SEAL PRESSURE

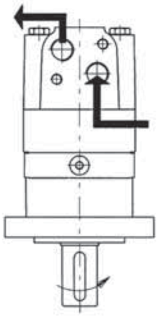




IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

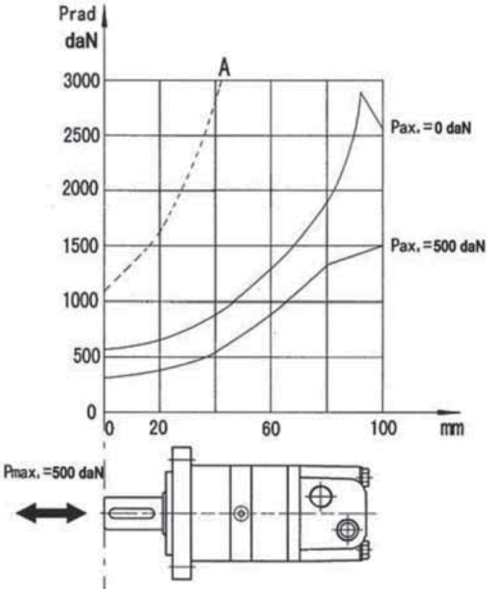
DIRECTION OF SHAFT ROTATION





WHEN FACING SHAFT END OF MOTOR,SHAFT TO ROTATE: CLOCKWISE WHEN PORT “A” IS PRESSURIZED.COUNTER CLOCK WISE WHEN PORT “B” IS PRESSURIZED.

AXIAL AND RADIAL FORCES



The output shaft runs in tapered bearings that permit high axial and radial forces, Curve “A” shows max radial shaft load, Any shaft loads exceeding the values quoted in the curve will involve a risk of breakage, The two other curves apply to a B10 bearing life of 3000 hours at 200 RPM

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMSY							

1	**2**		**3**		**4**		**5**		**6**		**7**	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
80	**E2**	SAE 2-Bolt , pilot 3.25x.25	**A**	Shaft :25mm Keyed, parallel Key 8×7×32	**D**	G1/2 Manifold Mount 2-M10, G1/4	**NONE**	STANDARD	**OO**	NO PAINT	**NONE**	STANDARD
100	**E4**	4- Bolt flange, pilot 3.25x.25	**B**	Shaft: 32mm Keyed parallel Key 10×8×45	**M**	M22×1.5 Manifold Mount 2-M10, M14×1.5	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
125	**F6**	Magneto flange, pilot 3.25x.25	**D**	Shaft: 1” Keyed parallel Key .25x.25x1.0	**S**	7/8-14 O-ring manifold 2-3/8-16 UNC, 7/16-20UNF			**B**	BLACK	**LL**	LOW LEAKAGE
160	**SP**	4 Bolt-flange, pilot 3.25x.25	**G**	Shaft: 11/4” Keyed parallel Key .31x.31x1.25	**P**	1/2-14 NPTF Manifold 2-3/8-16 UNC, 7/16-20UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
200	**W**	4-Ø13.5 Wheel-flange, pilot Ø125×8	**F**	Shaft: 11/4-14,splined 14-DP12/24	**EE M2**	M22X1,5 M14X1,5					**CRS**	CORROSION RESISTANT SHAFT
250	**E2B**	SAE B 2-Bolt pilot 4.00x.37	**FD**	Long Shaft: 11/4-14 splined splined14-DP12/24	**EE S2**	7/8-14 UNF O-RING 7/16-20 UNF					**HPS**	HIGH PRESSURE SEAL
315			**SL**	Shaft Ø34.85 ,Splined 6-34.85×28.14×8.64	**ED**	1-1/16-12 UF O-RING, 7/16-20 UNF					**HTS**	HIGH TEMP SEAL
400			**T1**	35mm Tapered parallel key b6x6x20								
475			**T3**	shaft: 11/4 Tapered parallel Key .31x.31x1.250								
			S1	Shaft :SAE-6 B splined								
			I	Shaft: 7/8-13 splined 13-DP16/32								

Ordering code:
All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

YMSE

The **YMSE** series motors incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum. A “DISC VALVE” distribution system which is internally balanced to reduce friction, leakage and permits better speed control producing higher efficiency, smoother rotation, higher speed and pressure.

The series has many sizes and options to make it very flexible for many applications. The output shaft is mounted on tapered roller bearings for high radial and axial load for very high duty applications

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMSE	[in^3./rev]	[4.88 ~ 22.88]	[PSI]	[3263]	RPM	[HP]	[27]
		cm^3/rev.	80 ~ 375	MPa	22.5	30 ~ 800	Kw	20

QUICK REFERENCE GUIDE

YMSE SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[4.92]	80.6	FLOW UP TO	90 LPM	[23.78 GPM]
[6.15]	100.8	PRESSURE UP TO	22.5 MPA	[3262 PSI]
[7.63]	125	TORQUE UP TO	751 NM	[3944 LB. IN.]
[9.59]	157.2	SPEED UP TO	446 RPM	
[12.2]	200			
[15.38]	252			
[19.19]	314.5			
[22.57]	370			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40^o C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

For individual motor performance charts consult equivalent YMS series data

DISTRIBUTION TYPE			YMSE 80	YMSE 100	YMSE 125	YMSE 160	YMSE 200	YMSE 250	YMSE 315	YMSE 375
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[4.92]	[6.16]	[7.63]	[9.60]	[12.21]	[15.38]	[19.20]	[22.58]
		cm^3/rev.	80.6	100.8	125	157.2	200	252	314.5	370
MAX. SPEED RPM		RATED	675	540	432	337	270	216	171	145
		CONT.	800	748	600	470	375	300	240	200
		INT	**988**	**900**	**720**	**560**	**450**	**360**	**280**	**240**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[1548]	[1946]	[2414]	[2795]	[3007]	[3980]	[4953]	[4740]
		N*M	**175**	**220**	**273**	**316**	**340**	**450**	**560**	**536**
	CONT.	[LB. IN.]	[1680]	[2123]	[2742]	[2795]	[3538]	[3980]	[4953]	[4740]
		N*M	**190**	**240**	**310**	**316**	**400**	**450**	**560**	**536**
	INT.	[LB. IN.]	[2123]	[2653]	[3272]	[3803]	[4121]	[4776]	[5819]	[5704]
		N*M	**240**	**300**	**370**	**430**	**466**	**540**	**659**	**645**
	PEAK	[LB. IN.]	[2299]	[2830]	[3538]	[4174]	[5749]	[6102]	[6545]	[6642]
		N*M	**260**	**320**	**400**	**472**	**650**	**690**	**740**	**751**
MAX. OUTPUT [HP] KW	RATED	[HP]	[17]	[17]	[17]	[15]	[13]	[14]	[14]	[12]
		KW	**12.4**	**12.4**	**12.4**	**11.2**	**9.6**	**10.2**	**10**	**8.6**
	CONT.	[HP]	[21]	[25]	[26]	[21]	[21]	[19]	[19]	[16]
		KW	**15.9**	**18.**	**19.5**	**15.6**	**15.7**	**14.1**	**14.1**	**11.8**
	INT.	[HP]	[27]	[32]	[32]	[29]	[25]	[23]	[25]	[23]
		KW	**20.1**	**23.5**	**23.2**	**21.2**	**18.3**	**17.0**	**18.9**	**17**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2175]	[1813]	[1813]	[1740]	[1450]
		MPa	**16**	**16**	**16**	**15**	**12.5**	**12.5**	**12**	**10**
	CONT.	[PSI]	[2538]	[2538]	[2538]	[2175]	[2030]	[1813]	[1740]	[1450]
		MPa	**17.5**	**17.5**	**17.5**	**15**	**14**	**12.5**	**12**	**10**
	INT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[2320]	[2320]	[2030]	[1740]
		MPa	**21**	**21**	**21**	**21**	**16**	**16**	**14**	**12**
	PEAK	[PSI]	[3263]	[3263]	[3263]	[3263]	[3263]	[2900]	[2683]	[2030]
		MPa	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**20**	**18.5**	**14**
MAX. FLOW [GPM] L/min	CONT.	[GPM]	[17.1]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**65**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
	INT.	[GPM]	[21.1]	[23.7]	[23.7]	[23.]	[23.7]	[23.7]	[23.7]	[23.7]
		L/MIN	**80**	**90**	**90**	**90**	**90**	**90**	**90**	**90**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	INT.	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[22]	[22]	[23]	[24]	[24]	[26]	[27]	[28]
		KG	**9.8**	**10**	**10.3**	**10.7**	**11.1**	**11.6**	**12.3**	**12.6**

- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Continuous pressure: Max. value of operating motor continuously.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

YMSE

PERFORMANCE DATA

YMSE 80

[4.92 in³/rev] 80.6 cm³/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[310] 35 **180**	[707] 80 **174**	[1061] 120 **168**	[1397] 158 **164**	[1724] 195 **158**	[2078] 235 **151**	[2202] 249 **143**	
	[7.9] 30	[310] 35 **362**	[707] 80 **352**	[1061] 120 **346**	[1397] 158 **338**	[1724] 195 **330**	[2122] 240 **322**	[2299] 260 **310**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[310] 35 **482**	[699] 79 **473**	[1052] 119 **464**	[1371 155 **453**	[1707] 193 **444**	[2070] 234 **434**	[2211] 250 **415**	
	[13.2] 50	[265] 30 **602**	[681] 77 **594**	[1035] 117 **587**	[1353] 153 **569**	[1698] 192 **560**	[2052] 232 **551**	[2193] 248 **522**	
Max cont	[15.8] 60	[248] 28 **724**	[681] 77 **713**	[1035] 117 **707**	[1353] 153 **683**	[1698] 192 **673**	[2052] 232 **664**	[2184] 247 **629**	
	[19.8] 75	[221] 25 **840**	[663] 75 **832**	[1008] 114 **817**	[1344] 152 **796**	[1680] 190 **786**	[2034] 230 **777**	[2167] 245 **737**	Max cont.
Max int.	[23.8] 90	[212] 24 **900**	[646] 73 **893**	[973] 110 **872**	[1327] 150 **853**	[1636] 185 **843**	[1990] 225 **834**	[2123] 240 **792**	Max int.

YMSE 100

6.16 in³/rev] 100.8 cm³/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[425] 48 **146**	[840] 95 **144**	[1327 150 **139**	[1769] 200 **135**	[2211] 250 **130**	[2556] 289 **120**	[2742] 310 **105**	
	[7.9] 30	[398] 45 **291**	[831] 94 **289**	[1291] 146 **278**	[1751] 198 **274**	[2211] 250 **269**	[2609] 295 **258**	[2804] 317 **242**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[380] 43 **387**	[787] 89 **384**	[1256] 142 **374**	[1733] 196 **359**	[2193] 248 **350**	[2591] 293 **335**	[2795] 316 **320**	
	[13.2] 50	[354] 40 **486**	[778] 88 **483**	[1194] 135 **473**	[1716] 194 **462**	[2184] 247 **450**	[2582] 292 **430**	[2786] 315 **420**	
	[15.8] 60	[327] 37 **588**	[778] 88 **584**	[1167] 132 **574**	[1636] 185 **562**	[2158] 244 **550**	[2556] 289 **538**	[2759] 312 **520**	
Max cont	[19.8] 75	[310] 35 **740**	[708] 80 **735**	[1150] 130 **720**	[1592] 180 **705**	[2123] 240 **696**	[2529] 286 **676**	[2742] 310 **653**	Max cont.
Max int.	[23.8] 90	[265] 30 **850**	[663] 75 **840**	[1097] 124 **810**	[1503] 170 **787**	[2087] 236 **770**	[2450] 277 **750**	[2680] 303 **747**	Max int.

YMSE 125

[7.63 in³/rev] 125 cm³/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[486] 55 **112**	[1061] 120 **110**	[1557] 176 **103**	[2167] 245 **96**	[2733] 309 **93**	[3087] 349 **90**	[3317] 375 **84**	
	[7.9] 30	[486] 55 **222**	1061] 120 **220**	[1548] 175 **217**	[2211] 250 **208**	[2865] 324 **200**	[3317] 375 **199**	[3608] 408 **190**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[486] 55 **302**	[1061] 120 **298**	[1548] 175 **292**	[2211] 250 **284**	[2865] 324 **276**	[3272] 370 **268**	[3608] 408 **260**	
	[13.2] 50	[442] 50 **379**	[1017] 115 **373**	[1557] 176 **368**	[2193] 248 **363**	[2830] 320 **350**	[3272] 370 **339**	[3591 406 **328**	
	[15.8] 60	[398] 45 **456**	[999] 113 **448**	[1512] 171 **443**	[2167] 245 **439**	[2865] 324 **425**	[3255] 368 **406**	[3591] 406 **393**	
Max cont	[19.8] 75	[398] 45 **570**	[973] 110 **563**	[1477] 167 **555**	[2123] 240 **546**	[2777] 314 **533**	[3272] 370 **515**	[3546] 401 **503**	Max cont.
Max int.	[23.8] 90	[354] 40 **685**	[929] 105 **676**	[1433] 162 **670**	[2096] 237 **659**	[2733] 309 **644**	[3228] 365 **625**	[3520] 398 **610**	Max int.

YMS 160

[9.60 in³/rev] 157.2 cm³/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[619] 70 **91**	[1238] 140 **88**	[1813] 205 **84**	[2697] 305 **78**	[3281] 371 **76**	[3803 430 **74**	[4183] 473 **58**	
	[7.9] 30	[663] 75 **185**	[1327] 150 **182**	[1893] 214 **176**	[2839] 321 **168**	[3361] 380 **164**	[3776] 427 **162**	[4333] 490 **152**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[619] 70 **248**	[1327] 150 **244**	[1901] 215 **239**	[2830] 320 **229**	[3343] 378 **224**	[3759] 425 **217**	[4316] 488 **204**	
	[13.2] 50	[575] 65 **312**	[1282] 145 **308**	[1901] 215 **304**	[2795] 316 **294**	[3343] 378 **288**	[3759] 425 **280**	[4263] 482 **270**	
	[15.8] 60	[575] 65 **375**	[1282] 145 **371**	[1893] 214 **365**	[2786] 315 **357**	[3317] 375 **346**	[3750] 424 **336**	[4263] 482 **323**	
Max cont	[19.8] 75	[531] 60 **470**	[1221] 138 **465**	[1840] 208 **458**	[2751] 311 **447**	[3317] 375 **436**	[3714] 420 **426**		Max cont.
Max int.	[23.8] 90	[495] 56 **564**	[1150] 130 **559**	[1769] 200 **551**	[2724] 308 **541**	[3272] 370 **526**	[3661] 414 **517**		Max int.

PERFORMANCE DATA

YMSE 200

[12.21 in^3/rev] 200 cm^3/rev.

					Max cont.		Max int.	
Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
	[3.9] 15	[787] 89 **73**	[1680] 190 **71**	[2609] 295 **68**	[3538] 400 **64**	[4281] 484 **60**	[5377] 608 **52**	
	[7.9] 30	[769] 87 **148**	[1680] 190 **146**	[2600] 294 **143**	[3529] 399 **140**	[4289] 485 **135**	[5306] 600 **127**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[761] 86 **193**	[1663] 188 **191**	[2582] 292 **189**	[3511] 397 **186**	[4272] 483 **181**	[5253] 594 **172**	
	[13.2] 50	[708] 80 **247**	[1627] 184 **245**	[2565] 290 **243**	[3493] 395 **240**	[4245] 480 **235**	[5218] 590 **226**	
	[15.8] 60	[654] 74 **298**	[1574] 178 **295**	[2530] 286 **293**	[3449] 390 **290**	[4201] 475 **284**	[5147] 582 **273**	
Max cont	[19.8] 75	[513] 58 **372**	[1415] 160 **369**	[2432] 275 **365**	[3317] 375 **362**	[4068] 460 **358**	[5041] 570 **346**	Max cont.
Max int.	[23.8] 90	[433] 49 **440**	[1309] 148 **435**	[2299] 260 **430**	[3140] 355 **422**	[3936] 445 **411**	[4908] 555 **401**	Max int.

YMSE

250 [15.38 in^3/rev] 252 cm^3/rev.

					Max cont.		Max int.	
Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
	[3.9] 15	[1035] 117 **58**	[2034] 230 **55**	[3140] 355 **52**	[3980] 450 **51**	[4900] 554 **47**	[5766] 652 **46**	
	[7.9] 30	[1035] 117 **118**	[1990] 225 **117**	[3095] 350 **112**	[3944] 446 **109**	[4953] 560 **107**	[5811] 657 **106**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[1017] 115 **160**	[1990] 225 **156**	[3078] 348 **152**	[3909] 442 **150**	[4882] 552 **146**	5749] 650 **142**	
	[13.2] 50	[973] 110 **202**	[1946] 220 **200**	[3051] 345 **198**	[3874] 438 **196**	[4829] 546 **195**	[5704] 645 **192**	
	[15.8] 60	[929] 105 **242**	[1946 220 **239**	[3007] 340 **237**	[3847] 435 **234**	[4793] 542 **231**	[5678] 642 **229**	
Max cont	[19.8] 75	[840] 95 **300**	[1901] 215 **296**	[2989] 338 **293**	[3803] 430 **286**	[4749] 537 **282**	[5642] 638 **278**	Max cont.
Max int.	[23.8] 90	[796] 90 **360**	[1813] 205 **354**	[2936] 332 **348**	[3714] 420 **340**	[4687] 530 **332**	[5589] 632 **326**	Max int.

YMSE 315

[19.20 in^3/rev] 314.5 cm^3/rev.

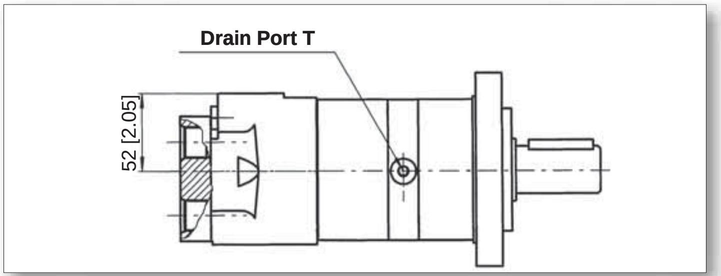
					Max cont.		Max int.	
Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	[1522] 10.5	[1740] 12	[2030] 14	[2682] 18.5	[PSI] MPA
	[3.9] 15	[1415] 160 **48**	[2830] 320 **47**	[4112] 465 **45**	[4908] 555 **43**	[5749] 650 **40**	[6615] 748 **38**	
	[7.9] 30	[1459] 165 **94**	[2848] 322 **92**	[4139] 468 **90**	[4953] 560 **89**	[5819] 658 **86**	[6651] 752 **85**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[1415] 160 **125**	[2742] 310 **123**	[4042] 457 **120**	[4829] 546 **118**	[5678] 642 **116**	[6553] 741 **115**	
	[13.2] 50	[1371] 155 **158**	[2697] 305 **156**	[3980] 450 **153**	[4758] 538 **150**	[5634] 637 **147**	[6509] 736 **145**	
	[15.8] 60	[1344] 152 **175**	[2671] 302 **174**	[3909] 442 **170**	[4705] 532 **164**	[5589] 632 **162**	[6474] 732 **159**	
Max cont	[19.8] 75	[1282] 145 **236**	[2609] 295 **234**	[3856] 436 **230**	[4643] 525 **227**	[5554] 628 **225**	[6421] 726 **222**	Max cont.
Max int.	[23.8] 90	[1167] 132 **285**	[2476] 280 **282**	[3803] 430 **280**	[4599] 520 **276**	[5501] 622 **273**	[6394] 723 **270**	Max int.

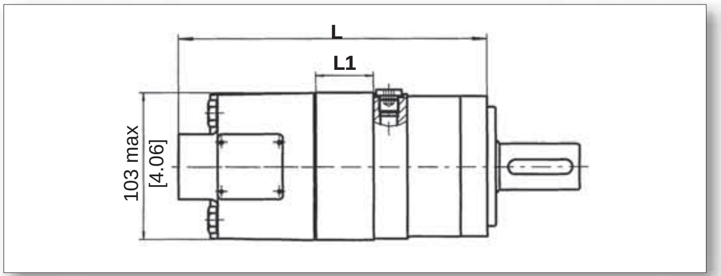
YMSE 375

[22.58 in^3/rev] 370 cm^3/rev.

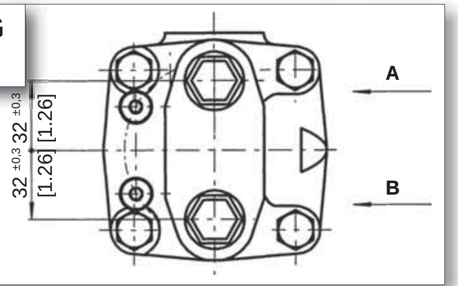
					Max cont		Max int.	
Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[PSI] MPA
	[3.9] 15	[1636] 185 **40**	[3202] 362 **39**	[4192] 474 **38**	[4528] 512 **37**	[5200] 588 **35**	[5837] 660 **33**	
	[7.9] 30	[1627] 184 **80**	[3219] 364 **78**	[4201] 475 **77**	[4546] 514 **76**	[5218] 590 **74**	[5846] 661 **72**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[1592] 180 **106**	[3202] 362 **104**	[4183] 473 **103**	[4537] 513 **102**	[5200] 588 **100**	[5828] 659 **97**	
	[13.2] 50	[1415] 160 **133**	[3184] 360 **131**	[4174] 472 **130**	[4519] 511 **129**	[5183] 586 **128**	[5819] 658 **125**	
	[15.8] 60	[1327] 150 **157**	[3175] 359 **156**	[4166] 471 **155**	[4510] 510 **154**	[5174] 585 **152**	5811] 657 **150**	
Max cont	[19.8] 75	1150] 130 **200**	[3122] 353 **198**	[4112] 465 **196**	[4457] 504 **195**	[5165] 584 **194**	[5757] 651 **193**	Max cont.
Max int.	[23.8] 90	[929] 105 **238**	[3095] 350 **235**	[4086] 462 **234**	[4422] 500 **232**	[5130] 580 **230**	[5722] 647 **227**	Max int.

END PORT MOUNTING DATA





PORTING EE



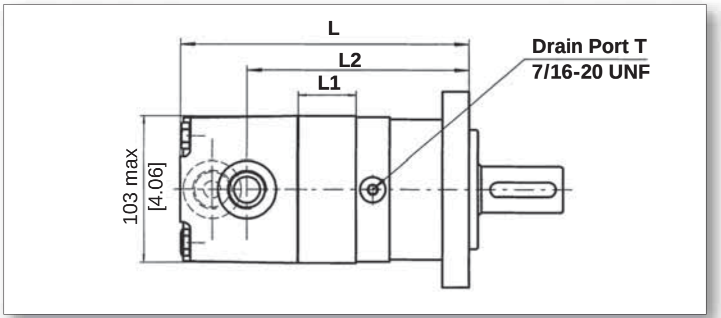
ORDER CODE	EE-D	DEPTH	EE-M2	DEPTH	EE-S2	DEPTH
PORTS - A and B	G1/2	18 mm	M22x1,5	18 mm	7/8-14 O-ring	18 mm
TANK PORT - T	G1/4	12 mm	M14x1,5	12 mm	7/16-20unf	12 mm

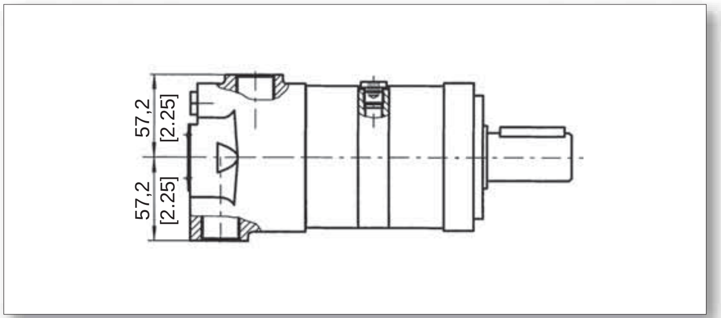
	[INCHES]		MM	
MODEL	L	L1	L	L1
YMSE 80	[6.97]	[0.51]	177	13
YMSE 100	[7.13]	[0.67]	181	17
YMSE 125	[7.32]	[0.87]	186	22
YMSE 160	[7.56]	[1.08]	192	27.5
YMSE 200	[7.91]	[.99]	201	35.1
YMSE 250	[8.31]	[1.85]	211	47
YMSE 315	[8.78]	[2.32]	223	59
YMSE 375	[9.25]	[2.80]	235	71

	[INCHES]		MM	
MODEL	L	L1	L	L1
YMSE 80 WE	[5.49]	[0.51]	139.4	13
YMSE 100 WE	[5.65]	[0.67]	143.4	17
YMSE 125 WE	[5.84]	[0.87]	148.4	22
YMSE 160 WE	[6.10]	[1.08]	154.9	27.5
YMSE 200 WE	[6.43]	[1.38]	163.4	35.1
YMSE 250 WE	[6.83]	[1.85]	173.4	47
YMSE 315 WE	[7.30]	[2.32]	185.4	59
YMSE 375 WE	[7.77]	[2.80]	197.4	71

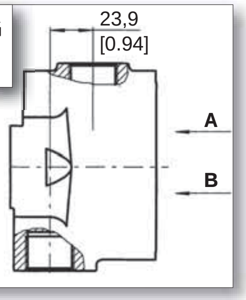
NOTE: THE THICKNESS OF THE STATOR AND ROTOR IS THE DIMENSION OF L1 PLUS 3MM

180 PORT MOUNTING DATA





PORTING ED



O-Ring 180 apart

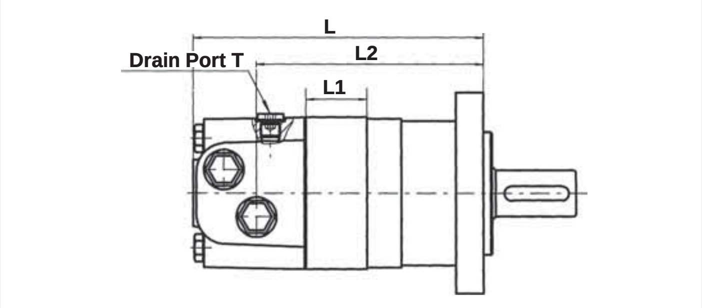
ORDER CODE	ED-S2	DEPTH
PORTS - A and B	11/16-12 O-RING	18 mm
TANK PORT - T	7/16-20UNF	12 mm

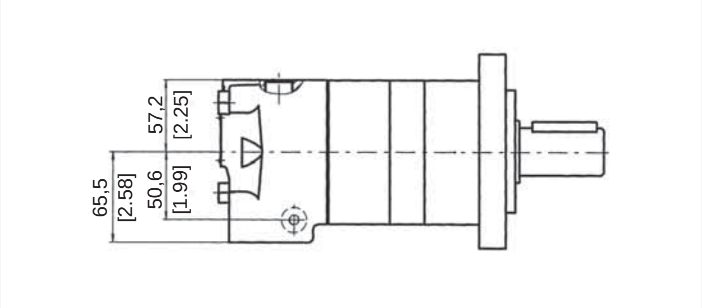
	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80	[6.81]	[.51]	[4.95]	173	13	125.7
YMSE 100	[6.97]	[.67]	[5.11]	177	17	129.7
YMSE 125	[7.17]	[.87]	[5.30]	182	22	134.7
YMSE 160	[7.38]	[1.08]	[5.52]	187.5	27.5	140.2
YMSE 200	[7.68]	[1.38]	[5.81]	195	35.1	147.7
YMSE 250	[8.15]	[1.85]	[6.29]	207	47	159.7
YMSE 315	[8.62]	[2.32]	[6.76]	219	59	171.7
YMSE 375	[9.09]	[2.80]	[7.23]	231	71	183.7

	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80 WE	[5.71]	[.51]	[3.84]	145	13	97.5
YMSE 100 WE	[5.87]	[.67]	[4.00]	149	17	101.5
YMSE 125 WE	[6.02]	[.87]	[4.19]	153	22	106.5
YMSE 160 WE	[6.24]	[1.08]	[4.41]	158.5	27.5	112
YMSE 200 WE	[6.54]	[1.38]	[4.70]	166	35.1	119.5
YMSE 250 WE	[7.05]	[1.85]	[5.18]	179	47	131.5
YMSE 315 WE	[7.52]	[2.32]	[5.65]	191	59	143.5
YMSE 375 WE	[7.99]	[2.80]	[6.12]	203	71	155.5

NOTE: THE THICKNESS OF THE STATOR AND ROTOR IS THE DIMENSION OF L1 PLUS 3MM

MOUNTING DATA

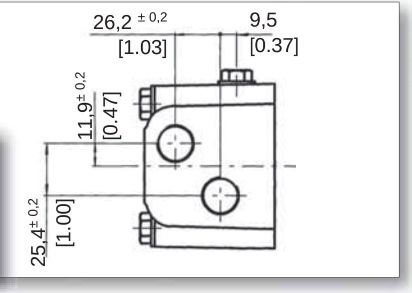




	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80	[6.74]	[.52]	[4.85]	171	13	123.2
YMSE 100	[6.89]	[.67]	[5.01]	175	17	127.2
YMSE 125	[7.09]	[.87]	[5.21]	180	22	132.2
YMSE 160	[7.27]	[1.09]	[5.43]	184.5	27.5	137.7
YMSE 200	[7.60]	[1.39]	[5.72]	193	35.1	145.2
YMSE 250	[8.07]	[1.85]	[6.19]	205	47	157.2
YMSE 315	[8.55]	[2.33]	[6.67]	217	59	169.2
YMSE 375	[9.02]	[2.80]	[7.14]	229	71	181.2

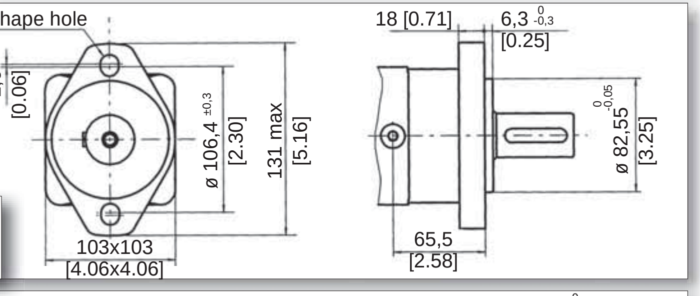
	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80 WE	[5.63]	[.51]	[3.74]	143	13	95
YMSE 100 WE	[5.79]	[.67]	[3.90]	147	17	99
YMSE 125 WE	[5.98]	[.87]	[4.09]	152	22	104
YMSE 160 WE	[6.20]	[1.08]	[4.31]	157.5	27.5	109.5
YMSE 200 WE	[6.50]	[1.38]	[4.61]	165	35.1	117
YMSE 250 WE	[6.97]	[1.85]	[5.08]	177	47	129
YMSE 315 WE	[7.44]	[2.32]	[5.55]	189	59	141
YMSE 375 WE	[7.91]	[2.80]	[6.02]	201	71	153

PORTING DB, DU, SU, SB, M4

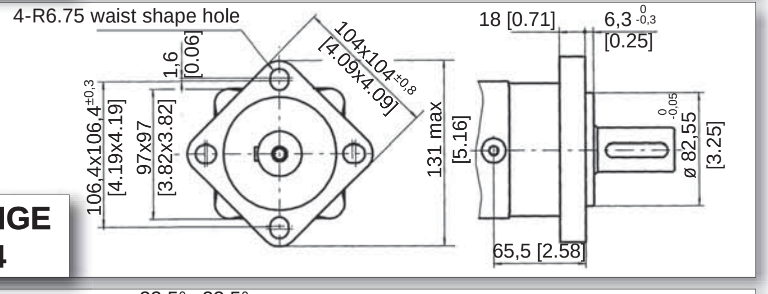


NOTE: THE THICKNESS OF THE STATOR AND ROTOR IS THE DIMENSION OF L1 PLUS 3MM

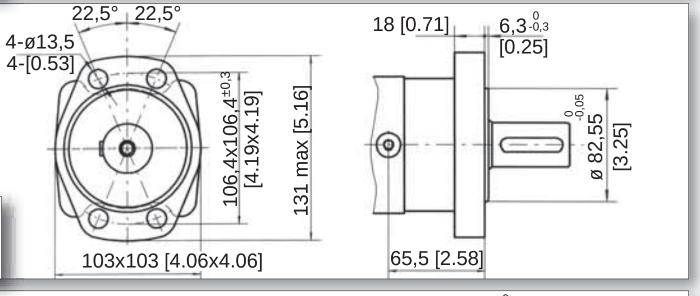
ORDER CODE	DB depth	DU depth	SU depth	SB depth	M4 depth
P(A, B)	G1/2 (18)	G1/2 (18)	7/8-14 O-ring (18)	7/8-14 O-ring (18)	M22 x 1,5 (18)
T	G1/4 (12)	7/16-20 UNF (12)	7/16-20 UNF (12)	G1/4 (12)	M14 x 1,5 (12)



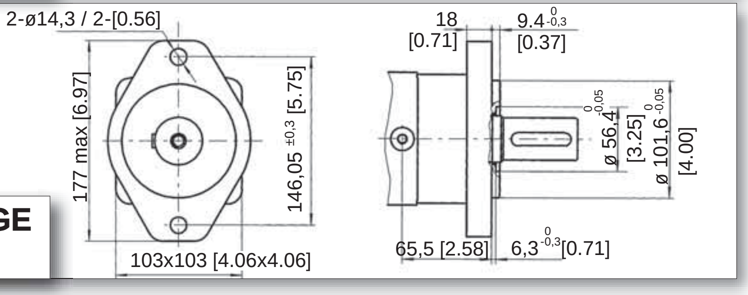
FLANGE E2



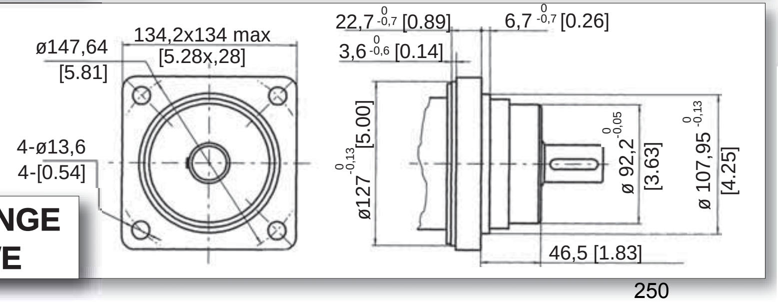
FLANGE E4



FLANGE E6

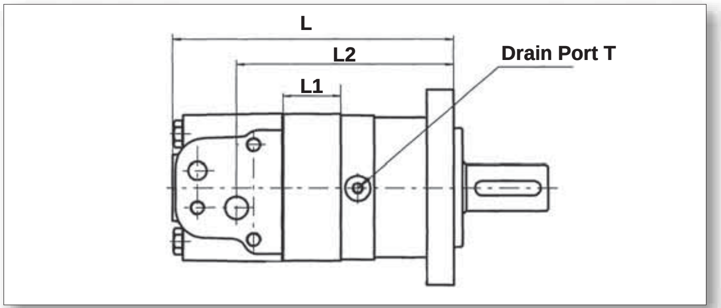


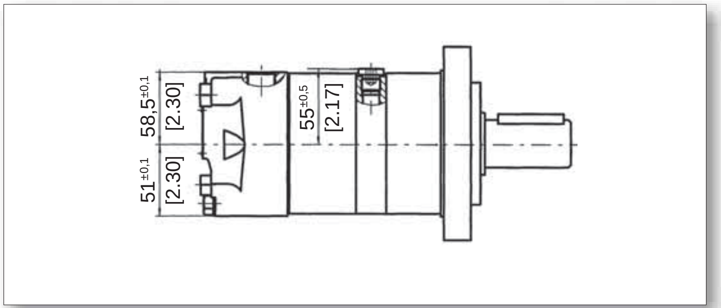
FLANGE E2B



FLANGE WE

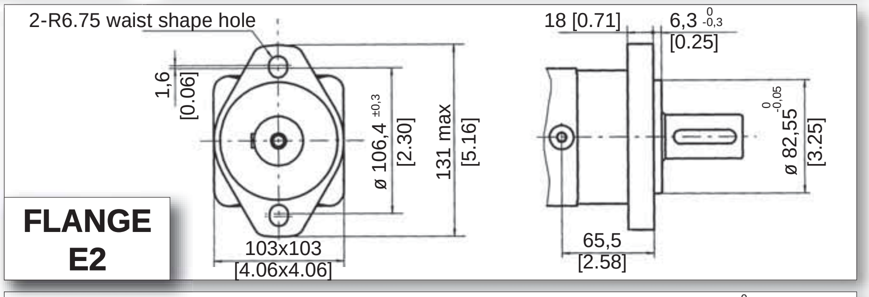
MOUNTING DATA



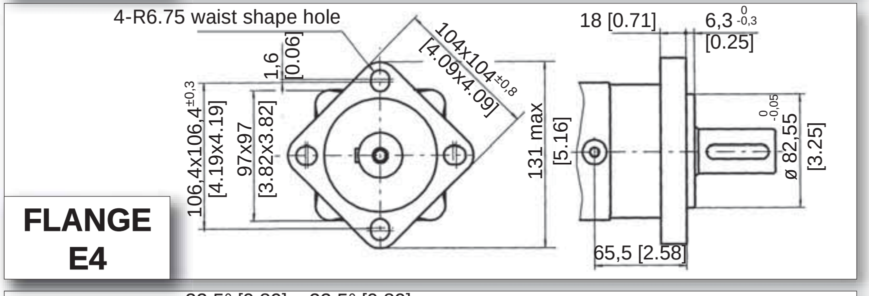


	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80	[6.57]	[.51]	[4.79]	167	13	121.7
YMSE 100	[6.73]	[.67]	4.95]	171	17	125.7
YMSE 125	[6.93]	[.87]	[5.15]	176	22	130.7
YMSE 160	[7.15]	[1.08]	[5.36]	181.5	27.5	136.2
YMSE 200	[7.44]	[.99]	[5.66]	189	25.1	143.7
YMSE 250	[7.91]	[1.85]	[6.13]	201	47	155.7
YMSE 315	8.39]	[2.32]	[6.60]	213	59	167.7
YMSE 375	[8.86]	[2.80]	[7.07]	225	71	179.7

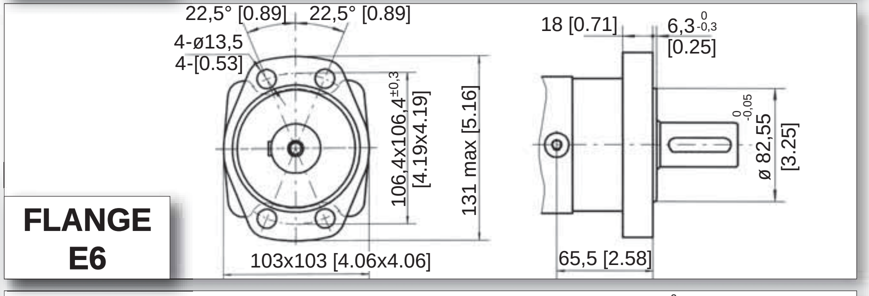
	[INCHES]			MM		
MODEL	L	L1	L2	L	L1	L2
YMSE 80 WE	[5.47]	[.51]	[3.68]	139	13	93.5
YMSE 100 WE	[5.63]	[.67]	[3.84]	143	17	97.5
YMSE 125 WE	[5.83]	[.87]	[4.04]	148	22	102.5
YMSE 160 WE	[6.04]	[1.08]	[4.25]	153.5	27.5	108
YMSE 200 WE	[6.34]	[1.38]	[4.55]	161	35.1	115.5
YMSE 250 WE	[6.81]	[1.85]	[5.02]	173	47	127.5
YMSE 315 WE	[7.28]	[2.32]	[5.49]	185	59	139.5
YMSE 375 WE	[7.76]	[2.80]	[5.96]	197	71	151.5



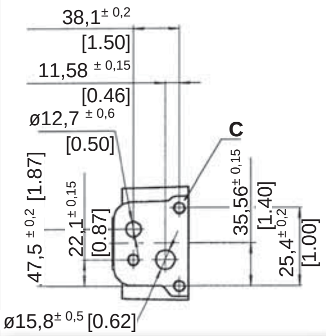
FLANGE E2



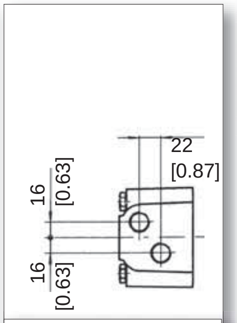
FLANGE E4



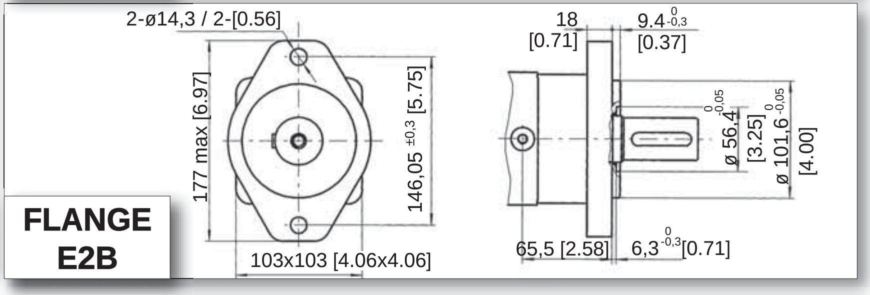
FLANGE E6



PORTING MU,MM

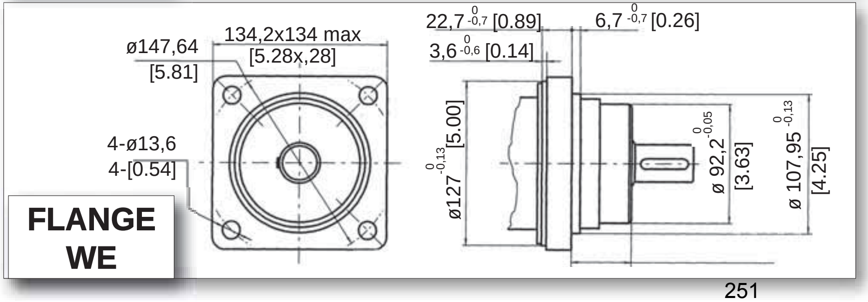


PORTING G, M2, S2



FLANGE E2B

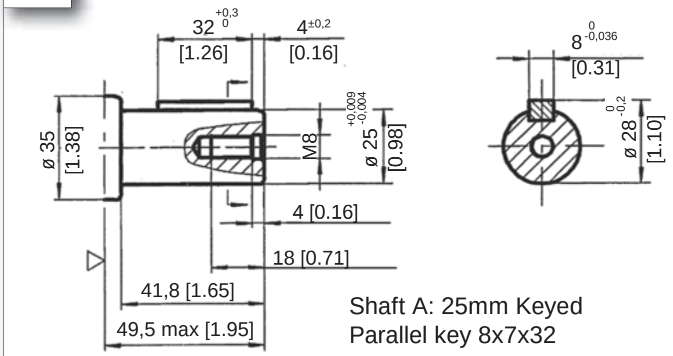
ORDER CODE	MU	MM	G depth	M2 depth	S2 depth
P(A, B)	ø12.7 ø 15.8	ø12.7 ø 15.8	G 1/2 (18)	M22 x 1.5 (18)	7/8-14 O-ring
T	7/16-20 UNF (12)	G 1/4 (12)	G 1/4 (12)	M14 x 1.5 (12)	7/16-20 UNF
C	3x3/8-16 UNC	3 x M10	-		-



FLANGE WE

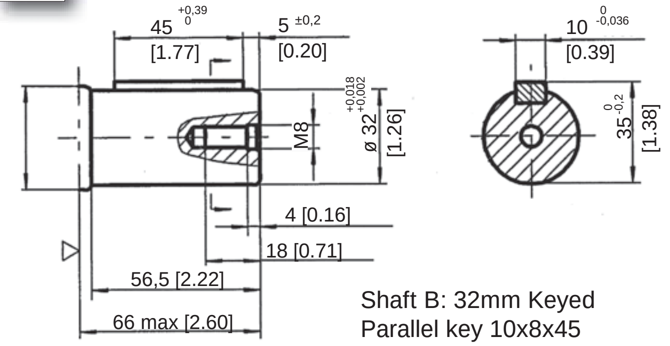
MOTOR SHAFT EXTENSIONS

A



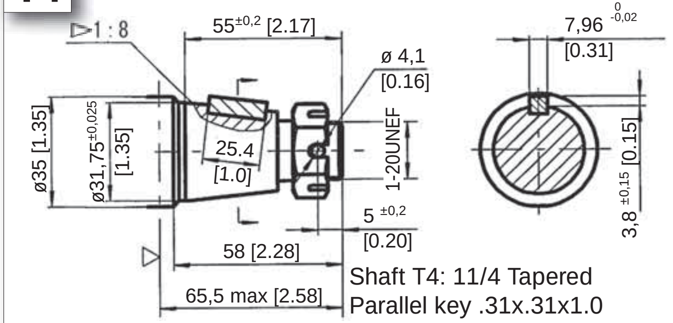
Shaft A: 25mm Keyed
Parallel key 8x7x32

B



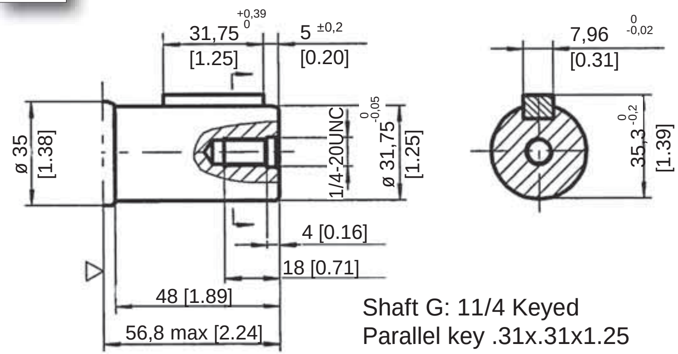
Shaft B: 32mm Keyed
Parallel key 10x8x45

T4



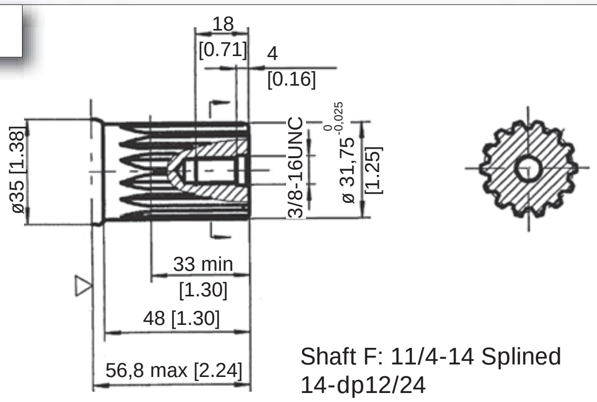
Shaft T4: 11/4 Tapered
Parallel key .31x.31x1.0
Tightening torque: 200±10Nm

G



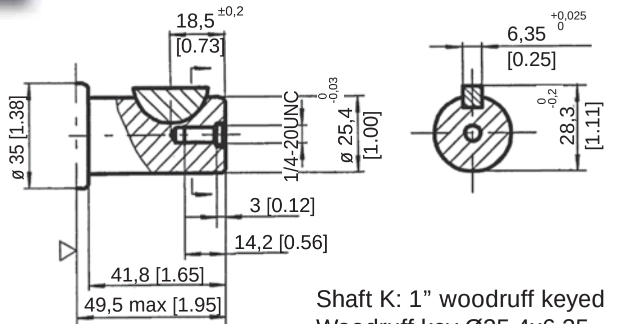
Shaft G: 11/4 Keyed
Parallel key .31x.31x1.25

F



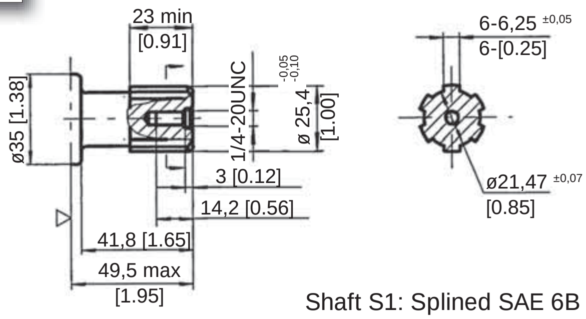
Shaft F: 11/4-14 Splined
14-dp12/24

K



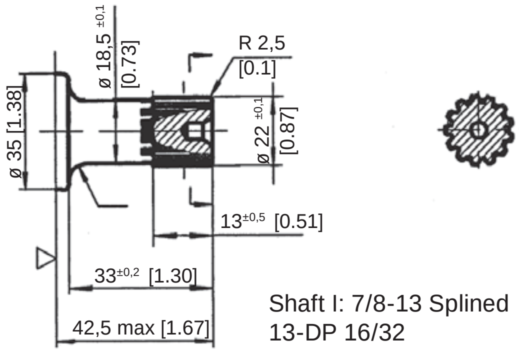
Shaft K: 1” woodruff keyed
Woodruff key Ø25.4x6.35

S1



Shaft S1: Splined SAE 6B

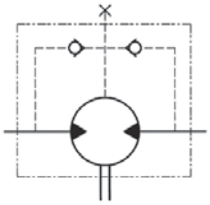
I

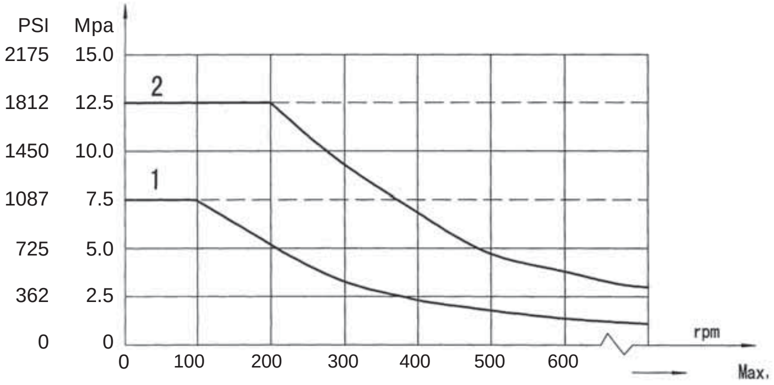


Shaft I: 7/8-13 Splined
13-DP 16/32

ADDITIONAL DATA

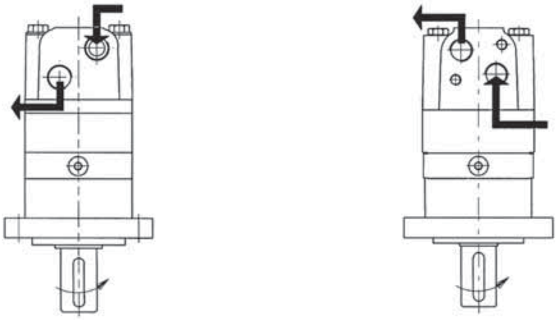
PERMISSIBLE SHAFT SEAL PRESSURE





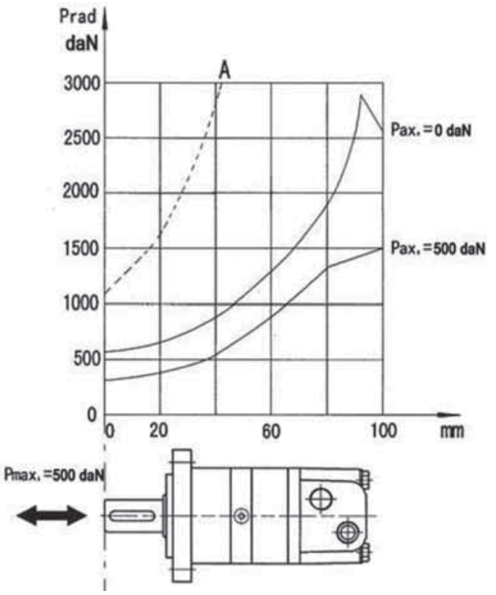
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

DIRECTION OF SHAFT ROTATION



WHEN FACING SHAFT END OF MOTOR,SHAFT TO ROTATE: CLOCKWISE WHEN PORT “A” IS PRESSURIZED.COUNTER CLOCK WISE WHEN PORT “B” IS PRESSURIZED.

AXIAL AND RADIAL FORCES



The output shaft runs in tapered bearings that permit high axial and radial forces, Curve “A” shows max radial shaft load, Any shaft loads exceeding the values quoted in the curve will involve a risk of breakage, The two other curves apply to a B10 bearing life of 3000 hours at 200 RPM

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMSE							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
80	**E2**	SAE 2-Bolt pilot 3.25X.25	**A**	Shaft: 25mm Keyed parallel Key 8×7×32	**MU**	1/2”,5/8”Crosshole Manifold 3×3/8-16UNC, 7/16-20UNF	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
100	**E4**	4-Bolt flange pilot 3.25x.25	**B**	Shaft: 32mm Keyed parallel Key 10×8×45	**MM**	1/2”,5/8”Crosshole Manifold 3×M10, G1/4	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
125	**E6**	Magneto-flange, pilot 3.25x.25	**K**	Shaft: 1”Woodruff Key key 1.0x.25	**EE-D**	G1/2,G1/4			**B**	BLACK	**LL**	LOW LEAKAGE
160	**E2B**	SAE 2-BOLT pilot4.00x .37	**G**	Shaft: 11/4 Keyed parallel Key .31x.31x1.25	**EE-M2**	M22X1.5, M14X1.5			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
200	**WE**	4-Ø13.5 Wheel-flange, pilot Ø125×8	**F**	Shaft: 11/4-14 Splined 14-DP12/24	**EE-S2**	7/8-14UNF O-RING 7/16-20 UNF					**CRS**	CORROSION RESISTANT SHAFT
250			**T4**	Shaft:11/4 Tapered parallel key .31x.31x1.0	**ED**	1-1/16-12UNF O-RING,7/16-20 UNF					**HPS**	HIGH PRESSURE SEAL
315			**S1**	Shaft: SAE 6B Splined	**DB**	G1/2,G1/4					**HTS**	HIGH TEMP SEAL
375			**I**	Shaft: 7/8-13 Splined 13-DP16/32	**DU**	G1/2,7/16-20UNF						
					SB	7/8-14UNF O-RING,G1/4						
					SU	7/8-14UNF O-RING 7/16-20UNF						
					M4	M22X1.5,M14X1.5						
					G	G1/2,G1/4						
					M2	M22X1.5,M14X1.5						
					S2	7/8-14UNF O-RING, 7/16-20UNF						

Ordering Code:
All options have been determined with letters,numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table,please contact us with your requirements.

YMSS

The **YMSS** series motor incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum. A “**DISC VALVE**” distribution system which is internally balanced to reduce friction, leakage and permits better speed control producing higher efficiency, smoother rotation, higher speed and pressure.

This series has many sizes and options to make it very flexible for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMSS	[in^3./rev]	[4.88 ~ 22.88]	[PSI]	[3263]	RPM	[HP]	[27]
		cm^3/rev.	80 ~ 375	MPa	22.5	30 ~ 800	Kw	20

YMSS SERIES QUICK REFERENCE:

Displacements				
[in³./rev]	cm³/rev.			
[4.92]	80.6	FLOW UP TO	90 LPM	[23.78 GPM]
[6.15]	100.8	PRESSURE UP TO	22.5 MPA	[3262 PSI]
[7.63]	125	TORQUE UP TO	751 NM	[3944 LB. IN.]
[9.59]	157.2	SPEED UP TO	446 RPM	
[12.2]	200			
[15.38]	252			
[19.19]	314.5			
[22.57]	370			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20° - 60° C [68° - 180° F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40° C
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

For individual motor performance chart consult equivalent YMS series data.

DISTRIBUTION TYPE			YMSS 80	YMSS 100	YMSS 125	YMSS 160	YMSS 200	YMSS 250	YMSS 315	YMSS 375
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[4.92]	[6.16]	[7.63]	[9.60]	[12.21]	[15.38]	[19.20]	[22.58]
		cm^3/rev.	80.6	100.8	125	157.2	200	252	314.5	370
MAX. SPEED RPM		RATED	675	540	432	337	270	216	171	145
		CONT.	800	748	600	470	375	300	240	200
		INT	988	900	720	560	450	360	280	240
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[1548]	[1946]	[2414]	[2795]	[3007]	[3980]	[4953]	[4740]
		N*M	**175**	**220**	**273**	**316**	**340**	**450**	**560**	**536**
	CONT.	[LB. IN.]	[1680]	[2123]	[2742]	[2795]	[3538]	[3980]	[4953]	[4740]
		N*M	**190**	**240**	**310**	**316**	**400**	**450**	**560**	**536**
	INT.	[LB. IN.]	[2123]	[2653]	[3272]	[3803]	[4121]	[4776]	[5819]	[5704]
		N*M	**240**	**300**	**370**	**430**	**466**	**540**	**658**	**645**
	PEAK	[LB. IN.]	[2299]	[2830]	[3538]	[4174]	[5749]	[6102]	[6545]	[6642]
		N*M	**260**	**320**	**400**	**472**	**650**	**690**	**740**	**751**
MAX. OUTPUT [HP] KW	RATED	[HP]	[16,7]	[16,7]	[16,7]	[15]	[13]	[14]	[14]	[12]
		KW	**12.4**	**12.4**	**12.4**	**11.2**	**9.6**	**10.2**	**10**	**8.6**
	CONT.	[HP]	[21]	[25]	[26]	[21]	[21]	[19]	[19]	[16]
		KW	**15.9**	**18.8**	**19.5**	**15.6**	**15.7**	**14.1**	**14.1**	**11.8**
	INT.	[HP]	[27]	[31]	[31]	[29]	[25]	[23]	[25]	[23]
		KW	**20.1**	**23.5**	**23.2**	**21.2**	**18.3**	**17.0**	**18.9**	**17**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2175]	[1813]	[1813]	[1740]	[1450]
		MPa	**16**	**16**	**16**	**15**	**12.5**	**12.5**	**12**	**10**
	CONT.	[PSI]	[2538]	[2538]	[2538]	[2175]	[2030]	[1813]	[1740]	[1450]
		MPa	**17.5**	**17.5**	**17.5**	**15**	**14**	**12.5**	**12**	**10**
	INT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[2320]	[2320]	[2030]	[1740]
		MPa	**21**	**21**	**21**	**21**	**16**	**16**	**14**	**12**
	PEAK	[PSI]	[3263]	[3263]	[3263]	[3263]	[3263]	[2900]	[2683]	[2030]
		MPa	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**20**	**18.5**	**14**
MAX. FLOW [GPM] L/MIN	CONT.	[GPM]	[17.1]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**65**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
	INT.	[GPM]	[21.1]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]	[23.7]
		L/MIN	**80**	**90**	**90**	**90**	**90**	**90**	**90**	**90**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	INT.	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[22]	[22]	[23]	[24]	[24]	[26]	[27]	[28]
		KG	**9.8**	**10**	**10.3**	**10.7**	**11.1**	**11.6**	**12.3**	**12.6**

PERFORMANCE DATA

YMSS 80

[4.92 in^3/rev] 80.6 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[310] 35 **180**	[707] 80 **174**	[1061] 120 **168**	[1397] 158 **164**	[1724] 195 **158**	[2078] 235 **151**	[2202] 249 **143**	
Flow (L/min)	[7.9] 30	[310] 35 **362**	[707] 80 **352**	[1061] 120 **346**	[1397] 158 **338**	[1724] 195 **330**	[2122] 240 **322**	[2299] 260 **310**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[310] 35 **482**	[699] 79 **473**	[1052] 119 **464**	[1371 155 **453**	[1707] 193 **444**	[2070] 234 **434**	[2211] 250 **415**	
	[13.2] 50	[265] 30 **602**	[681] 77 **594**	[1035] 117 **587**	[1353] 153 **569**	[1698] 192 **560**	[2052] 232 **551**	[2193] 248 **522**	
Max cont	[15.8] 60	[248] 28 **724**	[681] 77 **713**	[1035] 117 **707**	[1353] 153 **683**	[1698] 192 **673**	[2052] 232 **664**	[2184] 247 **629**	
	[19.8] 75	[221] 25 **840**	[663] 75 **832**	[1008] 114 **817**	[1344] 152 **796**	[1680] 190 **786**	[2034] 230 **777**	[2167] 245 **737**	Max cont.
Max int.	[23.8] 90	[212] 24 **900**	[646] 73 **893**	[973] 110 **872**	[1327] 150 **853**	[1636] 185 **843**	[1990] 225 **834**	[2123] 240 **792**	Max int.

YMSS 100

[6.16 in^3/rev] 100.8 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[425] 48 **146**	[840] 95 **144**	[1327 150 **139**	[1769] 200 **135**	[2211] 250 **130**	[2556] 289 **120**	[2742] 310 **105**	
Flow (L/min)	[7.9] 30	[398] 45 **291**	[831] 94 **289**	[1291] 146 **278**	[1751] 198 **274**	[2211] 250 **269**	[2609] 295 **258**	[2804] 317 **242**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[380] 43 **387**	[787] 89 **384**	[1256] 142 **374**	[1733] 196 **359**	[2193] 248 **350**	[2591] 293 **335**	[2795] 316 **320**	
	[13.2] 50	[354] 40 **486**	[778] 88 **483**	[1194] 135 **473**	[1716] 194 **462**	[2184] 247 **450**	[2582] 292 **430**	[2786] 315 **420**	
	[15.8] 60	[327] 37 **588**	[778] 88 **584**	[1167] 132 **574**	[1636] 185 **562**	[2158] 244 **550**	[2556] 289 **538**	[2759] 312 **520**	
Max cont	[19.8] 75	[310] 35 **740**	[708] 80 **735**	[1150] 130 **720**	[1592] 180 **705**	[2123] 240 **696**	[2529] 286 **676**	[2742] 310 **653**	Max cont.
Max int.	[23.8] 90	[265] 30 **850**	[663] 75 **840**	[1097] 124 **810**	[1503] 170 **787**	[2087] 236 **770**	[2450] 277 **750**	[2680] 303 **747**	Max int.

YMSS 125

[7.63 in^3/rev] 125 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[486] 55 **112**	[1061] 120 **110**	[1557] 176 **103**	[2167] 245 **96**	[2733] 309 **93**	[3087] 349 **90**	[3317] 375 **84**	
Flow (L/min)	[7.9] 30	[486] 55 **222**	1061] 120 **220**	[1548] 175 **217**	[2211] 250 **208**	[2865] 324 **200**	[3317] 375 **199**	[3608] 408 **190**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[486] 55 **302**	[1061] 120 **298**	[1548] 175 **292**	[2211] 250 **284**	[2865] 324 **276**	[3272] 370 **268**	[3608] 408 **260**	
	[13.2] 50	[442] 50 **379**	[1017] 115 **373**	[1557] 176 **368**	[2193] 248 **363**	[2830] 320 **350**	[3272] 370 **339**	[3591 406 **328**	
	[15.8] 60	[398] 45 **456**	[999] 113 **448**	[1512] 171 **443**	[2167] 245 **439**	[2865] 324 **425**	[3255] 368 **406**	[3591] 406 **393**	
Max cont	[19.8] 75	[398] 45 **570**	[973] 110 **563**	[1477] 167 **555**	[2123] 240 **546**	[2777] 314 **533**	[3272] 370 **515**	[3546] 401 **503**	Max cont.
Max int.	[23.8] 90	[354] 40 **685**	[929] 105 **676**	[1433] 162 **670**	[2096] 237 **659**	[2733] 309 **644**	[3228] 365 **625**	[3520] 398 **610**	Max int.

YMSS 160

[9.60 in^3/rev] 157.2 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[619] 70 **91**	[1238] 140 **88**	[1813] 205 **84**	[2697] 305 **78**	[3281] 371 **76**	[3803 430 **74**	[4183] 473 **58**	
Flow (L/min)	[7.9] 30	[663] 75 **185**	[1327] 150 **182**	[1893] 214 **176**	[2839] 321 **168**	[3361] 380 **164**	[3776] 427 **162**	[4333] 490 **152**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[10.6] 40	[619] 70 **248**	[1327] 150 **244**	[1901] 215 **239**	[2830] 320 **229**	[3343] 378 **224**	[3759] 425 **217**	[4316] 488 **204**	
	[13.2] 50	[575] 65 **312**	[1282] 145 **308**	[1901] 215 **304**	[2795] 316 **294**	[3343] 378 **288**	[3759] 425 **280**	[4263] 482 **270**	
	[15.8] 60	[575] 65 **375**	[1282] 145 **371**	[1893] 214 **365**	[2786] 315 **357**	[3317] 375 **346**	[3750] 424 **336**	[4263] 482 **323**	
Max cont	[19.8] 75	[531] 60 **470**	[1221] 138 **465**	[1840] 208 **458**	[2751] 311 **447**	[3317] 375 **436**	[3714] 420 **426**		Max cont.
Max int.	[23.8] 90	[495] 56 **564**	[1150] 130 **559**	[1769] 200 **551**	[2724] 308 **541**	[3272] 370 **526**	[3661] 414 **517**		Max int.

PERFORMANCE DATA

YMSS 200

[12.21 in^3/rev] 200 cm^3/rev.

					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[787] 89 **73**	[1680] 190 **71**	[2609] 295 **68**	[3538] 400 **64**	[4281] 484 **60**	[5377] 608 **52**	
	[7.9] 30	[769] 87 **148**	[1680] 190 **146**	[2600] 294 **143**	[3529] 399 **140**	[4289] 485 **135**	[5306] 600 **127**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[761] 86 **193**	[1663] 188 **191**	[2582] 292 **189**	[3511] 397 **186**	[4272] 483 **181**	[5253] 594 **172**	
	[13.2] 50	[708] 80 **247**	[1627] 184 **245**	[2565] 290 **243**	[3493] 395 **240**	[4245] 480 **235**	[5218] 590 **226**	
	[15.8] 60	[654] 74 **298**	[1574] 178 **295**	[2530] 286 **293**	[3449] 390 **290**	[4201] 475 **284**	[5147] 582 **273**	
Max cont	[19.8] 75	[513] 58 **372**	[1415] 160 **369**	[2432] 275 **365**	[3317] 375 **362**	[4068] 460 **358**	[5041] 570 **346**	Max cont.
Max int.	[23.8] 90	[433] 49 **440**	[1309] 148 **435**	[2299] 260 **430**	[3140] 355 **422**	[3936] 445 **411**	[4908] 555 **401**	Max int.

YMSS 250

[15.38 in^3/rev] 252 cm^3/rev.

					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[1035] 117 **58**	[2034] 230 **55**	[3140] 355 **52**	[3980] 450 **51**	[4900] 554 **47**	[5766] 652 **46**	
	[7.9] 30	[1035] 117 **118**	[1990] 225 **117**	[3095] 350 **112**	[3944] 446 **109**	[4953] 560 **107**	[5811] 657 **106**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1017] 115 **160**	[1990] 225 **156**	[3078] 348 **152**	[3909] 442 **150**	[4882] 552 **146**	5749] 650 **142**	
	[13.2] 50	[973] 110 **202**	[1946] 220 **200**	[3051] 345 **198**	[3874] 438 **196**	[4829] 546 **195**	[5704] 645 **192**	
	[15.8] 60	[929] 105 **242**	[1946 220 **239**	[3007] 340 **237**	[3847] 435 **234**	[4793] 542 **231**	[5678] 642 **229**	
Max cont	[19.8] 75	[840] 95 **300**	[1901] 215 **296**	[2989] 338 **293**	[3803] 430 **286**	[4749] 537 **282**	[5642] 638 **278**	Max cont.
Max int.	[23.8] 90	[796] 90 **360**	[1813] 205 **354**	[2936] 332 **348**	[3714] 420 **340**	[4687] 530 **332**	[5589] 632 **326**	Max int.

YMSs 315

[19.20 in^3/rev] 314.5 cm^3/rev.

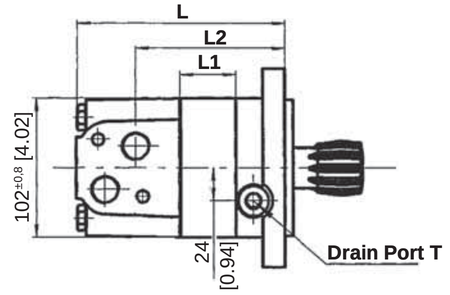
					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[1740] 12	[2030] 14	[2682] 18.5	[PSI] MPA
GPM L/ min	[3.9] 15	[1415] 160 **48**	[2830] 320 **47**	[4112] 465 **45**	[4908] 555 **43**	[5749] 650 **40**	[6615] 748 **38**	
	[7.9] 30	[1459] 165 **94**	[2848] 322 **92**	[4139] 468 **90**	[4953] 560 **89**	[5819] 658 **86**	[6651] 752 **85**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1415] 160 **125**	[2742] 310 **123**	[4042] 457 **120**	[4829] 546 **118**	[5678] 642 **116**	[6553] 741 **115**	
	[13.2] 50	[1371] 155 **158**	[2697] 305 **156**	[3980] 450 **153**	[4758] 538 **150**	[5634] 637 **147**	[6509] 736 **145**	
	[15.8] 60	[1344] 152 **175**	[2671] 302 **174**	[3909] 442 **170**	[4705] 532 **164**	[5589] 632 **162**	[6474] 732 **159**	
Max cont	[19.8] 75	[1282] 145 **236**	[2609] 295 **234**	[3856] 436 **230**	[4643] 525 **227**	[5554] 628 **225**	[6421] 726 **222**	Max cont.
Max int.	[23.8] 90	[1167] 132 **285**	[2476] 280 **282**	[3803] 430 **280**	[4599] 520 **276**	[5501] 622 **273**	[6394] 723 **270**	Max int.

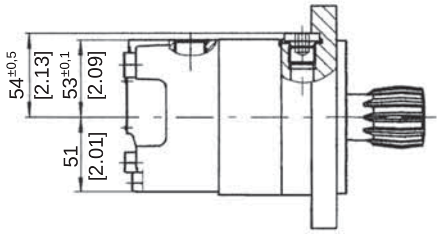
YMSS 37

[22.58 in^3/rev] 370 cm^3/rev.

					Max cont		Max int.	
		[507] 3.5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[PSI] MPA
GPM L/ min	[3.9] 15	[1636] 185 **40**	[3202] 362 **39**	[4192] 474 **38**	[4528] 512 **37**	[5200] 588 **35**	[5837] 660 **33**	
	[7.9] 30	[1627] 184 **80**	[3219] 364 **78**	[4201] 475 **77**	[4546] 514 **76**	[5218] 590 **74**	[5846] 661 **72**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1592] 180 **106**	[3202] 362 **104**	[4183] 473 **103**	[4537] 513 **102**	[5200] 588 **100**	[5828] 659 **97**	
	[13.2] 50	[1415] 160 **133**	[3184] 360 **131**	[4174] 472 **130**	[4519] 511 **129**	[5183] 586 **128**	[5819] 658 **125**	
	[15.8] 60	[1327] 150 **157**	[3175] 359 **156**	[4166] 471 **155**	[4510] 510 **154**	[5174] 585 **152**	5811] 657 **150**	
Max cont	[19.8] 75	1150] 130 **200**	[3122] 353 **198**	[4112] 465 **196**	[4457] 504 **195**	[5165] 584 **194**	[5757] 651 **193**	Max cont.
Max int.	[23.8] 90	[929] 105 **238**	[3095] 350 **235**	[4086] 462 **234**	[4422] 500 **232**	[5130] 580 **230**	[5722] 647 **227**	Max int.

MOUNTING DATA

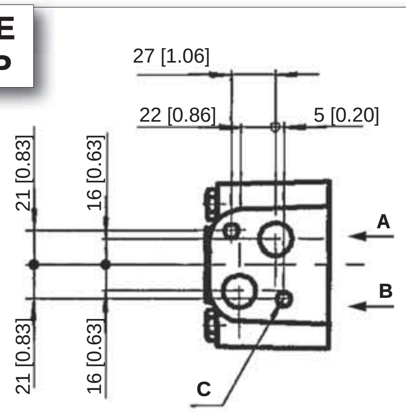




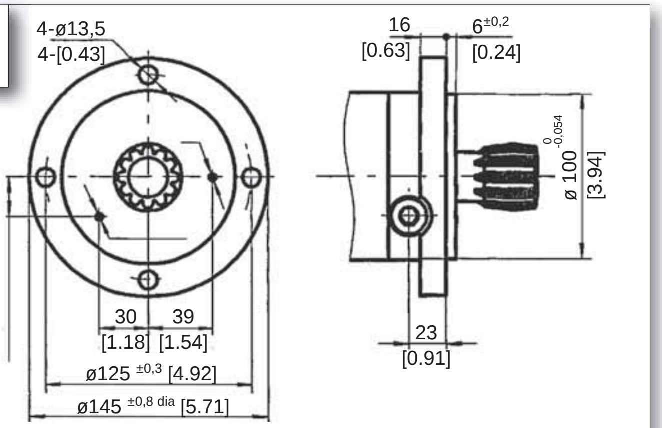
MODEL	[INCHES]			MILLIMETERS		
	L	L1	L2	L	L1	L2
YMSS 80	[5.12]	[0.52]	[3.39]	130	13	86
YMSS 100	[5.28]	[0.67]	[3.55]	134	17	90
YMSS 125	[5.48]	[0.87]	[3.74]	139	22	95
YMSS 160	[5.69]	[12.90]	[3.96]	144.5	27.5	100.5
YMSS 200	[5.99]	[1.39]	[4.26]	152	35.1	108
YMSS 250	[6.46]	[1.85]	[4.73]	164	47	120
YMSS 315	[6.93]	[2.33]	[5.20]	176	59	132
YMSS 375	[7.41]	[2.80]	[5.67]	188	71	144

NOTE:THE THICKNESS OF THE STATOR AND ROTOR IS THE DIMENSION OF L1 PLUS 3MM

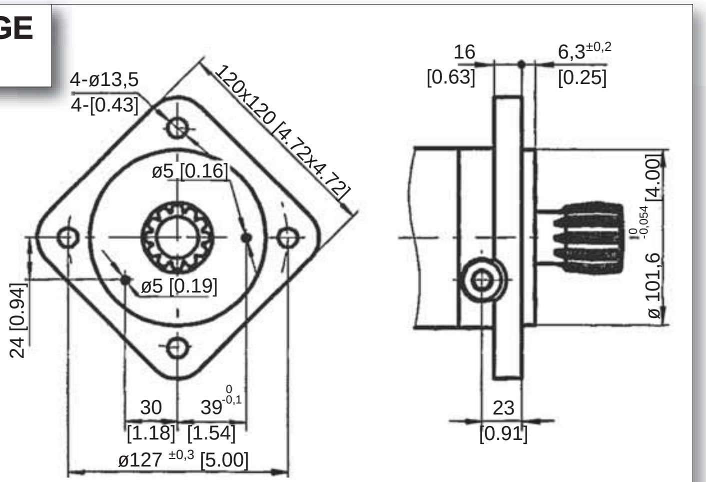
FLANGE D,M,S,P



FLANGE D



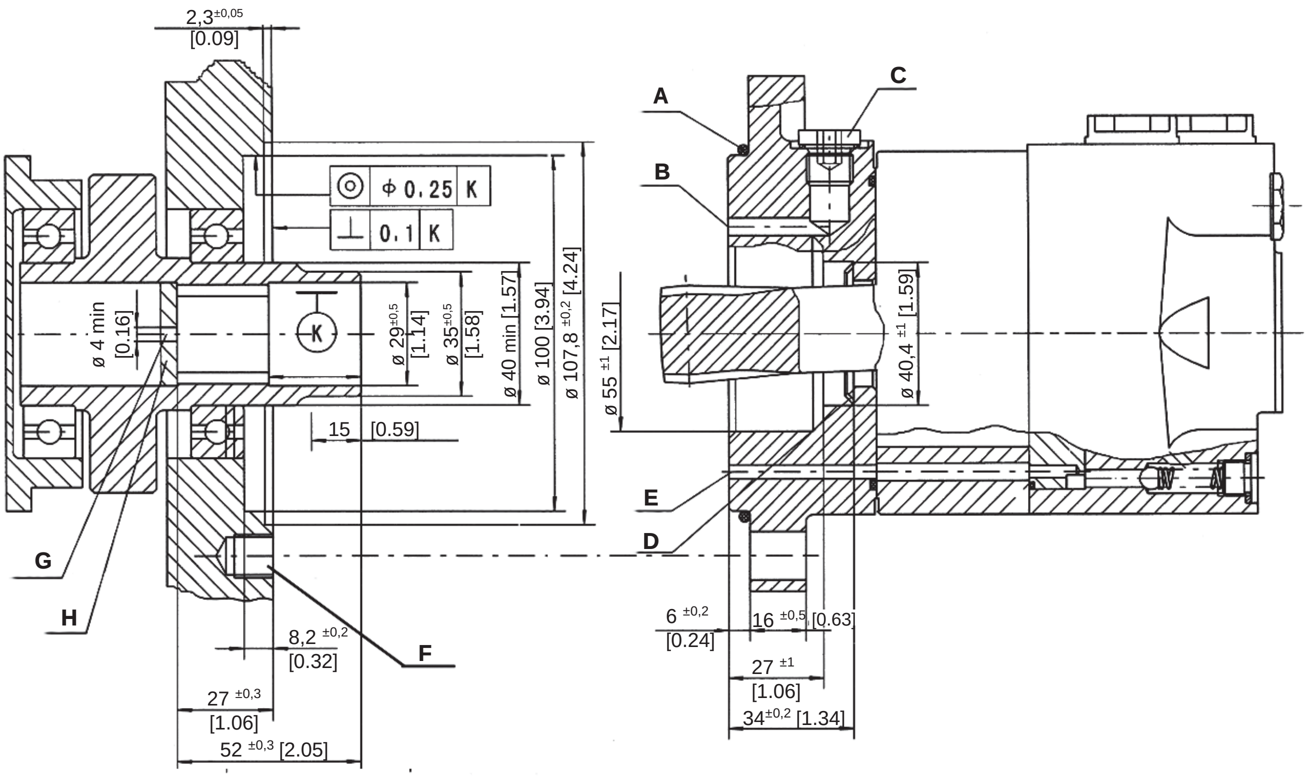
FLANGE E



PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	P	DEPTH
PORTS - A and B	G 1/2	18 mm	M22 X 1.5	18 mm	7/8-14 O-RING	18 mm	1/2-14NPTF	15 mm
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	7/16-20UNF	12 mm	7/16-20UNF	12 mm
BOLTS - C	2-M10	13 mm	2-M10	13 mm	2-3/8-16UNC	13 mm	2-3/8-16UNC	13 mm

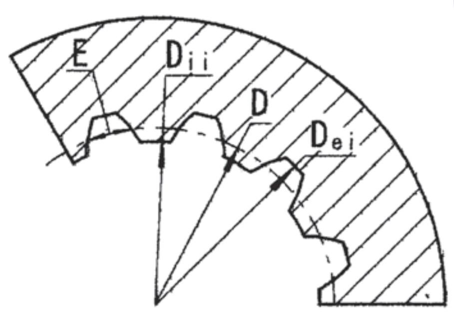
MOUNTING DATA



A:	O-ring:100x3
B:	External drain channel
C:	Drain connection G 1/4;12 mm deep
D:	Conical seal ring
E:	Internal drain channel
F:	M10;min. 15mm deep
G:	Oil circulation hole
H:	Hardened stop plate

INTERNAL SPLINE DATA FOR THE ATTACHED COMPONENT

FILLET ROOT SIDE FIT		mm
NUMBER OF TEETH	Z	12
DIAMETRAL PITCH	DP	12/24
PRESSURE ANGLE	α_D	30˚
PITCH DIA.	D	Ø25.4
MAJOR DIA.	D_{ei}	Ø28 $^{0}_{-0,1}$
MINOR DIA.	D_{ii}	Ø23 $^{+0,033}_{0}$
SPACE WIDTH CIRCULAR	E	4.308 $^{\pm0.02}$



Hardening Specification: HRC 62±2
Effective case depth 0.7±0.2

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMSS							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
80	**D**	4-Ø13.5 Circle-flange Ø125, pilot Ø100×6	**None**	Short shaft DP12/24	**D**	G1/2 Manifold Mount 2-M10, G1/4	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
100	**E**	4-Ø13.5 Square-flange Ø127, pilot Ø101.6×6.3			**M**	M22×1.5 Manifold Mount 2-M10, M14×1.5	**R**	OPPOSITE	**NONE**	BLUE	**LL**	LOW LEAKAGE
125					**S**	7/8-14 O-ring manifold 2-3/8-16 UNC, 7/16-20UNF			**B**	BLACK	**FR**	FREE RUNNING
160					**P**	1/2-14 NPTF Manifold 2-3/8-16 UNC, 7/16-20UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
200												
250												
315												
375												

Ordering Code:
All options have been determined with letters, numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table, please contact us with your requirements.

YMSJ

The **YMSJ** series motors incorporates the advanced **GEROLOR** gear set with reduces internal friction to a minimum. A “DISC VALVE” distribution system which is internally balanced to reduce friction, leakage and permits better speed control producing higher efficiency, smoother rotation, higher speed and pressure.

The series has many sizes and options to make it very flexible for many applications

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMSJ	[in^3./rev]	[4.88 ~ 22.88]	[PSI]	[3263]	RPM	[HP]	[27]
		cm^3/rev.	80 ~ 375	MPa	22.5	30 ~ 800	Kw	20

QUICK REFERENCE GUIDE

YMSJ SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[4.92]	80.6	FLOW UP TO	90 LPM	[23.78 GPM]
[6.15]	100.8	PRESSURE UP TO	22.5 MPA	[3262 PSI]
[7.63]	125	TORQUE UP TO	1100 NM	[3944 LB. IN.]
[9.59]	157.2	SPEED UP TO	470 RPM	
[12.2]	200			
[15.38]	252			
[19.19]	314.5			
[22.57]	370			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20° - 60° C [68° - 180° F]

* Oil filter of 10 - 20 micron

* Oil viscosity 42 - 74 mm^2 at 40° C

* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

For individual motor performance chart consult equivalent YMS series data

DISTRIBUTION TYPE			YMSJ 80	YMSJ 100	YMSJ 125	YMSJ 160	YMSJ 200	YMSJ 250	YMSJ 315	YMSJ 375
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[4.92]	[6.16]	[7.63]	[9.60]	[12.21]	[15.38]	[19.20]	[22.58]
		cm3/rev.	**80.6**	**100.8**	**125**	**157.2**	**200**	**252**	**314.5**	**370**
MAX. SPEED RPM		RATED	675	540	432	337	270	216	171	145
		CONT.	800	748	600	470	375	300	240	200
		INT	**988**	**900**	**720**	**560**	**450**	**360**	**280**	**240**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[1548]	[1946]	[2414]	[2795]	[3007]	[3980]	[4953]	[4740]
		N*M	**175**	**220**	**273**	**316**	**340**	**450**	**560**	**536**
	CONT.	[LB. IN.]	[1680]	[2123]	[2742]	[2795]	[3538]	[3980]	[4953]	[4740]
		N*M	**190**	**240**	**310**	**316**	**400**	**450**	**560**	**536**
	INT.	[LB. IN.]	[2123]	[2653]	[3272]	[3803]	[4121]	[4776]	[5819]	[5704]
		N*M	**240**	**300**	**370**	**430**	**466**	**540**	**659**	**645**
	PEAK	[LB. IN.]	[2299]	[2830]	[3538]	[4174]	[5749]	[6102]	[6545]	[6642]
		N*M	**260**	**320**	**400**	**472**	**650**	**690**	**740**	**751**
MAX. OUTPUT [HP] KW	RATED	[HP]	[16.7]	[16.7]	[16.7]	[15]	[13]	[14]	[14]	[12]
		KW	**12.4**	**12.4**	**12.4**	**11.2**	**9.6**	**10.2**	**10**	**8.6**
	CONT.	[HP]	[21]	[25]	[26]	[21]	[21]	[19]	[19]	[16]
		KW	**15.9**	**18.**	**19.5**	**15.6**	**15.7**	**14.1**	**14.1**	**11.8**
	INT.	[HP]	[27]	[31]	[32]	[29]	[25]	[23]	[25]	[23]
		KW	**20.1**	**23.5**	**23.2**	**21.2**	**18.3**	**17.0**	**18.9**	**17**
MAX. PRES-SURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2175]	[1813]	[1813]	[1740]	[1450]
		MPa	**16**	**16**	**16**	**15**	**12.5**	**12.5**	**12**	**10**
	CONT.	[PSI]	[2538]	[2538]	[2538]	[2175]	[2030]	[1813]	[1740]	[1450]
		MPa	**17.5**	**17.5**	**17.5**	**15**	**14**	**12.5**	**12**	**10**
	INT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[2320]	[2320]	[2030]	[1740]
		MPa	**21**	**21**	**21**	**21**	**16**	**16**	**14**	**12**
	PEAK	[PSI]	[3263]	[3263]	[3263]	[3263]	[3263]	[2900]	[2683]	[2030]
		MPa	**22.5**	**22.5**	**22.5**	**22.5**	**22.5**	**20**	**18.5**	**14**
MAX. FLOW [GPM] L/MIN	CONT.	[GPM]	[17.1]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]	[19.8]
		L/MIN	**65**	**75**	**75**	**75**	**75**	**75**	**75**	**75**
	INT.	[GPM]	[21.1]	[23.7]	[23.7]	[23.]	[23.7]	[23.7]	[23.7]	[23.7]
		L/MIN	**80**	**90**	**90**	**90**	**90**	**90**	**90**	**90**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	INT.	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[22]	[22]	[23]	[24]	[24]	[26]	[27]	[28]
		KG	**9.8**	**10**	**10.3**	**10.7**	**11.1**	**11.6**	**12.3**	**12.6**

- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Continuous pressure: Max. value of operating motor continuously.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

YMSJ

PERFORMANCE DATA

YMSJ 80

[4.92 in^3/rev] 80.6 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPa
GPM	[3.9]	[310]	[707]	[1061]	[1397]	[1724]	[2078]	[2202]	
L/		35	80	120	158	195	235	249	
min	15	**180**	**174**	**168**	**164**	**158**	**151**	**143**	
	[7.9]	[310]	[707]	[1061]	[1397]	[1724]	[2122]	[2299]	TORQUE [LB-IN]
		35	80	120	158	195	240	260	TORQUE (N•M)
	30	**362**	**352**	**346**	**338**	**330**	**322**	**310**	SPEED (RPM)
Flow (L/min)	[10.6]	[310]	[699]	[1052]	[1371	[1707]	[2070]	[2211]	
		35	79	119	155	193	234	250	
	40	**482**	**473**	**464**	**453**	**444**	**434**	**415**	
	[13.2]	[265]	[681]	[1035]	[1353]	[1698]	[2052]	[2193]	
		30	77	117	153	192	232	248	
	50	**602**	**594**	**587**	**569**	**560**	**551**	**522**	
	[15.8]	[248]	[681]	[1035]	[1353]	[1698]	[2052]	[2184]	
Max cont		28	77	117	153	192	232	247	
	60	**724**	**713**	**707**	**683**	**673**	**664**	**629**	
	[19.8]	[221]	[663]	[1008]	[1344]	[1680]	[2034]	[2167]	
		25	75	114	152	190	230	245	Max cont.
	75	**840**	**832**	**817**	**796**	**786**	**777**	**737**	
	[23.8]	[212]	[646]	[973]	[1327]	[1636]	[1990]	[2123]	
Max int.		24	73	110	150	185	225	240	Max int.
	90	**900**	**893**	**872**	**853**	**843**	**834**	**792**	

YMSJ 100

[6.16 in^3/rev] 100.8 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPa
GPM	[3.9]	[425]	[840]	[1327	[1769]	[2211]	[2556]	[2742]	
L/		48	95	150	200	250	289	310	
min	15	**146**	**144**	**139**	**135**	**130**	**120**	**105**	
	[7.9]	[398]	[831]	[1291]	[1751]	[2211]	[2609]	[2804]	TORQUE [LB-IN]
		45	94	146	198	250	295	317	TORQUE (N•M)
	30	**291**	**289**	**278**	**274**	**269**	**258**	**242**	SPEED (RPM)
Flow (L/min)	[10.6]	[380]	[787]	[1256]	[1733]	[2193]	[2591]	[2795]	
		43	89	142	196	248	293	316	
	40	**387**	**384**	**374**	**359**	**350**	**335**	**320**	
	[13.2]	[354]	[778]	[1194]	[1716]	[2184]	[2582]	[2786]	
		40	88	135	194	247	292	315	
	50	**486**	**483**	**473**	**462**	**450**	**430**	**420**	
	[15.8]	[327]	[778]	[1167]	[1636]	[2158]	[2556]	[2759]	
		37	88	132	185	244	289	312	
	60	**588**	**584**	**574**	**562**	**550**	**538**	**520**	
	[19.8]	[310]	[708]	[1150]	[1592]	[2123]	[2529]	[2742]	
Max cont		35	80	130	180	240	286	310	Max cont.
	75	**740**	**735**	**720**	**705**	**696**	**676**	**653**	
	[23.8]	[265]	[663]	[1097]	[1503]	[2087]	[2450]	[2680]	
Max int.		30	75	124	170	236	277	303	Max int.
	90	**850**	**840**	**810**	**787**	**770**	**750**	**747**	

YMSJ 125

[7.63 in^3/rev] 125 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPa
GPM	[3.9]	[486]	[1061]	[1557]	[2167]	[2733]	[3087]	[3317]	
L/		55	120	176	245	309	349	375	
min	15	**112**	**110**	**103**	**96**	**93**	**90**	**84**	
	[7.9]	[486]	1061]	[1548]	[2211]	[2865]	[3317]	[3608]	TORQUE [LB-IN]
		55	120	175	250	324	375	408	TORQUE (N•M)
	30	**222**	**220**	**217**	**208**	**200**	**199**	**190**	SPEED (RPM)
Flow (L/min)	[10.6]	[486]	[1061]	[1548]	[2211]	[2865]	[3272]	[3608]	
		55	120	175	250	324	370	408	
	40	**302**	**298**	**292**	**284**	**276**	**268**	**260**	
	[13.2]	[442]	[1017]	[1557]	[2193]	[2830]	[3272]	[3591	
		50	115	176	248	320	370	406	
	50	**379**	**373**	**368**	**363**	**350**	**339**	**328**	
	[15.8]	[398]	[999]	[1512]	[2167]	[2865]	[3255]	[3591]	
		45	113	171	245	324	368	406	
	60	**456**	**448**	**443**	**439**	**425**	**406**	**393**	
	[19.8]	[398]	[973]	[1477]	[2123]	[2777]	[3272]	[3546]	
Max cont		45	110	167	240	314	370	401	Max cont.
	75	**570**	**563**	**555**	**546**	**533**	**515**	**503**	
	[23.8]	[354]	[929]	[1433]	[2096]	[2733]	[3228]	[3520]	
Max int.		40	105	162	237	309	365	398	Max int.
	90	**685**	**676**	**670**	**659**	**644**	**625**	**610**	

YMSJ 160

[9.60 in^3/rev] 157.2 cm^3/rev.

						Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3045] 21	[3262] 22.5	[PSI] MPa
GPM	[3.9]	[619]	[1238]	[1813]	[2697]	[3281]	[3803	[4183]	
L/		70	140	205	305	371	430	473	
min	15	**91**	**88**	**84**	**78**	**76**	**74**	**58**	
	[7.9]	[663]	[1327]	[1893]	[2839]	[3361]	[3776]	[4333]	TORQUE [LB-IN]
		75	150	214	321	380	427	490	TORQUE (N•M)
	30	**185**	**182**	**176**	**168**	**164**	**162**	**152**	SPEED (RPM)
Flow (L/min)	[10.6]	[619]	[1327]	[1901]	[2830]	[3343]	[3759]	[4316]	
		70	150	215	320	378	425	488	
	40	**248**	**244**	**239**	**229**	**224**	**217**	**204**	
	[13.2]	[575]	[1282]	[1901]	[2795]	[3343]	[3759]	[4263]	
		65	145	215	316	378	425	482	
	50	**312**	**308**	**304**	**294**	**288**	**280**	**270**	
	[15.8]	[575]	[1282]	[1893]	[2786]	[3317]	[3750]	[4263]	
		65	145	214	315	375	424	482	
	60	**375**	**371**	**365**	**357**	**346**	**336**	**323**	
	[19.8]	[531]	[1221]	[1840]	[2751]	[3317]	[3714]		
Max cont		60	138	208	311	375	420		Max cont.
	75	**470**	**465**	**458**	**447**	**436**	**426**		
	[23.8]	[495]	[1150]	[1769]	[2724]	[3272]	[3661]		
Max int.		56	130	200	308	370	414		Max int.
	90	**564**	**559**	**551**	**541**	**526**	**517**		

PERFORMANCE DATA

YMSJ 200
[12.21 in^3/rev] 200 cm^3/rev.

					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[787] 89 **73**	[1680] 190 **71**	[2609] 295 **68**	[3538] 400 **64**	[4281] 484 **60**	[5377] 608 **52**	
	[7.9] 30	[769] 87 **148**	[1680] 190 **146**	[2600] 294 **143**	[3529] 399 **140**	[4289] 485 **135**	[5306] 600 **127**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[761] 86 **193**	[1663] 188 **191**	[2582] 292 **189**	[3511] 397 **186**	[4272] 483 **181**	[5253] 594 **172**	
	[13.2] 50	[708] 80 **247**	[1627] 184 **245**	[2565] 290 **243**	[3493] 395 **240**	[4245] 480 **235**	[5218] 590 **226**	
	[15.8] 60	[654] 74 **298**	[1574] 178 **295**	[2530] 286 **293**	[3449] 390 **290**	[4201] 475 **284**	[5147] 582 **273**	
Max cont	[19.8] 75	[513] 58 **372**	[1415] 160 **369**	[2432] 275 **365**	[3317] 375 **362**	[4068] 460 **358**	[5041] 570 **346**	Max cont.
Max int.	[23.8] 90	[433] 49 **440**	[1309] 148 **435**	[2299] 260 **430**	[3140] 355 **422**	[3936] 445 **411**	[4908] 555 **401**	Max int.

YMSJ 250
[15.38 in^3/rev] 252 cm^3/rev.

					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2537] 17.5	[3262] 22.5	[PSI] MPA
GPM L/ min	[3.9] 15	[1035] 117 **58**	[2034] 230 **55**	[3140] 355 **52**	[3980] 450 **51**	[4900] 554 **47**	[5766] 652 **46**	
	[7.9] 30	[1035] 117 **118**	[1990] 225 **117**	[3095] 350 **112**	[3944] 446 **109**	[4953] 560 **107**	[5811] 657 **106**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1017] 115 **160**	[1990] 225 **156**	[3078] 348 **152**	[3909] 442 **150**	[4882] 552 **146**	5749] 650 **142**	
	[13.2] 50	[973] 110 **202**	[1946] 220 **200**	[3051] 345 **198**	[3874] 438 **196**	[4829] 546 **195**	[5704] 645 **192**	
	[15.8] 60	[929] 105 **242**	[1946 220 **239**	[3007] 340 **237**	[3847] 435 **234**	[4793] 542 **231**	[5678] 642 **229**	
Max cont	[19.8] 75	[840] 95 **300**	[1901] 215 **296**	[2989] 338 **293**	[3803] 430 **286**	[4749] 537 **282**	[5642] 638 **278**	Max cont.
Max int.	[23.8] 90	[796] 90 **360**	[1813] 205 **354**	[2936] 332 **348**	[3714] 420 **340**	[4687] 530 **332**	[5589] 632 **326**	Max int.

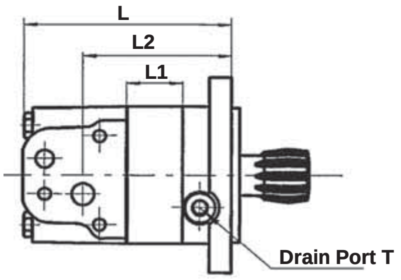
YMSJ 315
[19.20 in^3/rev] 314.5 cm^3/rev.

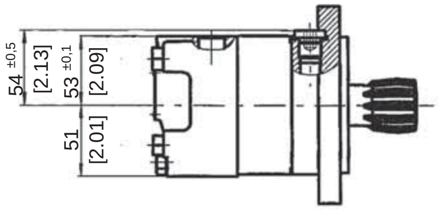
					Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[1740] 12	[2030] 14	[2682] 18.5	[PSI] MPA
GPM L/ min	[3.9] 15	[1415] 160 **48**	[2830] 320 **47**	[4112] 465 **45**	[4908] 555 **43**	[5749] 650 **40**	[6615] 748 **38**	
	[7.9] 30	[1459] 165 **94**	[2848] 322 **92**	[4139] 468 **90**	[4953] 560 **89**	[5819] 658 **86**	[6651] 752 **85**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1415] 160 **125**	[2742] 310 **123**	[4042] 457 **120**	[4829] 546 **118**	[5678] 642 **116**	[6553] 741 **115**	
	[13.2] 50	[1371] 155 **158**	[2697] 305 **156**	[3980] 450 **153**	[4758] 538 **150**	[5634] 637 **147**	[6509] 736 **145**	
	[15.8] 60	[1344] 152 **175**	[2671] 302 **174**	[3909] 442 **170**	[4705] 532 **164**	[5589] 632 **162**	[6474] 732 **159**	
Max cont	[19.8] 75	[1282] 145 **236**	[2609] 295 **234**	[3856] 436 **230**	[4643] 525 **227**	[5554] 628 **225**	[6421] 726 **222**	Max cont.
Max int.	[23.8] 90	[1167] 132 **285**	[2476] 280 **282**	[3803] 430 **280**	[4599] 520 **276**	[5501] 622 **273**	[6394] 723 **270**	Max int.

YMSJ 37
[22.58 in^3/rev] 370 cm^3/rev.

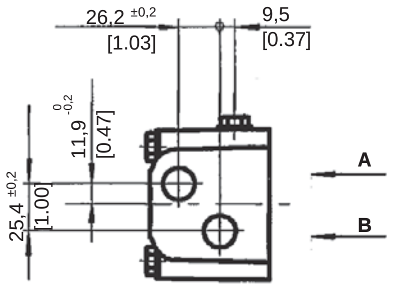
					Max cont		Max int.	
		[507] 3.5	[1015] 7	[1305] 9	[1450] 10	[1740] 12	[2030] 14	[PSI] MPA
GPM L/ min	[3.9] 15	[1636] 185 **40**	[3202] 362 **39**	[4192] 474 **38**	[4528] 512 **37**	[5200] 588 **35**	[5837] 660 **33**	
	[7.9] 30	[1627] 184 **80**	[3219] 364 **78**	[4201] 475 **77**	[4546] 514 **76**	[5218] 590 **74**	[5846] 661 **72**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
Flow (L/min)	[10.6] 40	[1592] 180 **106**	[3202] 362 **104**	[4183] 473 **103**	[4537] 513 **102**	[5200] 588 **100**	[5828] 659 **97**	
	[13.2] 50	[1415] 160 **133**	[3184] 360 **131**	[4174] 472 **130**	[4519] 511 **129**	[5183] 586 **128**	[5819] 658 **125**	
	[15.8] 60	[1327] 150 **157**	[3175] 359 **156**	[4166] 471 **155**	[4510] 510 **154**	[5174] 585 **152**	5811] 657 **150**	
Max cont	[19.8] 75	1150] 130 **200**	[3122] 353 **198**	[4112] 465 **196**	[4457] 504 **195**	[5165] 584 **194**	[5757] 651 **193**	Max cont.
Max int.	[23.8] 90	[929] 105 **238**	[3095] 350 **235**	[4086] 462 **234**	[4422] 500 **232**	[5130] 580 **230**	[5722] 647 **227**	Max int.

MOUNTING DATA



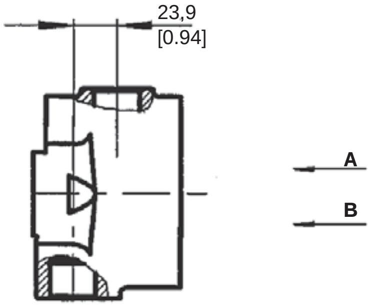


PORTING DB, DU, SU, SB, M4

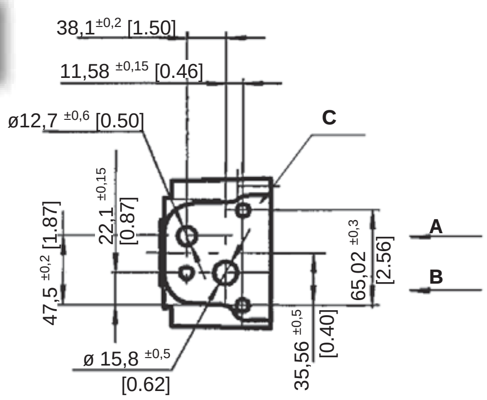


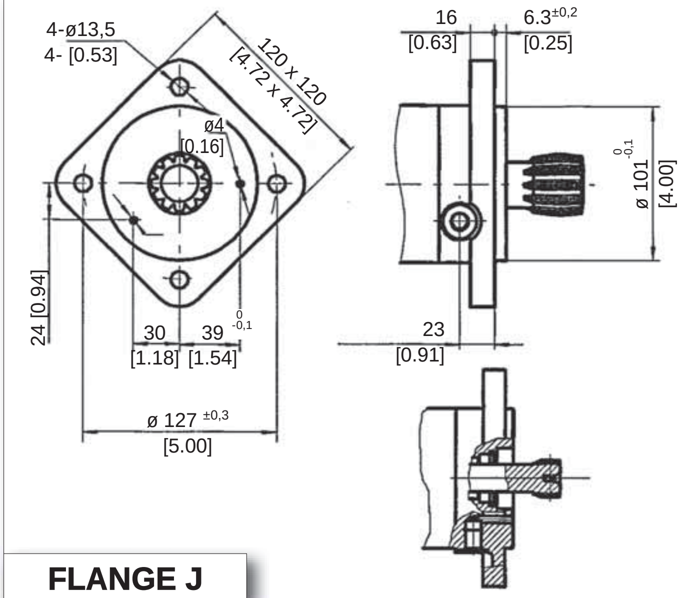
PORTING ED

O-ring Ports
180 Apart



PORTING MU, MM





FLANGE J

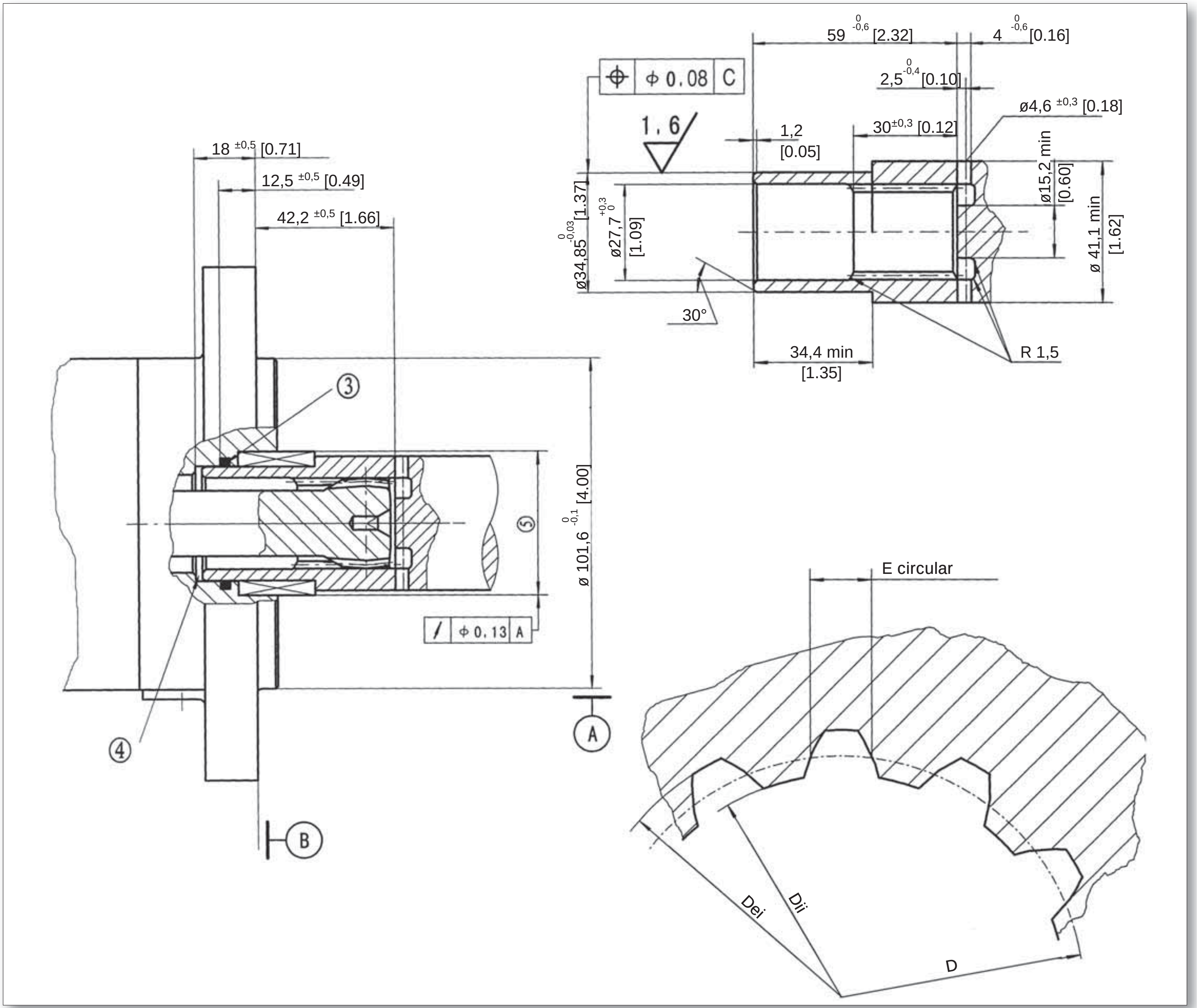
	[INCHES]			MILLIMETERS		
MODEL	L	L1	L2	L	L1	L2
YMSJ 80	[5.28]	[0.52]	[3.39]	134	13	86
YMSJ 100	[5.44]	[0.67]	[3.55]	138	17	90
YMSJ 125	[5.63]	[0.87]	[3.74]	143	22	95
YMSJ 160	[5.85]	[12.90]	[3.96]	148.5	27.5	100.5
YMSJ 200	[6.15]	[1.39]	[4.26]	156	35.1	108
YMSJ 250	[6.62]	[1.85]	[4.73]	168	47	120
YMSJ 315	[7.09]	[2.33]	[5.20]	180	59	132
YMSJ 375	[7.56]	[2.80]	[5.67]	192	71	144

Note:
1) If the porting MU, MM, S2 is used, the dimension of L2 should be reduced by 1,5 mm and L should be reduced by 4 mm
2) If the port ED is used, the dimensions of the L2 should be plus 2,5 mm and L should be plus 2 mm
3) The thickness of the stator and rotor is the dimension of L1 + 3mm.

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	DB	DEPTH	DU	DEPTH	SU	DEPTH	SB	DEPTH	M4	DEPTH	MU	MM	DEPTH	ED	DEPTH
PORTS - A and B	G12	18 mm	G1/2	18 mm	7/8-14 O-ring	18 mm	7/8-14 O-ring	18 mm	M22x1,5	18 mm	12.7 15.8	12.7 15.8		1-1/16-12un	18 mm
TANK PORT - T	G1/4	12 mm	7/16-20UNF	12 mm	7/16-20unf	12 mm	G 1/4	12 mm	M14x1.5	12 mm	7/16-20UNF	G 1/4	12 mm	7/16-20unf	12 mm
BOLTS - C											3x3/8-16UNF	3xM10			

DIMENSION AND MOUNTING DATA



INTERNAL SPLINE DATA FOR THE ATTACHED COMPONENT

FILLET ROOT SIDE FIT		mm
NUMBER OF TEETH	Z	12
DIAMETRAL PITCH	DP	12/24
PRESSURE ANGLE	α_D	30°
PITCH DIA.	D	ø 25.4
MAJOR DIA.	Dei	ø 27.6 $^{+0,14}_{0}$
MINOR DIA.	Dii	ø 23.1 $^{+0,12}_{0}$
SPACE WIDTH CIRCULAR	E	4.282 ±0.036
DIMENSION BETWEEN TWO PINS (Ø4)	Me	19.02-19.19

1. Internal spline in mating part to be as follows: Material to be ASTM A304, 8620H. Carborize to a hardness of 58-62 HRC with case depth (to 50HRC) of 0.75-1 [.030-.040] (dimensions apply after heat treat).
2. Mating part to have critical dimensions as shown. Oil holes must be provided and open for proper oil circulation.
3. Some means of maintaning clearance between shaft and mounting flange must be provided
4. Seal to be furnished with motor for proper oil circulation thru splines
5. Counterbore designed to adapt to a standard sleeve bearing 35.040 [1.3784-1.3795] ID by 44.040-44.070 [1.7339-1.7350] O.D. (Oilite Bronze sleeve bearing AAM3544-22)

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMSJ							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
80	**J**	Square Flange ø 127, Pilot ø 101,6x6,3	**None**	Short Shaft 12-DP-12/24	**MU**	1/2”,5/8” Crosshole Manifold 3x3/8-16 UNC, 7/16-20 UNF	**NONE**	STANDARD	**OO**	NO PAINT	**NONE**	STANDARD
100					**MM**	1/2”,5/8” Crosshole Manifold 3xM10, G1/4	**R**	OPPOSITE	**NONE**	BLUE	**LL**	LOW LEAKAGE
125					**EE-D**	G1/2, G1/4			**B**	BLACK	**FR**	FREE RUNNING
160					**EE-M2**	M22X1,5 - M14X1,5			**S**	SILVER GRAY	**LS**	LOW SPEED VALVE
200					**EE-S2**	7/8-14 UNF O-RING, 7/16-20 UNF						
250					**ED**	11/16-12 UNF O-RING, 7/16-20 UNF						
315					**DB**	G1/2, G1/4						
375					**DU**	G1/2, 7/16-20 UNF						
					SB	7/8-14 UNF O-RING, G1/4						
					SU	7/8-14 UNF O-RING 7/16-20 UNF						
					M4	M22X1.5, M14X1.5						
					G	G1/2, G1/4						
					M2	M22X1.5, M14X1.5						
					S2	7/8-14 UNF O-RING 7/16-20 UNF						

ORDERING CODE
All options have been determined with letter or numbers or combination. All boxes must be filled with proper code. If specification is not in the table, please contact us with your specific requirement

The **YMT** series motor incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum. A **DISC VALVE** distribution system which is internally balanced to reduce friction, leakage and permits better speed control producing higher efficiency, smoother rotation,higher speeds and pressure.

This series has many sizes and options to make it very flexible for many applications. The output shaft is mounted on tapered roller bearings for high radial and axial loads for very high duty applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output ower	
Disc Distribution	YMT	[in^3./rev]	[9.77~48.82]	[PSI]	[3480]	RPM	[HP]	[47]
		cm^3/rev.	160 ~ 800	MPa	24	30~705	Kw	35

QUICK REFERENCE GUIDE

YMT SERIES QUICK REFERENCE:

Displacements				
[in.^{3}/rev]	cm^3/rev.			
[9.83]	161.1	FLOW UP TO	125 LPM	[33 GPM]
[12.29]	201.4	PRESSURE UP TO	30 MPa	[4350 PSI]
[14.19]	232.5	TORQUE UP TO	1643 Nm	[14530 lbin.]
[15.36]	251.8	SPEED UP TO	770 RPM	
[19.91]	326.3			
[25.07]	410.9			
[31.95]	523.6			
[38.38]	629.1			
[48.92]	801.8			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40^o C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YMT 160	YMT 200	YMT 250	YMT 315	YMT 400	YMT 500	YMT 630	YMT 800
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[9.83]	[12.29]	[15.37]	[19.92]	[25.08]	[31.96]	[38.39]	[48.93]
		cm^3/rev.	161.1	201.4	251.8	326.3	410.9	523.6	629.1	801.8
MAX. SPEED RPM		RATED	470	475	381	294	228	183	150	121
		CONT.	614	615	495	380	302	237	196	154
		INT	770	743	592	458	364	284	233	185
MAX. TORQUE [IN. LB.] N*M	RATED	[IN.LB]	[3352]	[4166]	[5147]	[6704]	[7924]	[9401]	[10,224]	[10,675]
		N*M	**379**	**471**	**582**	**758**	**896**	**1063**	**1156**	**1207**
	CONT.	[IN. LB.]	[4166]	[5209]	[6430]	[8508]	[9684]	[11,011]	[11,656]	[12,948]
		N*M	**471**	**589**	**727**	**962**	**1095**	**1245**	**1318**	**1464**
	INT.	[IN. LB.]	[507]	[6350]	[7853]	[10,206]	[11,223]	[12,461]	[13,248]	[13,443]
		N*M	**57.3**	**718**	**888**	**1154**	**1269**	**1409**	**1498**	**1520**
	PEAK	[IN.LB]	[5917]	[7411]	[9162]	[11,907]	[12,826]	[14,538]	[14,317]	[1725]
		N*M	**669**	**838**	**1036**	**1346.3**	**1450.3**	**1643.8**	**1618.8**	**1665**
MAX. OUTPUT [HP] KW	RATED	[HP]	[25.0]	[31.4]	[31.1]	[31.2]	[28.7]	[27.3]	[24.4]	[20.5]
		KW	**18.7**	**23.4**	**23.2**	**23.3**	**21.4**	**20.4**	**18.2**	**15.3**
	CONT.	[HP]	[37.1]	[46.8]	[46.2]	[46.8]	[41.8]	[38.6]	[33.9]	[29.8]
		KW	**27.7**	**34.9**	**34.5**	**34.9**	**31.2**	**28.8**	**25.3**	**22.2**
	INT.	[HP]	[42.9]	[53.6]	[53.6]	[53.6]	[46.9]	[46.9]	[36.8]	[35.9]
		KW	**32**	**40**	**40**	**40**	**35**	**35**	**27.5**	**26.8**
MAX. PRES-SURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2320]	[2175]	[2030]	[1740]	[1523]
		MPa	**16**	**16**	**16**	**16**	**15**	**14**	**12**	**10.5**
	CONT.	[PSI]	[2900]	[2900]	[2900]	[2900]	[2610]	[2320]	[2030]	[1813]
		MPa	**20**	**20**	**20**	**20**	**18**	**16**	**14**	**12.5**
	INT.	[PSI]	[3480]	[3480]	[3480]	[3480]	[3045]	[2610]	[2320]	[1885]
		MPa	**24**	**24**	**24**	**24**	**21**	**18**	**16**	**13**
	PEAK	[PSI]	[4060]	[4060]	[4060]	[4060]	[3480]	[3045]	[2755]	[2320]
		MPa	**28**	**28**	**28**	**28**	**24**	**21**	**19**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[21.1]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.]
		L/MIN	**80**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	CONT.	[GPM]	[26.4]	[33]	[33]	[33]	[33]	[33]	[33]	[33]
		L/MIN	**100**	**125**	**125**	**125**	**125**	**125**	**125**	**125**
	INT.	[GPM]	[33]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]
		L/MIN	**125**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	INT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	PEAK	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[43]	[44]	[45]	[46]	[48]	[52]	[53]	[55]
		KG	**19.5**	**20**	**20.5**	**21**	**22**	**23**	**24**	**25**

- Continuous pressure: Max. value of operating motor continuously.
- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YMT 160 [9.83 in³./rev.] 161.1 cm³/rev.

		[580] 4	[1160] 8	[1450] 10	[1740] 12	[2320] 16	Max cont. [2900] 20	Max int. [3480] 24	[PSI] MPA
GPM	[2.7]	[778]	[1557]	[2016]	[2432]	[3193]	[3953]	[4732]	
		88	176	228	275	361	447	535	
L/ min	10	**60**	**59**	**58**	**56**	**54**	**50**	**44**	
	[5.3]	[787]	[1601]	[2070]	[2450]	[3290]	[4059]	[4926]	TORQUE [LB-IN]
		89	181	234	277	372	459	557	TORQUE (N•M)
	20	**121**	**120**	**117**	**114**	**109**	**103**	**95**	SPEED (RPM)
Flow (L/min)	[10.6]	[805]	[1592]	[2079]	[2450]	[3370]	[4166]	[5068]	
		91	180	235	277	381	471	573	
	40	**249**	**246**	**243**	**236**	**230**	**223**	**212**	
	[15.9]	[725]	[1574]	[2078]	[2449.79]	[3370]	[4157]	[5059]	
		82	178	235	277	381	470	572	
	60	**371**	**367**	**362**	**356**	**349**	**340**	**330**	
	[21.1]	[689.84]	[1530.02]	[2025.28]	[2440.95]	[3351.88]	[4121.31]	[5014.55]	
		78	173	229	276	379	466	567	
	80	**492**	**489**	**485**	**478**	**470**	**462**	**447**	
Max cont.	[26.4]	[619]	[1415]	[1928]	[2379]	[3272]	[4024]	[4935]	Max cont.
		70	160	218	269	370	455	558	
	100	**614**	**611**	**606**	**598**	**590**	**582**	**570**	
Max int.	[33.0]	[513]	[1309]	[1866]	[2308]	[3175]	[3962]	[4882]	Max int.
		58	148	211	261	359	448	552	
	125	**770**	**764**	**758**	**750**	**741**	**731**	**715**	

YMT 200 [12.29 in³./rev.] 201.4 cm³/rev.

		[580] 4	[1160] 8	[1450] 10	[1740] 12	[2320] 16	Max cont. [2900] 20	Max int. [3480] 24	[PSI] MPA
GPM	[2.7]	[1097]	[2061]	[2556]	[3007]	[4015]	[4953]	[5917]	
		124	233	289	340	454	560	669	
L/ min	10	**47**	**46**	**45**	**42**	**39**	**37**	**33**	
	[5.3]	[1106]	[2114]	[2635.52]	[3069]	[4139]	[5094]	[6155]	TORQUE [LB-IN]
		125	239	298	347	468	576	696	TORQUE (N•M)
	20	**95**	**94**	**92**	**90**	**87**	**84**	**75**	SPEED (RPM)
	[10.6]	[1061]	[2131]	[2618]	[3113]	[4201]	[5210]	[6332]	
		120	241	296	352	475	589	716	
	40	**195**	**193**	**191**	**187**	**183**	**178**	**167**	
Flow (L/min)	[15.9]	[1026]	[2096]	[2609]	[3113]	[4227]	[5209]	[6350]	
		116	237	295	352	478	589	718	
	60	**297**	**295**	**292**	**287**	**282**	**276**	**263**	
	[21.1]	[955]	[2043]	[2556]	[3095]	[4192]	[5183]	[6332]	
		108	231	289	350	474	586	716	
	80	**395**	**393**	**389**	**384**	**377**	**370**	**359**	
	[26.4]	[876]	[2008]	[2529]	[3042]	[4166]	[5130]	[6297]	
		99	227	286	344	471	580	712	
	100	**493**	**490**	**486**	**482**	**475**	**467**	**460**	
Max cont.	[33.0]	[743]	[1840]	[2441]	[2945]	[4059]	[5006]	[6164]	Max cont.
		84	208	276	333	459	566	697	
	125	**615**	**611**	**607**	**602**	**595**	**588**	**572**	
Max int.	[39.6]	[619]	[1716]	[2299]	[2865]	[3953]	[4900]	[6032]	Max int.
		70	194	260	324	447	554	682	
	150	**743**	**740**	**735**	**727**	**717**	**706**	**682**	

YMT 250 [15.37 in³./rev.] 251.8 cm³/rev.

		[580] 4	[1160] 8	[1450] 10	[1740] 12	[2320] 16	Max cont. [2900] 20	Max int. [3480] 24	[PSI] MPA
GPM	[2.7]	[1220]	[2529]	[3140]	[3706]	[4944]	[6094]	[7287]	
		138	286	355	419	559	689	824	
L/ min	10	**38**	**38**	**37**	**36**	**34**	**32**	**31**	
	[5.3]	[1265]	[2618]	[3219]	[3821]	[5130]	[6262]	[7544]	TORQUE [LB-IN]
		143	296	364	432	580	708	853	TORQUE (N•M)
	20	**76**	**75**	**74**	**72**	**70**	**67**	**62**	SPEED (RPM)
	[10.6]	[1229]	[2662]	[3290]	[3891]	[5244]	[6394]	[7818]	
		139	301	372	440	593	723	884	
	40	**156**	**154**	**152**	**149**	**146**	**142**	**134**	
Flow (L/min)	[15.9]	[1167]	[2600]	[3290]	[3900]	[5236]	[6430]	[7853]	
		132	294	372	441	592	727	888	
	60	**237**	**236**	**233**	**229**	**224**	**219**	**207**	
	[21.1]	[1132]	[2503]	[3219]	[3829]	[5191]	[6377]	[7845]	
		128	283	364	433	587	721	887	
	80	**317**	**316**	**314**	**308**	**303**	**299**	**284**	
	[26.4]	[1114]	[2494]	[3140]	[3776]	[5147]	[6332]	[7774]	
		126	282	355	427	582	716	879	
	100	**396**	**394**	**391**	**387**	**381**	**373**	**359**	
Max cont.	[33.0]	[1026]	[2299]	[3007]	[3661]	[5023]	[6217]	[7641]	Max cont.
		116	260	340	414	568	703	864	
	125	**495**	**492**	**488**	**483**	**476**	**469**	**454**	
Max int.	[39.6]	[778]	[2140]	[2830]	[3511]	[4882]	[6067]	[7491]	Max int.
		88	242	320	397	552	686	847	
	150	**592**	**589**	**585**	**580**	**572**	**565**	**545**	

YMT 315 [19.92 in³./rev.] 326.3 cm³/rev.

		[580] 4	[1160] 8	[1450] 10	[1740] 12	[2320] 16	Max cont. [2900] 20	Max int. [3480] 24	[PSI] MPA
GPM	[2.7]	[1627]	[3210]	[4006]	[4820]	[6491]	[7880]	[9392]	
		184	363	453	545	734	891	1062	
L/ min	10	**30**	**29**	**28**	**27**	**26**	**25**	**23**	
	[5.3]	[1672]	[3361]	[4174]	[4970]	[6695]	[8110]	[9808]	TORQUE [LB-IN]
		189	380	472	562	757	917	1109	TORQUE (N•M)
	20	**60**	**59**	**58**	**56**	**54**	**52**	**50**	SPEED (RPM)
	[10.6]	[1689]	[3370]	[4280]	[5041]	[6845]	[8437]	[10,162]	
		191	381	484	570	774	954	1149	
	40	**121**	**120**	**118**	**115**	**112**	**109**	**104**	
Flow (L/min)	[15.9]	[1672]	[3325]	[4360]	[5068]	[6828]	[8508]	[10,206]	
		189	376	493	573	772	962	1154	
	60	**183**	**181**	**179**	**175**	**172**	**168**	**158**	
	[21.1]	[1583]	[3263]	[4236]	[4997]	[6951]	[8437]	[10,197]	
		179	369	479	565	786	954	1153	
	80	**244**	**242**	**239**	**236**	**231**	**227**	**217**	
	[26.4]	[1495]	[3157]	[4130]	[4970]	[6704]	[8331]	[10,109]	
		169	357	467	562	758	942	1143	
	100	**305**	**304**	**301**	**298**	**294**	**289**	**276**	
Max cont.	[33.0]	[1300]	[2972]	[3953]	[4811]	[6589]	[8136]	[9967]	Max cont.
		147	336	447	544	745	920	1127	
	125	**380**	**378**	**375**	**371**	**367**	**362**	**349**	
Max int.	[39.6]	[1052]	[2812]	[3821]	[4652]	[6306]	[7907]	[9702]	Max int.
		119	318	432	526	713	894	1097	
	150	**458**	**456**	**453**	**449**	**444**	**431**	**425**	

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PERFORMANCE DATA

YMT 400 [25.08 in^3./rev.] 410,9 cm^3/rev.

							Max cont.	Max int.	
		[435] 3	[870] 6	[1305] 9	[1740] 12	[2175] 15	[2610] 18	[3045] 21	[PSI] MPA
GPM	[2.7]	[1557]	[3246]	[4953]	[6323]	[7827]	[9286]	[10,692]	
		176	367	560	715	885	1050	1209	
L/ min	10	**24**	**23**	**22**	**21**	**20**	**19**	**18**	
	[5.3]	[1583]	[3272]	[4997]	[6421]	[7951]	[9472]	[10,931]	TORQUE [LB-IN]
		179	370	565	726	899	1071	1236	TORQUE (N•M)
	20	**49**	**48**	**47**	**44**	**42**	**40**	**38**	SPEED (RPM)
Flow (L/min)	[10.6]	[1557]	[3272]	[5015]	[6483]	[8128]	[9649]	[11,170]	
		176	370	567	733	919	1091	1263	
	40	**96**	**95**	**93**	**90**	**87**	**83**	**79**	
	[15.9]	[1539]	[3193]	[4979]	[6447]	[8136]	[9684]	[11,223]	
		174	361	563	729	920	1095	1269	
	60	**145**	**143**	**139**	**135**	**131**	**127**	**121**	
	[21.1]	[1468]	[3122]	[4891]	[6359]	[8066]	[9587]	[11,170]	
		166	353	553	719	912	1084	1263	
	80	**193**	**191**	**188**	**184**	**180**	**176**	**170**	
	[26.4]	[1327]	[2998]	[4758]	[6262]	[7924]	[9437]	[11,073]	
		150	339	538	708	896	1067	1252	
	100	**242**	**240**	**238**	**234**	**228**	**224**	**218**	
	[33.0]	[1194]	[2733]	[4634]	[6085]	[7721]	[9242]	[10,799]	
Max cont.		135	309	524	688	873	1045	1221	
	125	**302**	**300**	**298**	**294**	**289**	**285**	**178**	Max cont.
	[39.6]	[1114]	[2582]	[4493]	[5890]	[7535]	[9021]	[10,586]	
Max int.		126	292	508	666	852	1020	1197	Max int.
	150	**364**	**362**	**358**	**354**	**350**	**346**	**339**	

YMT 500 [31.96 in^3./rev.] 523,6 cm^3/rev.

							Max cont.	Max int.	
		[435] 3	[870] 6	[1305] 9	[1740] 12	[2030] 14	[2320] 16	[2610] 18	[PSI] MPA
GPM	[2.7]	[1963]	[3989]	[6120]	[7889]	[9286]	[10,551]	[11,851]	
		222	451	692	892	1050	1193	1340	
L/ min	10	**18**	**18**	**18**	**17**	**16**	**15**	**13**	
	[5.3]	[2043]	[4104]	[6313]	[8119]	[9463]	[10,790]	[12,178]	TORQUE [LB-IN]
		231	464	714	918	1070	1220	1377	TORQUE (N•M)
	20	**37**	**36**	**35**	**34**	**33**	**32**	**30**	SPEED (RPM)
Flow (L/min)	[10.6]	[2034]	[4121]	[6430]	[8322]	[9675]	[11,002]	[12,576]	
		230	466	727	941	1094	1244	1422	
	40	**75**	**74**	**73**	**72**	**70**	**68**	**64**	
	[15.9]	[1990]	[4042]	[6315]	[8322]	[9622]	[11,011]	[12,461]	
		225	457	714	941	1088	1245	1409	
	60	**113**	**112**	**111**	**109**	**107**	**105**	**101**	
	[21.1]	[1884]	[3812]	[6155]	[8198]	[9516]	[11,002]	[12,390]	
		213	431	696	927	1076	1244	1401	
	80	**151**	**150**	**149**	**147**	**145**	**143**	**138**	
	[26.4]	[1716]	[3714]	[6014]	[7968]	[9401]	[10,825]	[12,231]	
		194	420	680	901	1063	1224	1383	
	100	**189**	**188**	**187**	**185**	**183**	**181**	**177**	
	[33.0]	[1610]	[3520]	[5669]	[7756]	[9056]	[10,604]	[11,957]	
Max cont.		182	398	641	877	1024	1199	1352	
	125	**237**	**236**	**235**	**233**	**231**	**229**	**225**	Max cont.
	[39.6]	[1300]	[3263]	[5466]	[7544]	[8879]	[10,321]	[11,718]	
Max int.		147	369	618	853	1004	1167	1325	Max int.
	150	**284**	**283**	**282**	**280**	**278**	**276**	**272**	

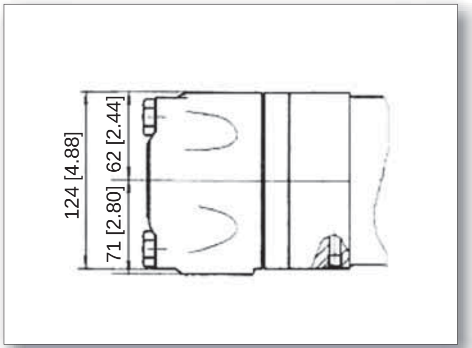
YMT 630 [38.39 in^3./rev.] 629,1 cm^3/rev.

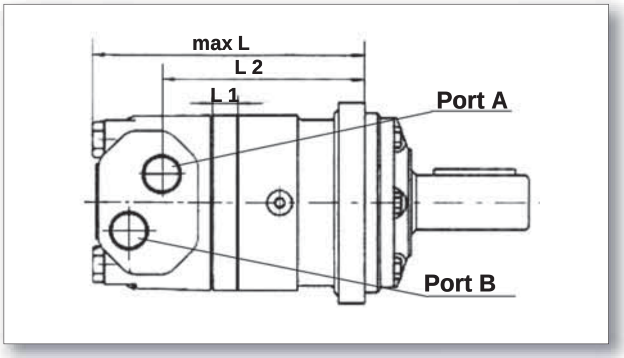
							Max cont.	Max int.	
		[435] 3	[870] 6	[1305] 9	[1522] 10.5	[1740] 12	[2030] 14	[2320] 16	[PSI] MPA
GPM	[2.7]	[2061]	[4599]	[7031]	[7977]	[9498]	[10,560]	[12,054]	
		233	520	795	902	1074	1194	1363	
L/ min	10	**14**	**14**	**13**	**13**	**13**	**11**	**11**	
	[5.3]	[2096]	[4900]	[7402]	[8428]	[9879]	[10,958]	[12,444]	TORQUE [LB-IN]
		237	554	837	953	1117	1239	1407	TORQUE (N•M)
	20	**28**	**27**	**27**	**26**	**26**	**24**	**22**	SPEED (RPM)
Flow (L/min)	[10.6]	[2114]	[4891]	[7606]	[8729]	[10,356]	[11,568]	[13,116]	
		239	553	860	987	1171	1308	1483	
	40	**62**	**62**	**61**	**60**	**59**	**56**	**54**	
	[15.9]	[1972]	[4811]	[7632]	[8649]	[10,365]	[11,656]	[13,248]	
		223	544	863	978	1172	1318	1498	
	60	**94**	**94**	**92**	**91**	**90**	**86**	**82**	
	[21.1]	[1946]	[4749]	[7553]	[8534]	[10,365]	[11,621]	[13,239]	
		220	537	854	965	1172	1314	1497	
	80	**123**	**122**	**121**	**119**	**118**	**114**	**110**	
	[26.4]	[1840]	[4617]	[7358]	[8358]	[10,224]	[11,524]	[13,160]	
		208	522	832	945	1156	1303	1488	
	100	**156**	**155**	**153**	**152**	**150**	**147**	**142**	
	[33.0]	[1778]	[4413]	[7164]	[8234]	10,056]	[11,426]	[13,018]	
Max cont.		201	499	810	931	1137	1292	1472	
	125	**196**	**196**	**194**	**192**	**191**	**187**	**183**	Max cont.
	[39.6]	[1539]	[4351]	[6943]	[8145]	[9914]	[11,294]	[12,859]	
Max int.		174	492	785	921	1121	1277	1454	Max int.
	150	**233**	**232**	**231**	**230**	**227**	**223**	**217**	

YMT 800 [48.93 in^3./rev.] 801,8 cm^3/rev.

						Max cont.	Max int.	
		[435] 3	[870] 6	[1305] 9	[1522] 10.5	[1812] 12.5	[1885] 13	[PSI] MPA
GPM	[2.7]	[3060]	[5987]	[8871]	[10,250]	[12,072]	[12,293]	
		346	677	1003	1159	1365	1390	
L/ min	10	**12**	**12**	**11**	**11**	**11**	**10**	
	[5.3]	[3148]	[6120]	[9145]	[10,462]	[12,417]	[12,895]	TORQUE [LB-IN]
		356	692	1034	1183	1404	1458	TORQUE (N•M)
	20	**24**	**24**	**24**	**23**	**22**	**18**	SPEED (RPM)
Flow (L/min)	[10.6]	[3228]	[6217]	[9428]	[10,931]	[12,903]	[13,408]	
		365	703	1066	1236	1459	1516	
	40	**50**	**50**	**49**	**48**	**46**	**40**	
	[15.9]	[3131]	[6217]	[9375]	[10,940]	[12,948]	[13,443]	
		354	703	1060	1237	1464	1520	
	60	**74**	**73**	**71**	**71**	**68**	**63**	
	[21.1]	[2936]	[6067]	[9286]	[10,843]	[12,948]	[13,390]	
		332	686	1050	1226	1464	1514	
	80	**99**	**98**	**98**	**96**	**93**	**86**	
	[26.4]	[2697]	[5784]	[9065]	[10.675]	[12,780]	[13,319]	
		305	654	1025	1207	1445	1506	
	100	**125**	**123**	**123**	**121**	**118**	**110**	
	[33.0]	[2476]	[5501]	[8747]	[10,445]	[12,576]	[13,151]	
Max cont.		280	622	989	1181	1422	1487	
	125	**154**	**153**	**153**	**150**	**149**	**140**	Max cont.
	[39.6]	[2184]	[5218]	[8428]	[10,224]	[12,435]	[13,054]	
Max int.		247	590	953	1156	1406	1476	Max int.
	150	**185**	**184**	**183**	**181**	**179**	**172**	

MOUNTING DATA



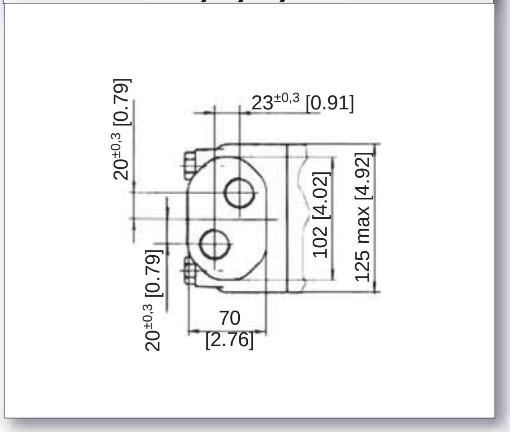


	[INCHES]		MILLIMETERS	
MODEL	**L1**	**L2**	**L1**	**L2**
YMTW160	[0.67]	[3.03]	17	77
YMTW200	[0.83]	[3.19]	21	81
YMTW250	[1.07]	[3.42]	27	87
YMTW315	[0.79]	[3.58]	20	91
YMTW400	[1.07]	[3.86]	27	98
YMTW500	[1.38]	[4.17]	35	106
YMTW630	[1.85]	[4.64]	47	118
YMTW800	[2.29]	[5.08]	58	129

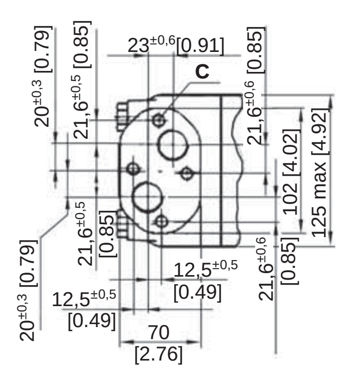
	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMT160	[7.60]	[0.67]	[5.61]	193	17	142.5
YMT200	[7.76]	[0.83]	[5.77]	197	21	146.5
YMT250	[8.00]	[1.07]	[6.01]	203	27	152.5
YMT315	[8.19]	[0.79]	[6.17]	208	20	156.5
YMT400	[8.47]	[1.07]	[6.44]	215	27	163.5
YMT500	[8.78]	[1.38]	[6.76]	223	35	171.5
YMT630	[9.26]	[1.85]	[7.23]	235	47	183.5
YMT800	[9.69]	[2.29]	[7.66]	246	58	194.5

Note: 1) The thickness of the stator and rotor for displacements from 160-250 is the dimension of L1 + 3mm
2) The thickness of the stator and rotor for displacements from 315-800 is the dimension of L1 + 7mm.

PORTS
S1,S,G,M3



PORTS
D,M

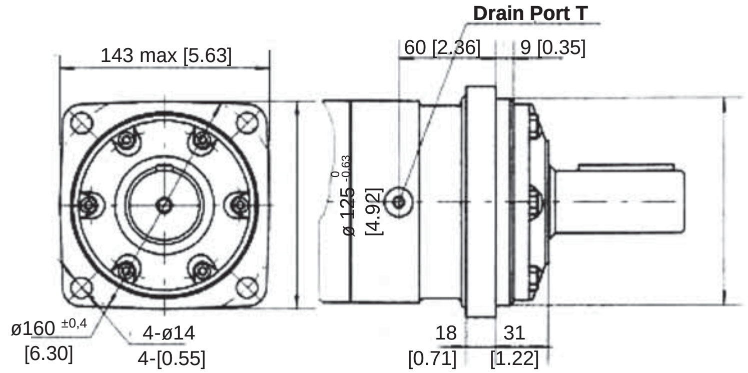


PORT & DRAIN PORT ORDERING CODES

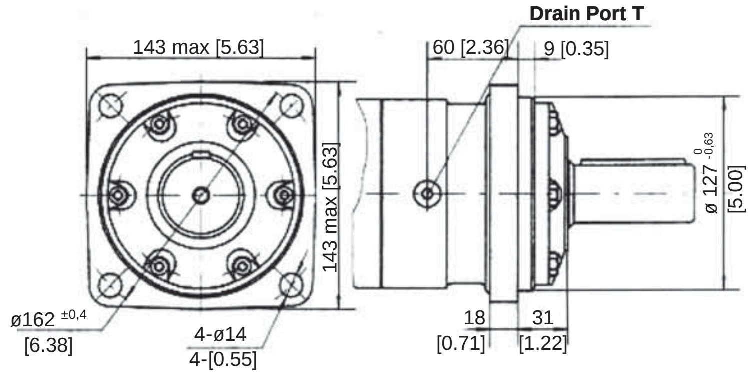
ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	G	DEPTH	M3	DEPTH	S1	DEPTH
PORTS - A and B	G 3/4	18 mm	M27 X 2	18 mm	1-1/16-12 UN	18 mm	G 3/4	18 mm	M27 X 2	18 mm	1-1/16-12 UN	18 MM
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	9/16-18UNF	12 mm	G 1/4	12 mm	M14X1.5	12MM	7/16-20UNF	12MM
BOLTS - C	4-M10	10 mm	4-M10	10 mm								

MOUNTING DATA

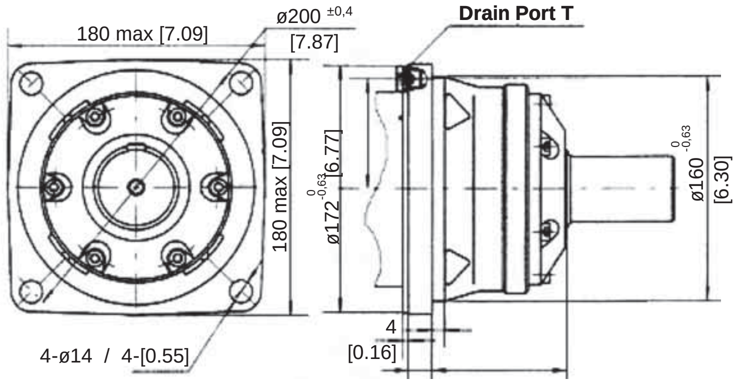
FLANGE 4



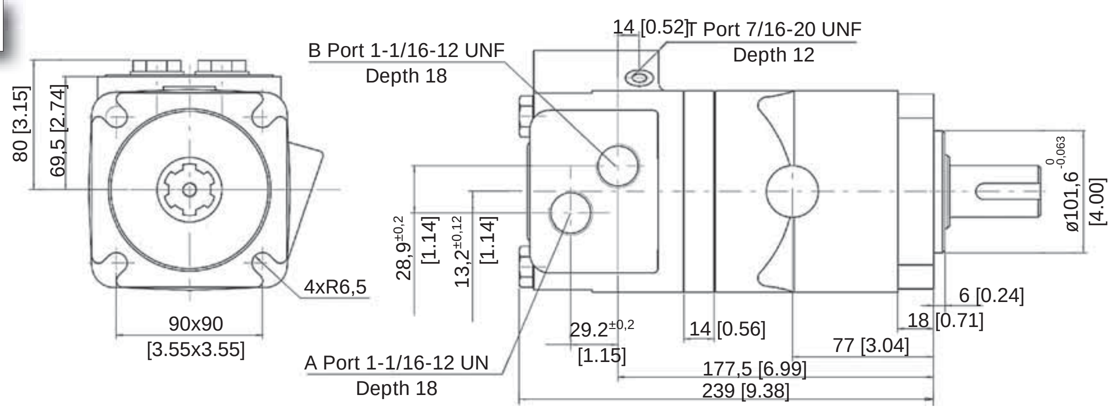
FLANGE K6



FLANGE W



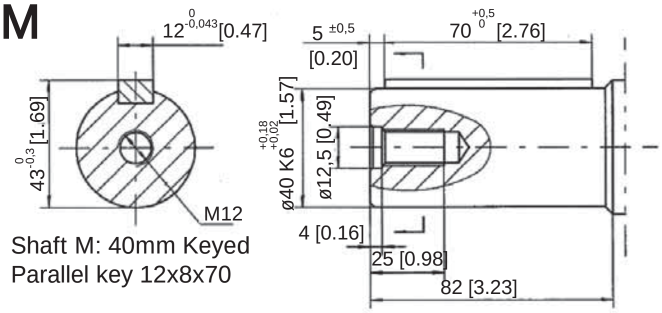
FLANGE B2E



YMT

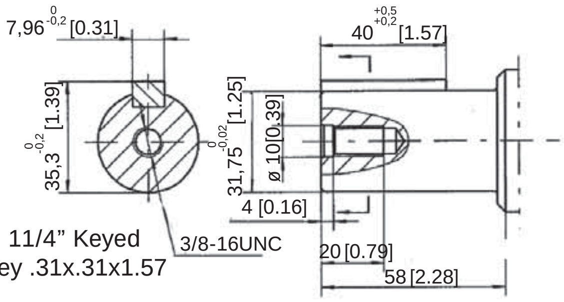
MOTOR SHAFT EXTENSIONS

M



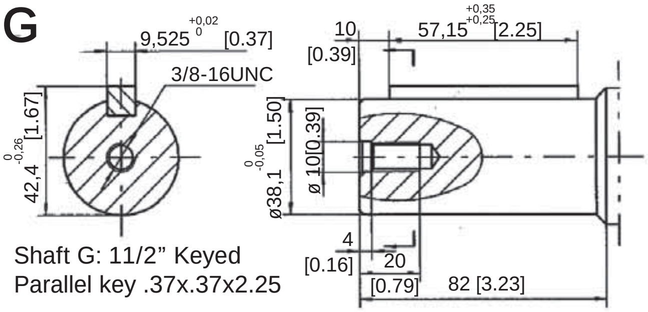
Shaft M: 40mm Keyed
Parallel key 12x8x70

G1



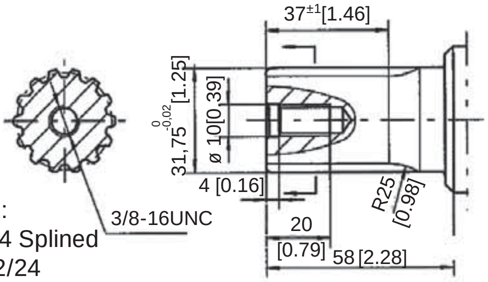
Shaft G1: 11/4” Keyed
Parallel key .31x.31x1.57

G



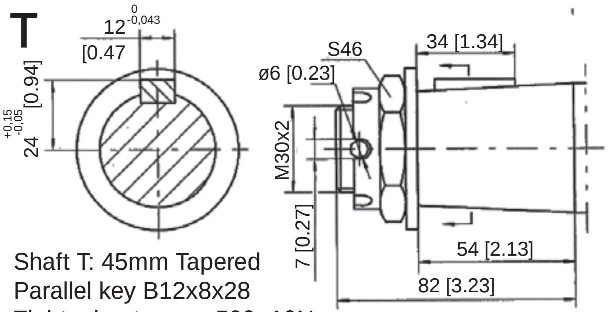
Shaft G: 11/2” Keyed
Parallel key .37x.37x2.25

F1



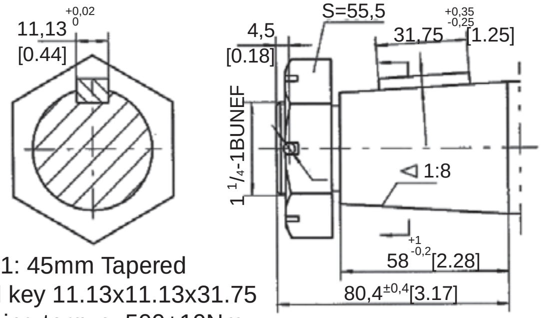
Shaft F1:
11/4” -14 Splined
14-DP12/24

T



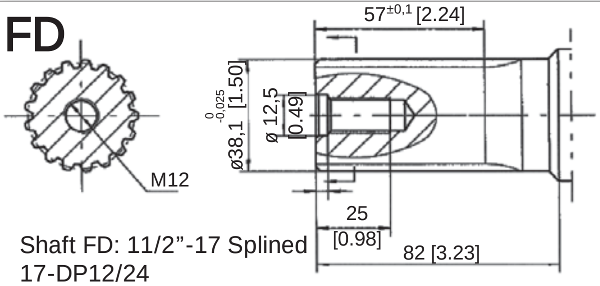
Shaft T: 45mm Tapered
Parallel key B12x8x28
Tightening torque: 500±10Nm

T1



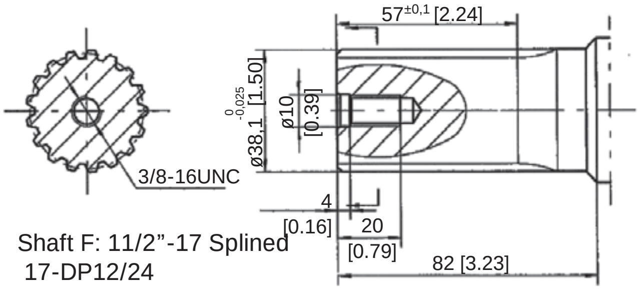
Shaft T1: 45mm Tapered
Parallel key 11.13x11.13x31.75
Tightening torque: 500±10Nm

FD



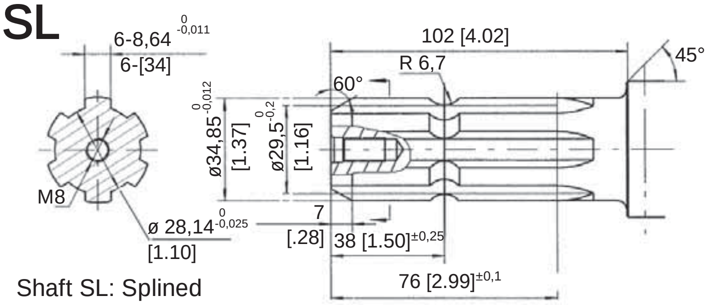
Shaft FD: 11/2”-17 Splined
17-DP12/24

F



Shaft F: 11/2”-17 Splined
17-DP12/24

SL

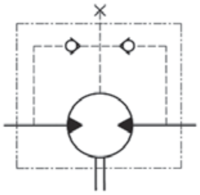


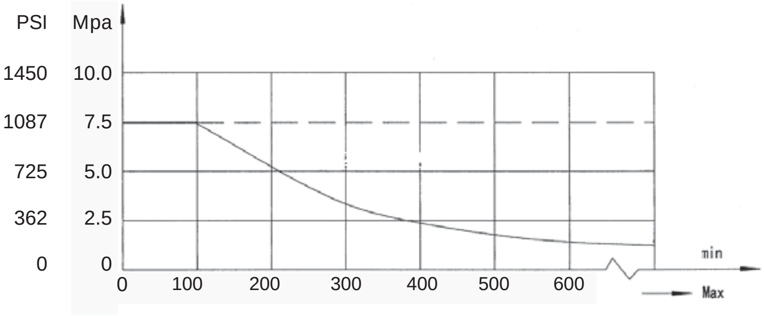
Shaft SL: Splined
6-1.37x1.11x.34

▷

ADDITIONAL DATA

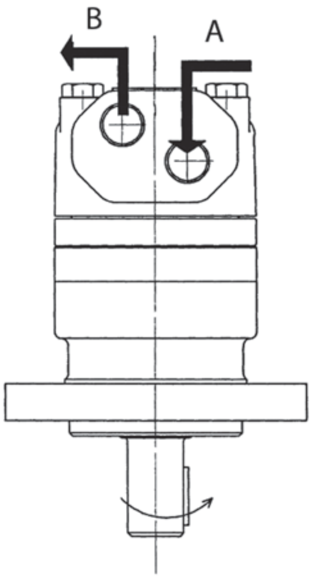
PERMISSIBLE SHAFT SEAL PRESSURE





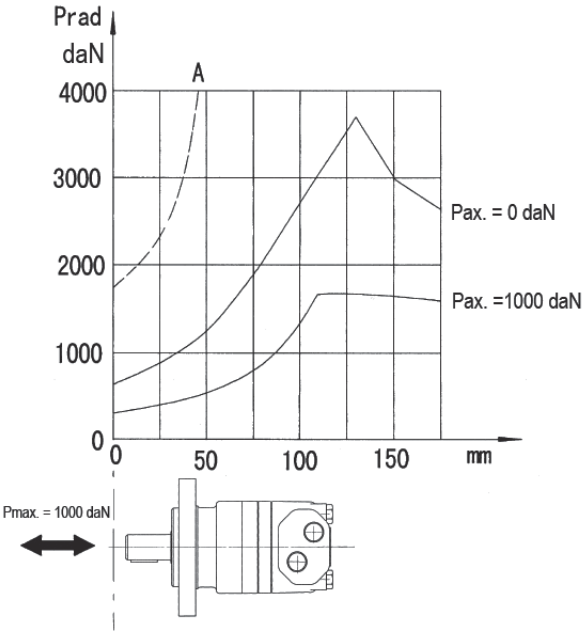
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

DIRECTION OF SHAFT ROTATION



WHEN FACING SHAFT END OF MOTOR,SHAFT TO ROTATE:
CLOCKWISE WHEN PORT “A” IS PRESSURIZED.
COUNTER CLOCK WISE WHEN PORT “B” IS PRESSURIZED.

AXIAL AND RADIAL FORCES



The output shaft is mounted on tapered roller bearings that permit high radial and axial loads.Curve “A” shows Max radial shaft load,Any shaft load exceeding the values quoted in the curve could determine premature failure of the shaft bearings or other parts.The other curves show a B10 life of 3000 hours and 200 RPM.

ORDERING INFORMATION

	1	2	3	4	5	6	7	8
YMT								

1	**2**		**3**		**4**		**5**		**6**		**7**	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
160	**4**	4-Ø14 Square-flange Ø160, pilot Ø125×9	**M**	Shaft: 40mmKeyed Key 12×8×70	**D**	G3/4Manifold Mount 4-M10, G1/4	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
200	**K6**	4-Ø14.5 Square-flange Ø162, pilot Ø127×9	**G**	Shaft: 11/2” Keyed parallel Key .38x.38x2.25	**M**	M27×2 Manifold Mount 4-M10, M14×1.5	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
250	**W**	4-Ø18 Wheel-flange Ø200, pilot Ø160×7	**F**	Shaft: 11/2”-17,Splined 17-DP12/24	**S**	1 1/16-12un,9/16-18unf			**B**	BLACK	**LL**	LOW LEAKAGE VALVE
315	**B2E**	4-6.5 Square Flange 4” pilot	**T**	Shaft: 45mm Tapered parllel key B12×28×8	**S1**	1-1/16-12UN, 7/16-20UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
400			**T1**	Shaft: 45mm Tapered key 11.13×11.13×31.75	**G**	G3/4 - G1/4					**CRS**	CORROSION RESISTANT SHAFT
500			**S L**	Shaft: Ø34.85, splined 6-34.85×28.14×8.64	**M3**	M27×2 - M14×1.5					**HPS**	HIGH PRESSURE SEAL
630			**G1**	Shaft:11/4 Keyed parllel key 7.96×7.96×40							**HTS**	HIGH TEMP SEAL
800			**F1**	Shaft: 11/4”-14 Splined 14-DP12/24								
			FD	Shaft: 11/2”-17 Splined 17-DP12/24								

Ordering code:

All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

The **YMTE** series motor incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum. A **DISC VALVE** distribution system which is internally balanced to reduce friction, leakage and permit better speed control. Producing efficiency, smoother rotation, higher speed and pressure.

This series has many sizes and options to make it very flexible for many applications. The output shaft is mounted on tapered rollor bearings for high radial and axial loads for very high duty applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output ower	
Disc Distribution	YMTE	[in^3./rev]	[9.77~48.82]	[PSI]	[3480]	RPM	[HP]	[47]
		cm^3/rev.	160 ~ 800	MPa	24	30~705	Kw	35

YMTE SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[14.19]	232.5	FLOW UP TO	125 LPM	[33 GPM]
[15.36]	251.8	PRESSURE UP TO	30 MPA	[4350 PSI]
[19.91]	326.3	TORQUE UP TO	1643 NM	[14530 LBIN.]
[25.07]	410.9	SPEED UP TO	770 RPM	
[31.95]	523.6			
[38.38]	629.1			
[48.91]	801.8			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict precedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

- Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40^o C
- Different shafts are used when there is a radial load or not. Check data pages
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

- For individual motor performance charts consult equivalent YMT series data

DISTRIBUTION TYPE			YMTE 230	YMTE 250	YMTE 315	YMTE 400	YMTE 500	YMTE 630	YMTE 800
GEOMETRIC DISPLACEMENT		[in³./rev.]	[14.19]	[15.37]	[19.92]	[25.08]	[31.96]	[38.39]	[48.93]
		cm³/rev.	**232.5**	**251.8**	**326.3**	**410.9**	**523.6**	**629.1**	**801.8**
MAX. SPEED RPM		RATED	412	381	294	228	183	150	121
		CONT.	536	495	380	302	237	196	154
		INT	**643**	**592**	**458**	**364**	**284**	**233**	**185**
MAX. TORQUE [IN. LB.] N*M	RATED	[IN.LB]	[4687]	[5147]	[6704]	[7924]	[9401]	[10,224]	[10,675]
		N*M	**530**	**582**	**758**	**896**	**1063**	**1156**	**1207**
	CONT.	[IN. LB.]	[5925]	[6430]	[8508]	[9684]	[11,011]	[11,656]	[12,948]
		N*M	**670**	**727**	**962**	**1095**	**1245**	**1318**	**1464**
	INT.	[IN. LB.]	[7261]	[7853]	[10,206]	[11,223]	[12,461]	[13,248]	[13,443]
		N*M	**821**	**888**	**1154**	**1269**	**1409**	**1498**	**1520**
	PEAK	[IN.LB]	[8473]	[9162]	[11,907]	[12,826]	[14,538]	[14,317]	[1725]
		N*M	**958**	**1036**	**1346.3**	**1450.3**	**1643.8**	**1618.8**	**1665**
MAX. OUTPUT [HP] KW	RATED	[HP]	[31.1]	[31.1]	[31.2]	[28.7]	[27.3]	[24.4]	[20.5]
		KW	**23.2**	**23.2**	**23.3**	**21.4**	**20.4**	**18.2**	**15.3**
	CONT.	[HP]	[46.5]	[46.2]	[46.8]	[41.8]	[38.6]	[33.9]	[29.8]
		KW	**34.7**	**34.5**	**34.9**	**31.2**	**28.8**	**25.3**	**22.2**
	INT.	[HP]	[53.6]	[53.6]	[53.6]	[46.9]	[46.9]	[36.8]	[35.9]
		KW	**40**	**40**	**40**	**35**	**35**	**27.5**	**26.8**
MAX. PRES-SURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2175]	[2030]	[1740]	[1523]
		MPa	**16**	**16**	**16**	**15**	**14**	**12**	**10.5**
	CONT.	[PSI]	[2900]	[2900]	[2900]	[2610]	[2320]	[2030]	[1813]
		MPa	**20**	**20**	**20**	**18**	**16**	**14**	**12.5**
	INT.	[PSI]	[3480]	[3480]	[3480]	[3045]	[2610]	[2320]	[1885]
		MPa	**24**	**24**	**24**	**21**	**18**	**16**	**13**
	PEAK	[PSI]	[4060]	[4060]	[4060]	[3480]	[3045]	[2755]	[2320]
		MPa	**28**	**28**	**28**	**24**	**21**	**19**	**16**
MAX. FLOW [GPM] L/min	RATED	[GPM]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.]
		L/MIN	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	CONT.	[GPM]	[33]	[33]	[33]	[33]	[33]	[33]	[33]
		L/MIN	**125**	**125**	**125**	**125**	**125**	**125**	**125**
	INT.	[GPM]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]
		L/MIN	**150**	**150**	**150**	**150**	**150**	**150**	**150**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	INT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	PEAK	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[45]	[45]	[46]	[48]	[52]	[53]	[55]
		KG	**20.4**	**20.5**	**21**	**22**	**23**	**24**	**25**

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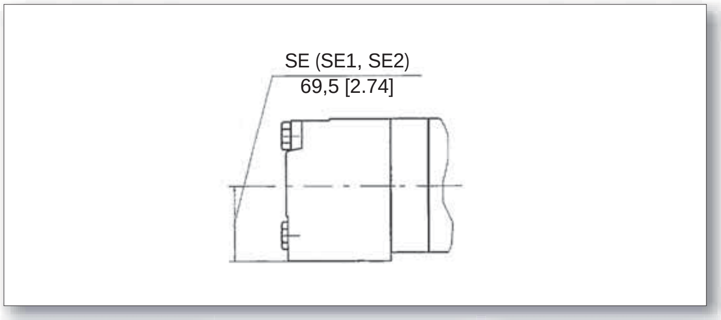
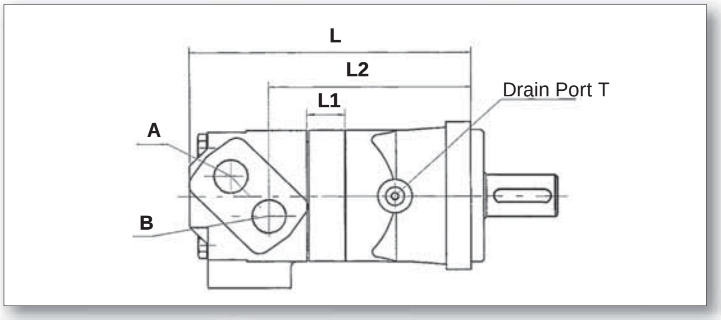
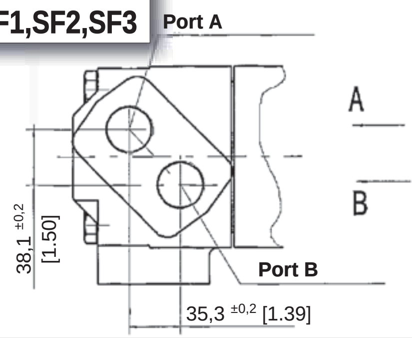
PORTING DATA





PORTING SF1,SF2,SF3



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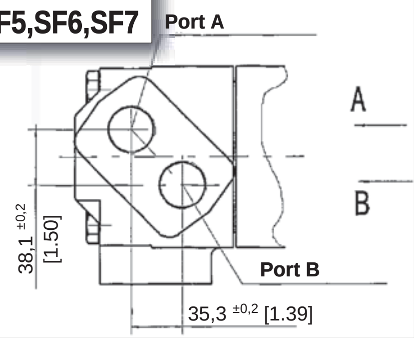

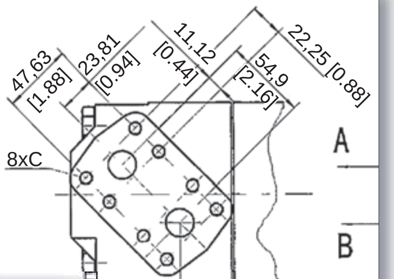

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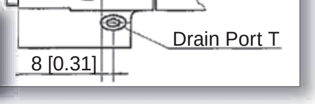
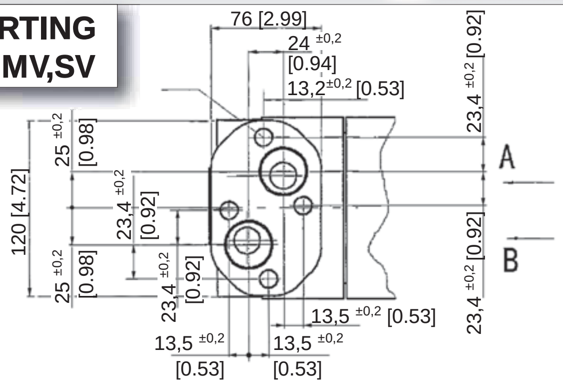
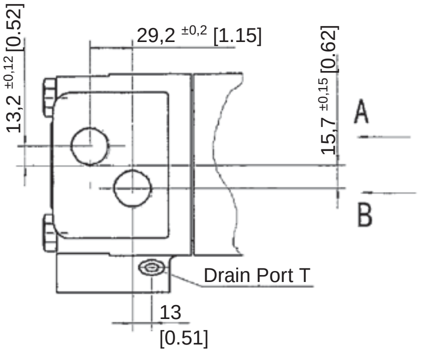


PORTING DV,MV,SV



PORTING SE,SE1,SE2

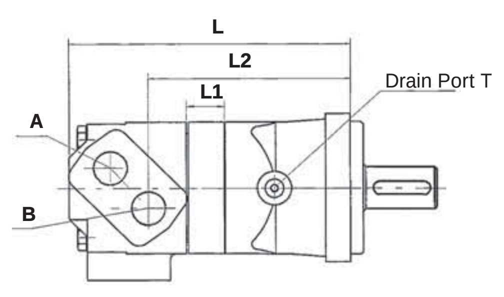


	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMTE 230	[9.39]	[0.48]	[6.48]	238.5	12	164.5
YMTE 250	[9.47]	[0.56]	[6.56]	240.5	14	166.5
YMTE 315	[9.71]	[0.79]	[6.80]	246.5	20	172.5
YMTE 400	[9.98]	[1.07]	[7.07]	253.5	27	179.5
YMTE 500	[10.30]	[1.38]	[7.39]	261.5	35	187.5
YMTE 630	[10.77]	[1.85]	[7.86]	273.5	47	199.5
YMTE 800	[11.20]	[2.29]	[8.29]	284.5	58	210.5

Note: 1)The dimentional data for ports SF,SF1 and SF2 are as the chart indicates
2) The dimensional data for ports DV,MV and SV are as followed: L dimension-16mm and L2 dimension + 6.5mm.
3) The dimensional date for ports SE,SE1,SE2 and WE are as followed: L dimension -70mm and L2 dimension -52mm
4)The thickness of the stator and rotor for displacements from 315-800 is the dimension of L1 + 7mm.

ORDER CODE	SF1 SF6	DEPTH	SF2 SF7	DEPTH	SF	DEPTH	DV	DEPTH	MV	DEPTH	SV SF3/SF5	DEPTH	SE	DEPTH	SE1	DEPTH	SE2	DEPTH
PORTS - A and B	M33X2	18 mm	G1	18 mm	3/4”	18 mm	G1	18 mm	M33X2	18 mm	1-5/16-12UN	18 mm	1-1/16-12UN	18 mm	1-1/16-12UN	18 mm	G3/1	18 mm
TANK PORT - T	M14X1.5	12 mm	G 1/4	12 mm	7/16-20UNF	12 mm	G 1/4	12 mm	M14X1.5	12 mm	7/16-20UNF	12 mm	9/16 UNF	12 mm	7/16-20UNF	12 mm	G 1/4	12 mm
BOLTS - C	-	-	-	-	8X3/8-16UNC	-	4XM12	-	4XM12	-	-							

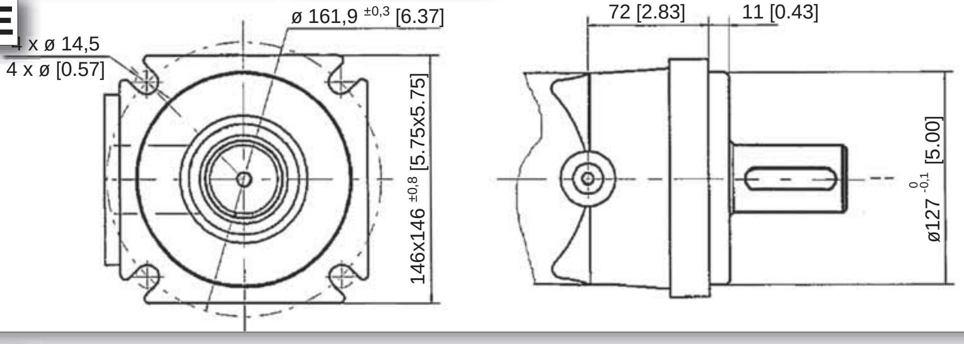
MOUNTING FLANGE DATA



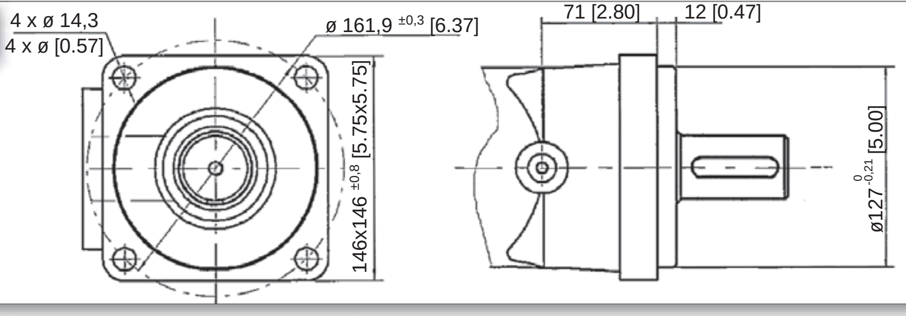
**NOTE:
THE THICKNESS
OF THE STATOR
AND ROTOR FOR
DISPLACEMENTS
315-800 IS THE
DIMENSION OF
L1 + 7 MM**

	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMTE 230	[9.39]	[0.48]	[6.48]	238.5	12	164.5
YMTE 250	[9.47]	[0.56]	[6.56]	240.5	14	166.5
YMTE 315	[9.71]	[0.79]	[6.80]	246.5	20	172.5
YMTE 400	[9.98]	[1.07]	[7.07]	253.5	27	179.
YMTE 500	[10.30]	[1.38]	[7.39]	261.5	35	187.5
YMTE 630	[10.77]	[1.85]	[7.86]	273.5	47	199.5
YMTE 800	[11.20]	[2.29]	[8.29]	284.5	58	210.5

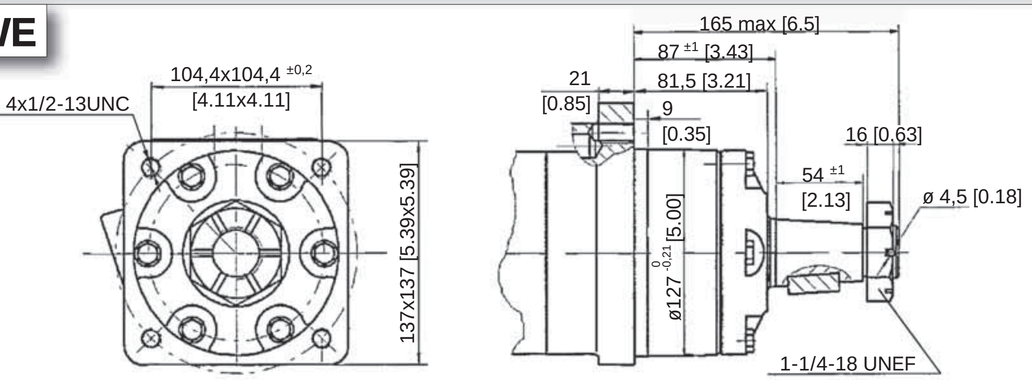
FLANGE B2E



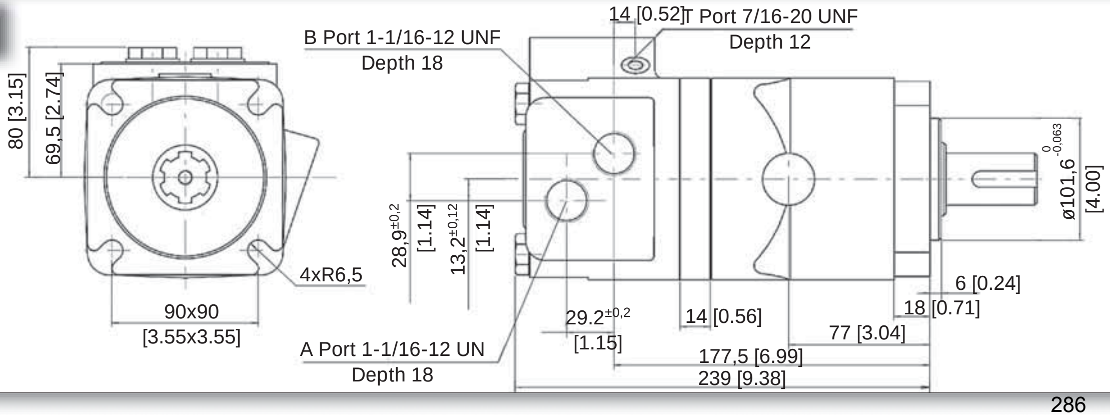
FLANGE CC



FLANGE WE

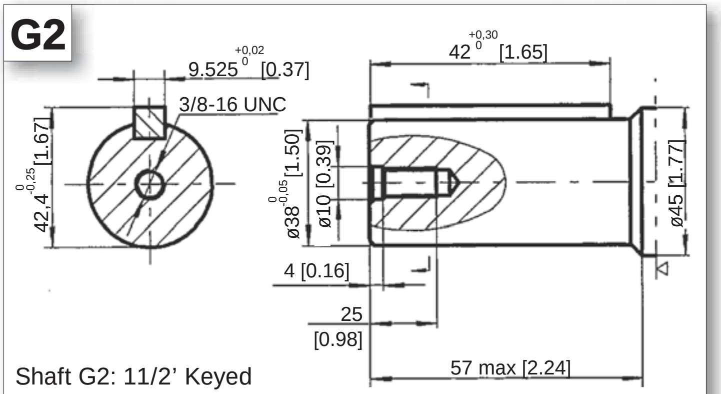


FLANGE B2E



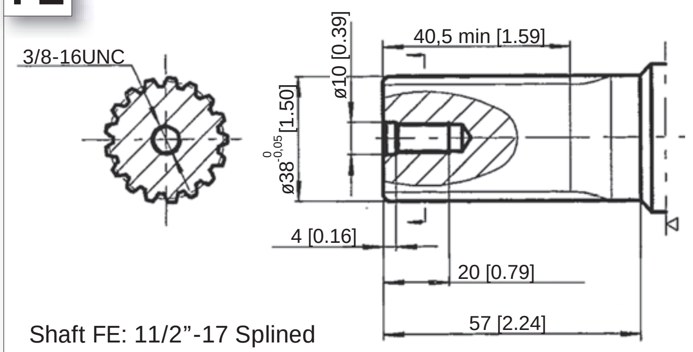
MOTOR SHAFT EXTENSIONS

G2



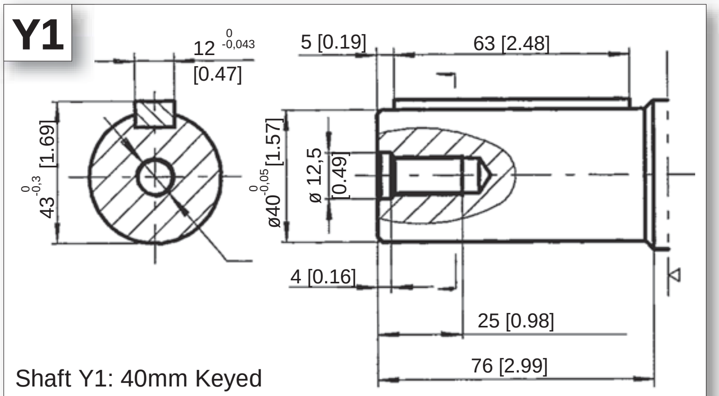
Shaft G2: 11/2' Keyed
Parallel Key .37x.37x1.65

FE



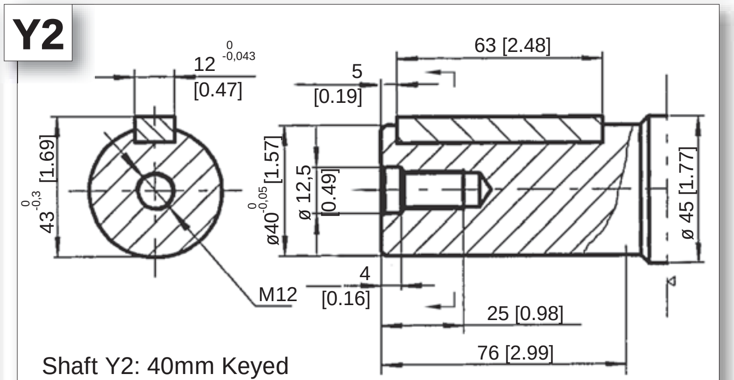
Shaft FE: 11/2"-17 Splined
17-dp12/24

Y1



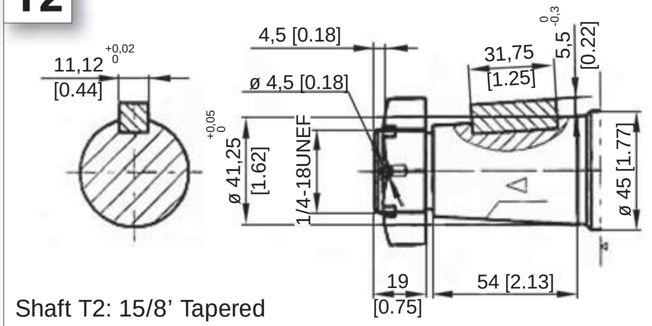
Shaft Y1: 40mm Keyed
Parallel Key 12x8x63

Y2



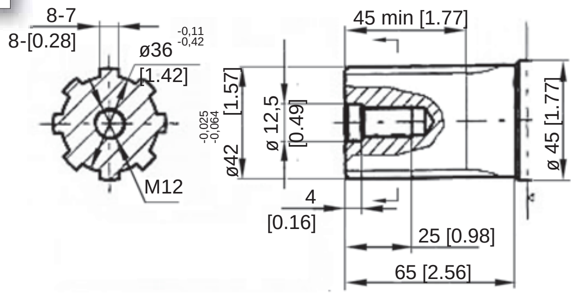
Shaft Y2: 40mm Keyed
Parallel Key 12x8x63

T2



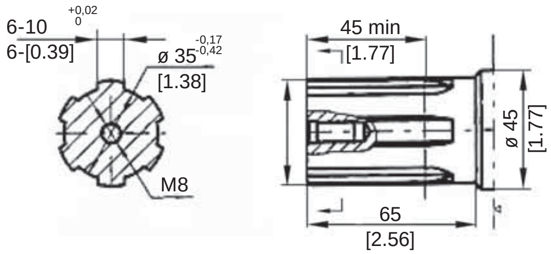
Shaft T2: 15/8' Tapered
Parallel Key .44x.44x1.25
Tightening torque: 500±10Nm

H



Shaft H: 42mm Splined
Splines 8-42x36x7

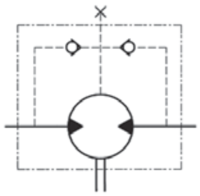
P

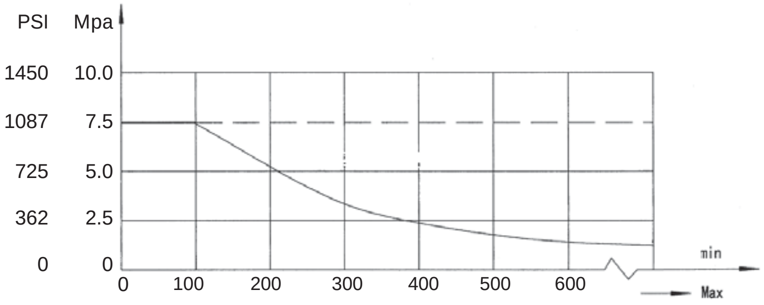


Shaft P: 40mm Splined
Splines 6-40x35x10

ADDITIONAL DATA

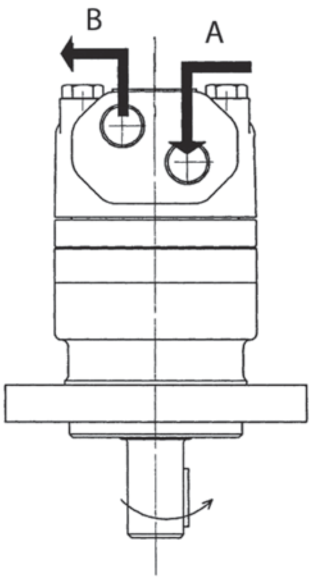
PERMISSIBLE SHAFT SEAL PRESSURE





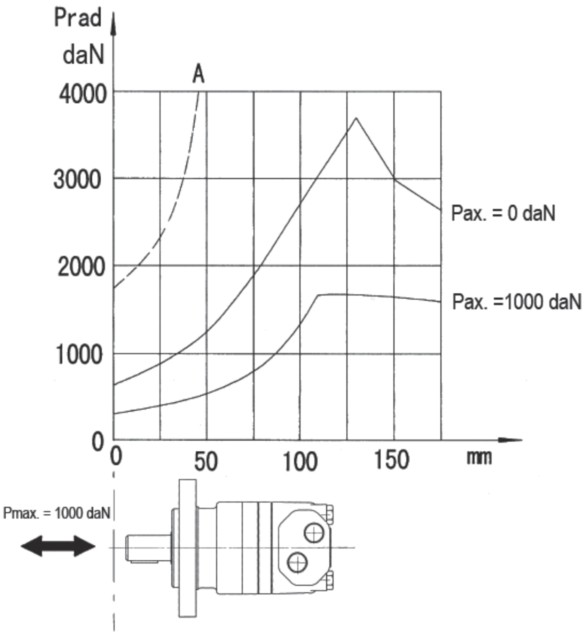
IN APPLICATIONS WITHOUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

DIRECTION OF SHAFT ROTATION



WHEN FACING SHAFT END OF MOTOR,SHAFT TO ROTATE: CLOCKWISE WHEN PORT "A" IS PRESSURIZED.COUNTER CLOCK-WISE WHEN PORT "B" IS PRESSURIZED.

AXIAL AND RADIAL FORCE



The output shaft is mounted on tapered rollor bearings that permit high radial and axial loads.Curve "A" shows MAX radial shaft loads,Any shaft load exceeding the values quoted in the curve could determine premature failure of the shaft,bearings or other parts.The other curves show a B10 life of 3000 Hours and 200 RPM.

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMTE							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
230	**CC**	4-Ø14.3 Square-flange Ø161.9 pilot Ø127X12	**G2**	11/2” KEYED PARALLEL KEY .37X.37X1.65	**SF**	3/4’ MANIFOLD MOUNT, 8-3/8-16UNC 7/16-20UNF	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
250	**KV**	4-Ø14.5 Square flange Ø161.9 Ø127×9	**FE**	11/2”-17 SPLINED 17-DP 12/24	**SF1**	M33 X 2, M14 X 1.5	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
315	**WE**	4-Ø18 Wheel-flange Ø 147, pilot Ø 127×9	**Y1**	40MM KEYED PARALLEL KEY 12X8X63	**SF2**	G1,G1/4			**B**	BLACK	**LL**	LOW LEAKAGE
400	**B2E**	4-6.5 Square Flange 101.6 [4.00] Pilot	**Y2**	40MM KEYED PARALLEL KEY 12X8X63	**SE**	1-1/16-12UNF ORING 9/16-18 UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
500			**T2**	15/8” TAPERED PARALLELKEY .44X.44X1.25	**SE1**	1-1/16-12UNF ORING 7/16-20UNF					**CRS**	CORRSION RISISTANT SHAFT
630			**H**	42MM SPLINED 8-42X36X7	**SE2**	G3/4, G1/4					**HPS**	HIGH PRESSURE SEAL
800			**P**	40MM SPLINED 6-40X35X10	**DV**	G1,MANIFOLD MOUNT 4-M12, G1/4					**HTS**	HIGH TEMP SEAL
					MV	M33X2, MANIFOLD MOUNT, 4-M12,M14X1.5						
					SV	1-5/16-12UNF ORING 7/16-20UNF						
					SF3	1-5/16-12UNF 7/16-20UNF						
					SF5	1-5/16-12 O-ring 7/16-20 UNF on rear cover						
					SF6	M33x2, M14x1.5						
					SF7	G1, G 1/4						

Ordering code:

All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

The **YMTS** series motor incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum and a **DISC VALVE** distribution system which is internally balanced to reduce friction, leakage and permit better speed control producing higher efficiency, smoother rotation,higher speed and pressure.

This series has many sizes and options to make it very flexible for many applicaton.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output ower	
DISC Distribution	YMTS	[in^3./rev]	[9.77~48.82]	[PSI]	[3480]	RPM	[HP]	[47]
		cm^3/rev.	160 ~ 800	MPa	24	30~705	Kw	35

QUICK REFERENCE GUIDE

YMTS SERIES QUICK REFERENCE:

DISPLACEMENTS				
[IN^3./REV]	CM^3/REV.			
[9.83]	161.1	FLOW UP TO	125 LPM	[33.03 GPM]
[12.29]	201.4	PRESSURE UP TO	30 MPA	[4350 PSI]
[14.19]	232.5	TORQUE UP TO	1643 NM	[14530 LBIN.]
[15.36]	251.8	SPEED UP TO	770 RPM	
[19.91]	326.3			
[25.07]	410.9			
[31.95]	523.6			
[38.38]	629.1			
[48.92]	801.8			

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APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

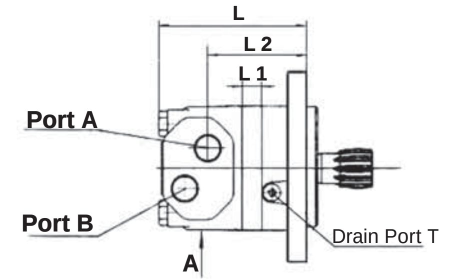
- Oil temperature should be between 20° - 60° C [68° - 180° F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40° C
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

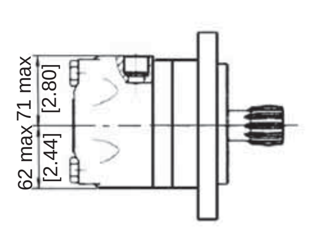
SPECIFICATION DATA

- For individual motor performance charts consult equivalent YMT series data

DISTRIBUTION TYPE			YMTS 160	YMTS 200	YMTS 230	YMTS 250	YMTS 315	YMTS 400	YMTS 500	YMTS 630	YMTS 800
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[9.83]	[12.29]	[14.19]	[15.37]	[19.92]	[25.08]	[31.96]	[38.39]	[48.93]
		cm^3/rev.	**161.1**	**201.4**	**232.5**	**251.8**	**326.3**	**410.9**	**523.6**	**629.1**	**801.8**
MAX. SPEED RPM		RATED	470	475	412	381	294	228	183	150	121
		CONT.	614	615	536	495	380	302	237	196	154
		INT	**770**	**743**	**643**	**592**	**458**	**364**	**284**	**233**	**185**
MAX. TORQUE [IN. LB.] N*M	RATED	[IN.LB]	[3352]	[4166]	[4687]	[5147]	[6704]	[7924]	[9401]	[10,224]	[10,675]
		N*M	**379**	**471**	**530**	**582**	**758**	**896**	**1063**	**1156**	**1207**
	CONT.	[IN. LB.]	[4166]	[5209]	[5925]	[6430]	[8508]	[9684]	[11,011]	[11,656]	[12,948]
		N*M	**471**	**589**	**670**	**727**	**962**	**1095**	**1245**	**1318**	**1464**
	INT.	[IN. LB.]	[507]	[6350]	[7261]	[7853]	[10,206]	[11,223]	[12,461]	[13,248]	[13,443]
		N*M	**57.3**	**718**	**821**	**888**	**1154**	**1269**	**1409**	**1498**	**1520**
	PEAK	[IN.LB]	[5917]	[7411]	[8473]	[9162]	[11,907]	[12,826]	[14,538]	[14,317]	[1725]
		N*M	**669**	**838**	**958**	**1036**	**1346.3**	**1450.3**	**1643.8**	**1618.8**	**1665**
MAX. OUTPUT [HP] KW	RATED	[HP]	[25.0]	[31.4]	[31.1]	[31.1]	[31.2]	[28.7]	[27.3]	[24.4]	[20.5]
		KW	**18.7**	**23.4**	**23.2**	**23.2**	**23.3**	**21.4**	**20.4**	**18.2**	**15.3**
	CONT.	[HP]	[37.1]	[46.8]	[46.5]	[46.2]	[46.8]	[41.8]	[38.6]	[33.9]	[29.8]
		KW	**27.7**	**34.9**	**34.7**	**34.5**	**34.9**	**31.2**	**28.8**	**25.3**	**22.2**
	INT.	[HP]	[42.9]	[53.6]	[53.6]	[53.6]	[53.6]	[46.9]	[46.9]	[36.8]	[35.9]
		KW	**32**	**40**	**40**	**40**	**40**	**35**	**35**	**27.5**	**26.8**
MAX. PRESSURE DROP [PSI] MPA	RATED	[PSI]	[2320]	[2320]	[2320]	[2320]	[2320]	[2175]	[2030]	[1740]	[1523]
		MPA	**16**	**16**	**16**	**16**	**16**	**15**	**14**	**12**	**10.5**
	CONT.	[PSI]	[2900]	[2900]	[2900]	[2900]	[2900]	[2610]	[2320]	[2030]	[1813]
		MPA	**20**	**20**	**20**	**20**	**20**	**18**	**16**	**14**	**12.5**
	INT.	[PSI]	[3480]	[3480]	[3480]	[3480]	[3480]	[3045]	[2610]	[2320]	[1885]
		MPA	**24**	**24**	**24**	**24**	**24**	**21**	**18**	**16**	**13**
	PEAK	[PSI]	[4060]	[4060]	[4060]	[4060]	[4060]	[3480]	[3045]	[2755]	[2320]
		MPA	**28**	**28**	**28**	**28**	**28**	**24**	**21**	**19**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[21.1]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.]
		L/MIN	**80**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	CONT.	[GPM]	[26.4]	[33]	[33]	[33]	[33]	[33]	[33]	[33]	[33]
		L/MIN	**100**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**
	INT.	[GPM]	[33]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]
		L/MIN	**125**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
MAX. INLET PRESSURE [PSI] MPA	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPA	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPA	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	INT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPA	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	PEAK	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPA	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[43]	[44]	[45]	[45]	[46]	[48]	[52]	[53]	[55]
		KG	**19.5**	**20**	**20.4**	**20.5**	**21**	**22**	**23**	**24**	**25**

DIMENSION AND MOUNTING DATA

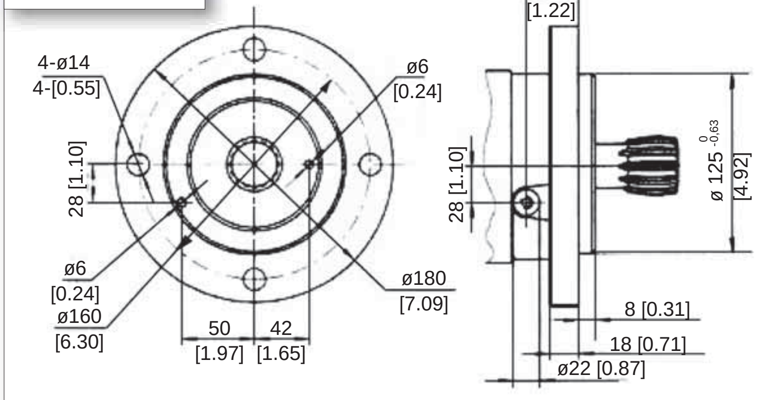




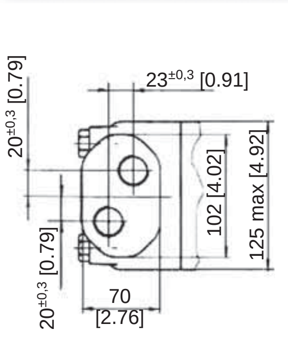
	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMTS 160	[5.83]	[0.67]	[3.80]	148	17	96.5
YMTS 200	[5.98]	[0.83]	[3.96]	152	21	100.5
YMTS 250	[6.22]	[1.06]	[4.23]	158	27	107.5
YMTS 315	[6.42]	[0.79]	[4.53]	163	20	115
YMTS 400	6.69]	[1.06]	[4.80]	170	27	122
YMTS 500	[7.01]	[1.38]	[5.12]	178	35	130
YMTS 630	[7.48]	[1.85]	[5.59]	190	47	142
YMTS 800	[7.91]	[2.28]	[6.02]	201	58	153

Note: 1)The thickness of the stator and rotor for displacements from 160-250 is the dimension of L1 + 3mm
2)The thickness of the stator and rotor for displacements from 315-800 is the dimension of L1 + 7mm.

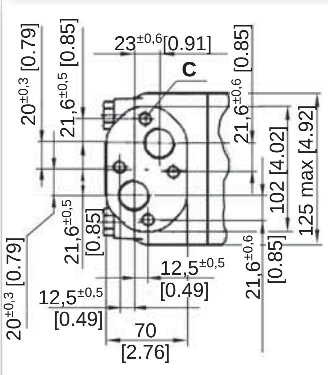
FLANGE D



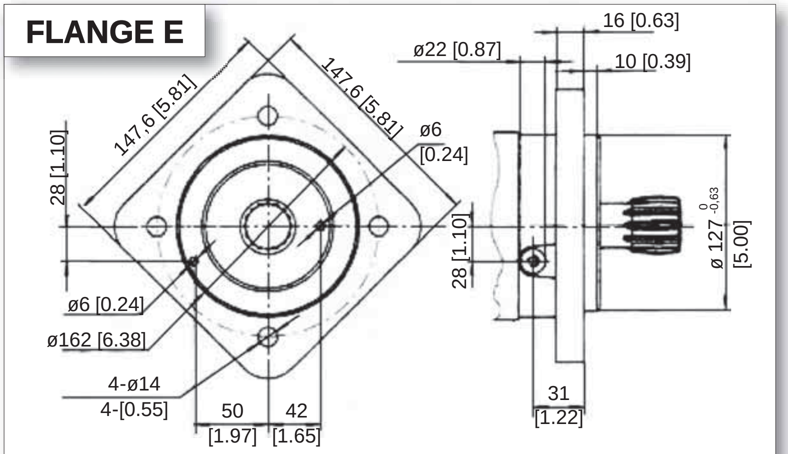
PORTS S1,S,G2,M3



PORTS D,M



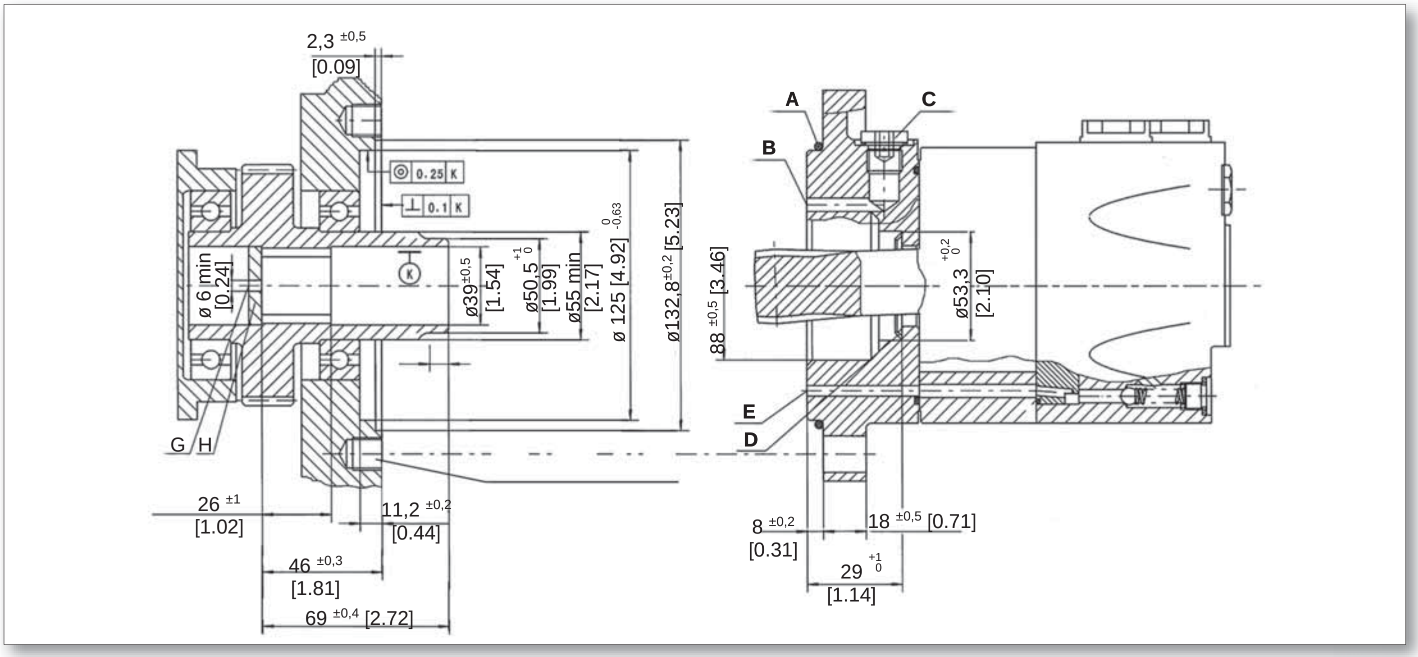
FLANGE E



PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	G	DEPTH	M3	DEPTH	S1	DEPTH
PORTS - A and B	G 3/4	18 mm	M27 X 2	18 mm	1-1/16-12 UN	18 mm	G 3/4	18 mm	M27 X 2	18 mm	1-1/16-12 UN	18 MM
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	9/16-18UNF	12 mm	G 1/4	12 mm	M14X1.5	12 mm	7/16-20UNF	12MM
BOLTS - C	4-M10	10 mm	4-M10	10 mm								

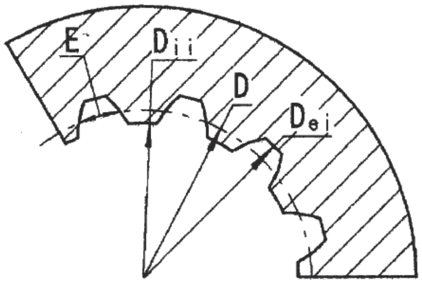
MOUNTING DATA



A: O-ring:125x3
B: External drain channel
C: Drain connection G 1/4;12 mm deep
D: Conical seal ring
E: Internal drain channel
F: M12;min. 18mm deep
G: Oil circulation hole
H: Hardened stop plate

INTERNAL SPLINE DATA FOR THE ATTACHED COMPONENT

FILLET ROOT SIDE FIT		mm
NUMBER OF TEETH	Z	16
DIAMETRAL PITCH	DP	12/24
PRESSURE ANGLE	α_D	30˚
PITCH DIA.	D	Ø33.8656
MAJOR DIA.	D_{EI}	Ø38.4
MINOR DIA.	D_{II}	Ø32.15
SPACE WIDTH CIRCULAR	E	$4.516^{\pm0.037}$



Hardering Specification: HRC 62±2
Effective case depth 0.7±0.2

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMTS							

1	**2**		**3**		**4**		**5**		**6**		**7**	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
160	**D**	4-Ø14Circle-flange Ø160, pilot Ø125×8	**NONE**	Short shaft DP12/24	**D**	G3/4Manifold Mount 4-M10, G1/4	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
200					**M**	M27×2 Manifold Mount 4-M10, M14×1.5			**NONE**	BLUE	**FR**	FREE RUNNING
250					**S**	17/16-12 O-RING, 9/16-18UNF	**R**	REVERSE	**B**	BLACK	**LL**	LOW LEAKAGE
315	**E**	4-Ø14.5Square-flange Ø162, pilot Ø127×10			**S1**	1-1/16-12 O-RING, 7/16-20UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
400					**G**	G3/4 - G1/4						
500					**M3**	M27X2, M14X1.5						
630												
800												

Ordering code:

All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

The **YMTJ** series motor incorporates the advanced **GEROLOR** gear set which reduces internal friction to a minimum. A **DISC VALVE** distribution system which is internally balanced to reduce friction, leakage and permits better speed control producing higher efficiency, smoother rotation,higher speed and pressure.

This series has many sizes and options to make it very flexible for many applications.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMTJ	[in^3./rev]	[14.03 ~48.82]	[PSI]	[3480]	RPM	[HP]	[47]
		cm^3/rev.	230 ~ 800	MPa	24	30~705	Kw	35

QUICK REFERENCE GUIDE

YMTJ SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[14.19]	232.5	FLOW UP TO	125 LPM	[33 GPM]
[15.36]	251.8	PRESSURE UP TO	30 MPA	[4350 PSI]
[19.91]	326.3	TORQUE UP TO	1643 NM	[14530 LBIN.]
[25.07]	410.9	SPEED UP TO	770 RPM	
[31.95]	523.6			
[38.38]	629.1			
[48.84]	801.8			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^{o} - 60^{o} C [68^{o} - 180^{o} F]

* Oil filter of 10 - 20 micron

* Oil viscosity 42 - 74 mm^2 at 40^{o} C

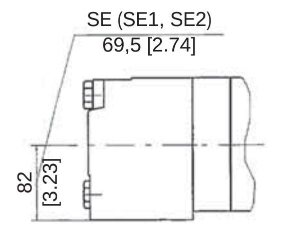
* For longer life we suggest the motor at start, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

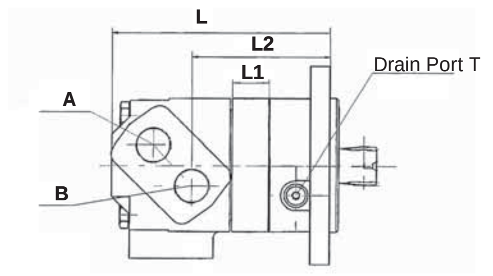
SPECIFICATION DATA

- For individual motor performance charts consult equivalent YMT series data

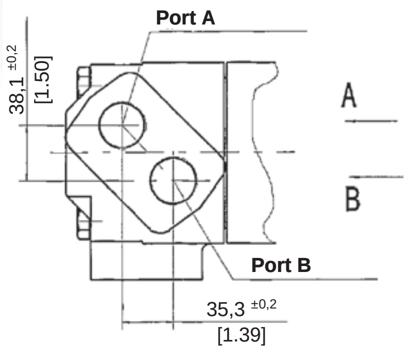
DISTRIBUTION TYPE			YMTJ 160	YMTJ 200	YMTJ 230	YMTJ 250	YMTJ 315	YMTJ 400	YMTJ 500	YMTJ 630	YMTJ 800
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[9.83]	[12.29]	[14.19]	[15.37]	[19.92]	[25.08]	[31.96]	[38.39]	[48.93]
		cm^3/rev.	**161.1**	**201.4**	**232.5**	**251.8**	**326.3**	**410.9**	**523.6**	**629.1**	**801.8**
MAX. SPEED RPM		RATED	470	475	412	381	294	228	183	150	121
		CONT.	614	615	536	495	380	302	237	196	154
		INT	**770**	**743**	**643**	**592**	**458**	**364**	**284**	**233**	**185**
MAX. TORQUE [IN. LB.] N*M	RATED	[IN.LB]	[3352]	[4166]	[4687]	[5147]	[6704]	[7924]	[9401]	[10,224]	[10,675]
		N*M	**379**	**471**	**530**	**582**	**758**	**896**	**1063**	**1156**	**1207**
	CONT.	[IN. LB.]	[4166]	[5209]	[5925]	[6430]	[8508]	[9684]	[11,011]	[11,656]	[12,948]
		N*M	**471**	**589**	**670**	**727**	**962**	**1095**	**1245**	**1318**	**1464**
	INT.	[IN. LB.]	[507]	[6350]	[7261]	[7853]	[10,206]	[11,223]	[12,461]	[13,248]	[13,443]
		N*M	**57.3**	**718**	**821**	**888**	**1154**	**1269**	**1409**	**1498**	**1520**
	PEAK	[IN.LB]	[5917]	[7411]	[8473]	[9162]	[11,907]	[12,826]	[14,538]	[14,317]	[1725]
		N*M	**669**	**838**	**958**	**1036**	**1346.3**	**1450.3**	**1643.8**	**1618.8**	**1665**
MAX. OUTPUT [HP] KW	RATED	[HP]	[25.0]	[31.4]	[31.1]	[31.1]	[31.2]	[28.7]	[27.3]	[24.4]	[20.5]
		KW	**18.7**	**23.4**	**23.2**	**23.2**	**23.3**	**21.4**	**20.4**	**18.2**	**15.3**
	CONT.	[HP]	[37.1]	[46.8]	[46.5]	[46.2]	[46.8]	[41.8]	[38.6]	[33.9]	[29.8]
		KW	**27.7**	**34.9**	**34.7**	**34.5**	**34.9**	**31.2**	**28.8**	**25.3**	**22.2**
	INT.	[HP]	[42.9]	[53.6]	[53.6]	[53.6]	[53.6]	[46.9]	[46.9]	[36.8]	[35.9]
		KW	**32**	**40**	**40**	**40**	**40**	**35**	**35**	**27.5**	**26.8**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2320]	[2320]	[2175]	[2030]	[1740]	[1523]
		MPa	**16**	**16**	**16**	**16**	**16**	**15**	**14**	**12**	**10.5**
	CONT.	[PSI]	[2900]	[2900]	[2900]	[2900]	[2900]	[2610]	[2320]	[2030]	[1813]
		MPa	**20**	**20**	**20**	**20**	**20**	**18**	**16**	**14**	**12.5**
	INT.	[PSI]	[3480]	[3480]	[3480]	[3480]	[3480]	[3045]	[2610]	[2320]	[1885]
		MPa	**24**	**24**	**24**	**24**	**24**	**21**	**18**	**16**	**13**
	PEAK	[PSI]	[4060]	[4060]	[4060]	[4060]	[4060]	[3480]	[3045]	[2755]	[2320]
		MPa	**28**	**28**	**28**	**28**	**28**	**24**	**21**	**19**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[21.1]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.4]	[26.]
		L/MIN	**80**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	CONT.	[GPM]	[26.4]	[33]	[33]	[33]	[33]	[33]	[33]	[33]	[33]
		L/MIN	**100**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**
	INT.	[GPM]	[33]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]
		L/MIN	**125**	**150**	**150**	**150**	**150**	**150**	**150**	**150**	**150**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**	**21**
	INT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**
	PEAK	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[43]	[44]	[45]	[45]	[46]	[48]	[52]	[53]	[55]
		KG	**19.5**	**20**	**20.4**	**20.5**	**21**	**22**	**23**	**24**	**25**

PORTING DATA

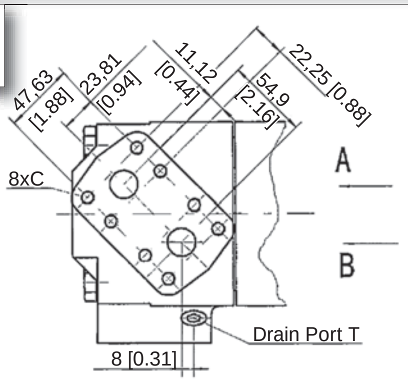




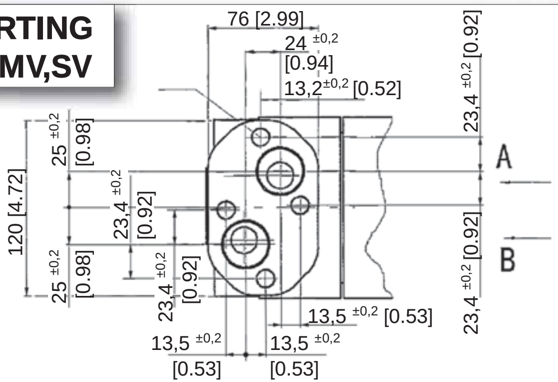
PORTING SF1,SF2,SF3



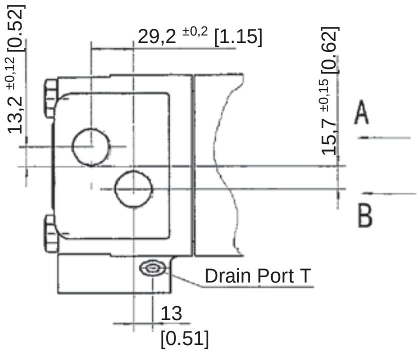
PORTING SF



PORTING DV,MV,SV



PORTING SE,SE1,SE2



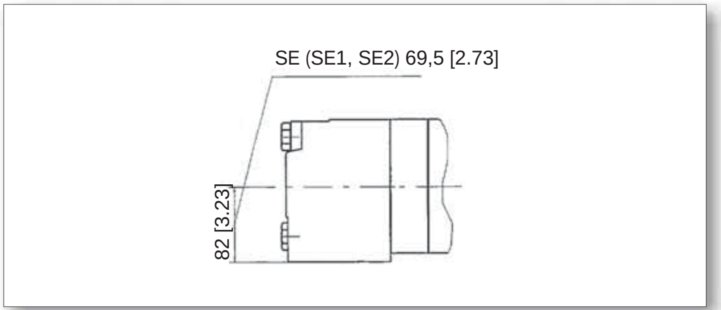
	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMTJ 230	[6.93]	[0.48]	[41.15]	176	12	104.5
YMTJ 250	[7.01]	[0.56]	[4.20]	178	14	106.5
YMTJ 315	[7.25]	[0.79]	[4.43]	184	20	112.5
YMTJ 400	[7.52]	[1.07]	[4.71]	191	27	119.5
YMTJ 500	[7.84]	[1.38]	[5.02]	199	35	127.5
YMTJ 630	[8.31]	[1.85]	[5.50]	211	47	139.5
YMTJ 800	[8.74]	[2.29]	[5.93]	222	58	150.5

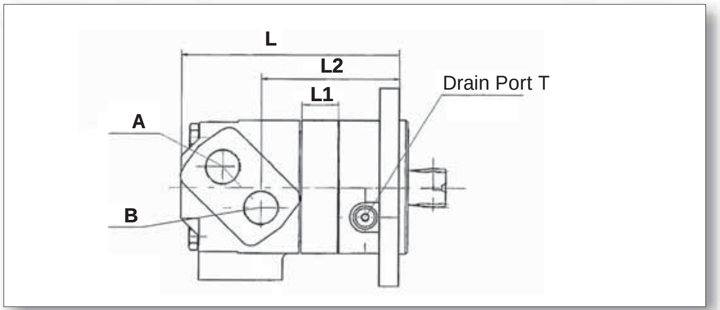
Note:
1) The dimentional data for ports SF,SF1 and SF2 are as the chart indecates
2) The dimensional data for ports DV,MV and SV are as followed: L dimension-16mm and L2 dimension + 6.5mm.
3) The dimensional data for ports SE,SE1,SE2 and WE are as followed: L dimension -70mm and L2 dimension -59 mm
4) The thickness of the stator and rotor for displacements from 315-800 is the dimension of L1 + 7mm.

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	SF1	DEPTH	SF2	DEPTH	SF	DEPTH	DV	DEPTH	MV	DEPTH	SV/SF3	DEPTH	SE	DEPTH	SE1	DEPTH	SE2	DEPTH
PORTS - A and B	M33X2	18 mm	G1	18 mm	3/4”	18 mm	G1	18 mm	M33X2	18 mm	1-5/16-12UN	18 mm	1-16-12UN	18 mm	1-1/16-12UN	18 mm	G3/4	18 mm
TANK PORT - T	M14X1.5	12 mm	G1/4	12 mm	7/16-20UNF	12 mm	G 1/4	12 mm	M14X1.5	12 mm	7/16-20UNF	12 mm	9/16-18UNF	12 mm	7/16-20UNF	12 mm	G1/4	12 mm
BOLTS - C					8X3/8-16UNC	-	4XM12	-	4XM12	-	-	-						

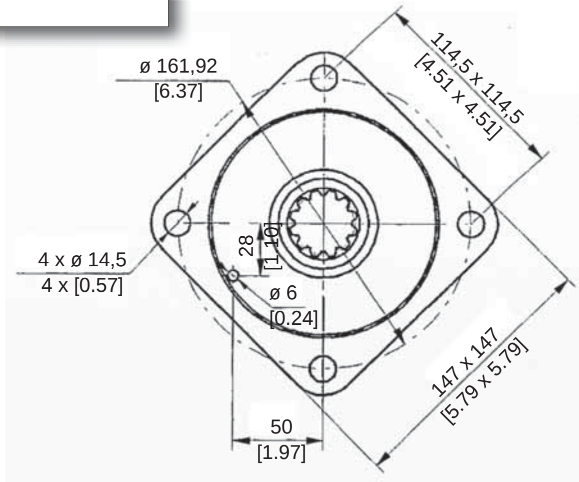
MOUNTING FLANGE DATA

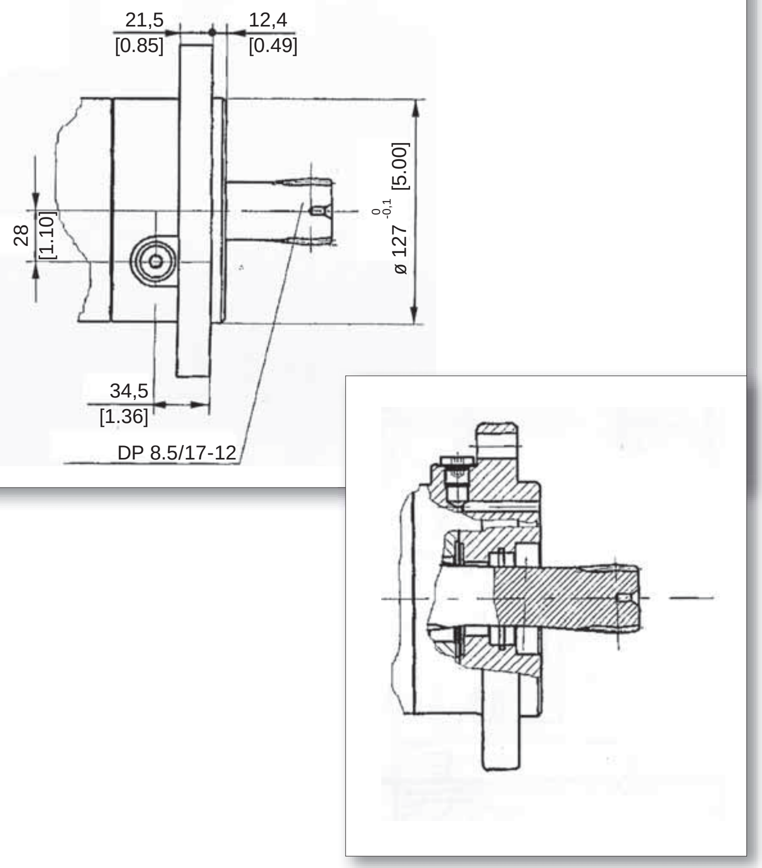




NOTE: THE THICKNESS OF THE STATOR AND ROTOR FOR DISPLACEMENTS 230-800 IS THE DIMENSION OF L1 + 7MM

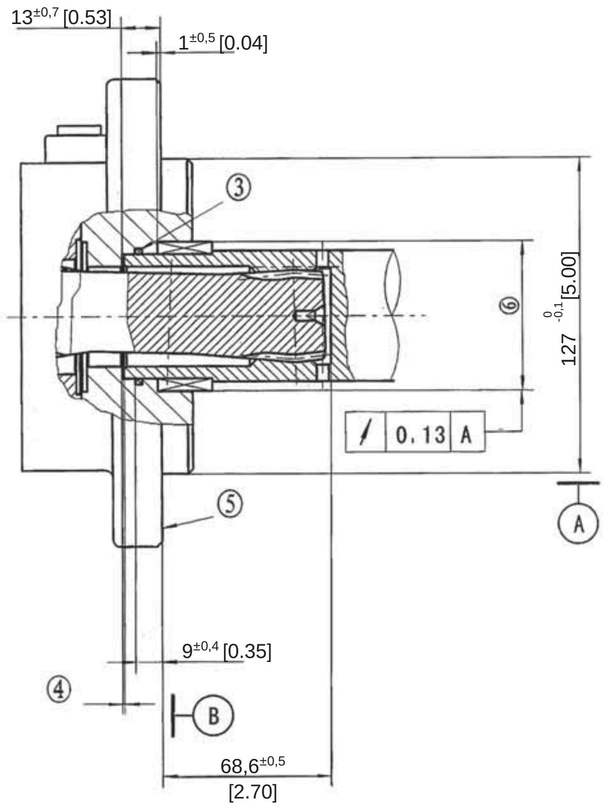
FLANGE J

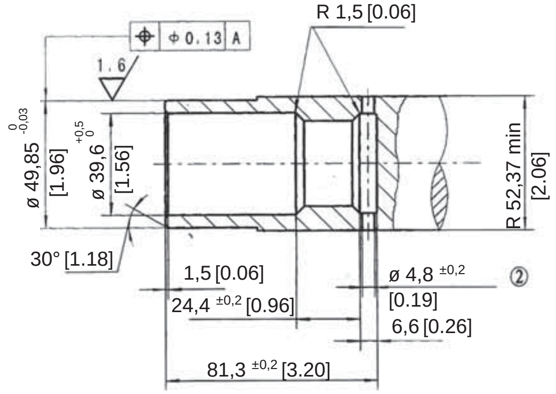


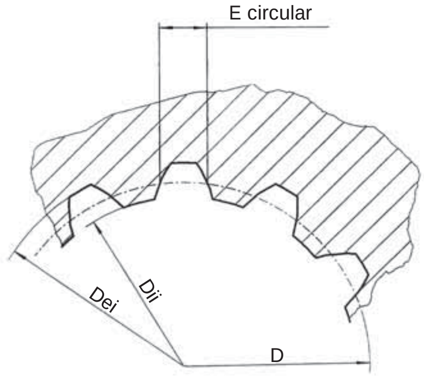


	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMTJ 230	[6.93]	[0.48]	[41.15]	176	12	104.5
YMTJ 250	[7.01]	[0.56]	[4.20]	178	14	106.5
YMTJ 315	[7.25]	[0.79]	[4.43]	184	20	112.5
YMTJ 400	[7.52]	[1.07]	[4.71]	191	27	119.5
YMTJ 500	[7.84]	[1.38]	[5.02]	199	35	127.5
YMTJ 630	[8.31]	[1.85]	[5.50]	211	47	139.5
YMTJ 800	[8.74]	[2.29]	[5.93]	222	58	150.5

MOUNTING DATA







INTERNAL SPLINE DATA FOR THE ATTACHED COMPONENT

FILLET ROOT SIDE FIT		mm
NUMBER OF TEETH	Z	12
DIAMETRAL PITCH	DP	8.5/17
PRESSURE ANGLE	D	30˚
PITCH DIA.	D	ø 35.858823
MAJOR DIA.	DEI	ø $38.97^{+0,20}_{0}$
MINOR DIA.	DII	ø $33.3^{+0,18}_{0}$
SPACE WIDTH CIRCULAR	E	5.866 ±0.032
DIMENSION BETWEEN TWO PINS (Ø4)	ME	26.929-27.084

1. Internal spline in mating part to be as follows: Material to be ASTM A304, 8620H. Carborize to a hardness of 60-64 HRC with case depth (to 50HRC) of 0.75-1 [.030-.040] (dimensions apply after heat treat).
2. Mating part to have critical dimensions as shown. Oil holes must be provided and open for proper oil circulation.
3. Some means of maintaning clearance between shaft and mounting flange must be provided
4. Seal to be furnished with motor for proper oil circulation thru splines
5. Similar to SAE “C” Four Bolt Flange
6. Counterbore designed to adapt to a standard sleeve bearing 50.010-50.038 [1.9689-1.9700] ID by 60.51-60.079 [2.3642-2.3653] O.D. (Oilite Bronze sleeve bearing)

ORDERING INFORMATION

	1	2	3	4	5	6	7	8
YMTJ								

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
230	**J**	Squareflange, 161.9mm pilot127mmx12.4	**NONE**	Short shaft12-DP8.5/17	**SF**	3/4”,Manifold Mount,8-3/8UNC 7/16-20UNF	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
250					**SF1**	M33X2,M14X1.5	**R**	REVERSE	**NONE**	BLUE	**FR**	FREE RUNNING
315					**SF2**	G1,G1/4			**B**	BLACK	**LL**	LOW LEAKAGE
400					**SE**	1-1/16-12 UN O-RING, 9/16-18UNF			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
500					**SE1**	1-1/16-12UNC O-RING 7/16-20 UNF						
630					**SE2**	G3/4,G1/4						
800					**DV**	G1,Manifold Mount, 4-M12 G1/4						
					MV	M33X2, Manifold Mount 4-M12,M14X1.5						
					SV	1-5/16-12UNC O-RING 7/16-20UNF						
					SF3	1-5/16-12 ORING 7/16-20 UNF						

Ordering Code:
All options have been determined with letters, numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table, please contact us with your requirements.

The **YMV** series motors adapts an advanced **GEROLOR** gear set designed with disc distribution flow and high pressure.

This motor series uses the **“ROLOR”** gear type manufactured with most advanced technology and quality available to provide low pressure start up, smooth reliable operation and high efficiency.

The output shaft tapered roller bearings allow for high axial and radial forces.

Advanced design in disc distribution flow,which can automatically compensate in operating with high volume efficiency and long life.

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Disc Distribution	YMV	[in^3./rev]	[19.23~6040]	[PSI]	[4060]	RPM	[HP]	[27]
		cm^3/rev.	315 ~ 990	MPa	28	10 ~ 446	Kw	58

YMV SERIES QUICK REFERENCE:

Displacements				
[in^3./rev]	cm^3/rev.			
[20.32]	333	FLOW UP TO	225 LPM	[59 GPM]
[25.56]	419	PRESSURE UP TO	28 MPa	[4060 PSI]
[31.60]	518	TORQUE UP TO	2470 Nm	[21,84 lb.in.]
[40.63]	666	SPEED UP TO	446 RPM	
[48.87]	801			
[60.40]	990			

Shaft Seals: Standard high pressure shaft seals permit applications in series or without drain line when required

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and life of the motors and other components.

Special Motors: These motors have special options like nickel plated shafts or housings for corrosive environment and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40^o C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YMV 315	YMV 400	YMV 500	YMV 630	YMV 800	YMV 1000
GEOMETRIC DISPLACEMENT		[in./rev.]	[20.32]	[25.57]	[31.61]	[40.63]	[48.88]	[60.40]
		cm^3/rev.	**333**	**419**	**518**	**666**	**801**	**990**
MAX. SPEED RPM		RATED	335	270	215	170	140	105
		CONT.	446	354	386	223	185	145
		INT	**649**	**526**	**425**	**331**	**275**	**220**
MAX. TORQUE [LB. IN.] N*M	RATED	[LB. IN.]	[6456]	[9021]	[10701]	[12576]	[14061]	[17821]
		N*M	**730**	**1020**	**1210**	**1422**	**1590**	**2015**
	CONT.	[LB. IN.]	[8181]	[10790]	[12824]	[14504]	[16008]	[17821]
		N*M	**925**	**1220**	**1450**	**1640**	**1810**	**2015**
	INT.	[LB. IN.]	[9728]	[12727]	[15742]	[17688]	[18661]	[20164]
		N*M	**1100**	**1439**	**1780**	**2000**	**2110**	**2280**
	PEAK	[LB. IN.]	[11931]	[15035]	[18758]	[20677]	[21845]	[21226]
		N*M	**1349**	**1700**	**2121**	**2338**	**2470**	**2400**
MAX. OUTPUT [HP] KW	RATED	[HP]	[34]	[39]	[37]	[34]	[31]	[28]
		KW	**25.6**	**28.8**	**27.2**	**25.3**	**23.3**	**21.2**
	CONT.	[HP]	[58]	[61]	[78]	[52]	[47]	[38]
		KW	**43**	**45.2**	**58.6**	**38.3**	**35.1**	**28.6**
	INT.	[HP]	[70]	[70]	[70]	[62]	[54]	[54]
		KW	**52**	**52**	**52**	**46**	**40**	**40**
MAX. PRESSURE DROP [PSI] MPa	RATED	[PSI]	[2320]	[2320]	[2320]	[2320]	[2030]	[2030]
		MPa	**16**	**16**	**16**	**16**	**14**	**14**
	CONT.	[PSI]	[2900]	[2900]	[2900]	[2610]	[2320]	[2030]
		MPa	**20**	**20**	**20**	**18**	**16**	**14**
	INT.	[PSI]	[3480]	[3480]	[3480]	[3045]	[2610]	[2329]
		MPa	**24**	**24**	**24**	**21**	**18**	**16**
	PEAK	[PSI]	[4060]	[4060]	[4060]	[3480]	[3045]	[2610]
		MPa	**28**	**28**	**28**	**24**	**21**	**18**
MAX. FLOW [GPM] L/min	RATED	[GPM]	[29.0]	[29.0]	[29.0]	[29.0]	[29.0]	[29.0]
		L/MIN	**110**	**110**	**110**	**110**	**110**	**110**
	CONT.	[GPM]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]	[39.6]
		L/MIN	**150**	**150**	**150**	**150**	**150**	**150**
	INT.	[GPM]	[59.4]	[59.4]	[59.4]	[59.4]	[59.4]	[59.4]
		L/MIN	**225**	**225**	**225**	**225**	**225**	**225**
MAX. INLET PRESSURE [PSI] MPa	RATED	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**
	CONT.	[PSI]	[3045]	[3045]	[3045]	[3045]	[3045]	[3045]
		MPa	**21**	**21**	**21**	**21**	**21**	**21**
	INT.	[PSI]	[3625]	[3625]	[3625]	[3625]	[3625]	[3625]
		MPa	**25**	**25**	**25**	**25**	**25**	**25**
	PEAK	[PSI]	[4350]	[4350]	[4350]	[4350]	[4350]	[4350]
		MPa	**30**	**30**	**30**	**30**	**30**	**30**
WEIGHT [LB] KG		[LB]	[70]	[72]	[74]	[77]	[80]	[84.6]
		KG	**31.8**	**32.6**	**33.5**	**34.9**	**36.5**	**38.6**

• Rated speed and rated torque:	Output value of speed and torque under rated flow and rated pressure.
• Continuous pressure:	Max. value of operating motor continuously.
• Intermittent pressure:	Max. value of operating motor in 6 seconds per minute.
• Peak pressure:	Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YMV 315 [20.32 in^3/rev] 333 cm^3/rev.

GPM L/min	[1015] 7	[1450] 10	[2030] 14	[2320] 16	[2610] 18	Max cont. [2900] 20	[3045] 21	Max int. [3480] 24
[7.9] 30	[2697] 305 **89**	[3847] 435 **85**	[5351] 605 **79**	[6350] 718 **71**	[6987] 790 **70**	[7889] 892 **68**	[8331] 942 **62**	[9375] 1060 **55**
[15.9] 60	[2680] 303 **183**	[3936] 445 **179**	[5528] 625 **174**	[6509] 736 **168**	[7323] 828 **163**	[8181] 925 **160**	[8561] 968 **154**	[9702] 1097 **148**
[23.8] 90	[2653] 300 **275**	[3891] 440 **272**	[5528] 625 **266**	[6456] 730 **258**	[7305] 826 **254**	[8154] 922 **248**	[8508] 962 **242**	[9569] 1082 **235**
[27.7] 105	[2609] 295 **325**	[3847] 435 **320**	[5483] 620 **312**	[6421] 726 **306**	[7270] 822 **300**	[8110] 917 **292**	[8473] 958 **290**	[9534] 1078 **285**
[31.7] 120	[2565] 290 **371**	[3812] 431 **366**	[5395] 610 **359**	[6368] 720 **350**	[7252] 820 **345**	[8066] 912 **337**	[8419] 952 **332**	[9463] 1070 **325**
Max cont [39.6] 150	[2459] 278 **464**	[3635] 411 **459**	[5324] 602 **454**	[6332] 716 **445**	[7093] 802 **435**	[7995] 904 **428**	[8331] 942 **422**	[9348] 1057 **412**
Max int. [50.2] 190	[2299] 260 **595**	[3467] 392 **588**	[5200] 588 **582**	[6279] 710 **575**	[7031] 795 **568**	[7889] 892 **562**	[8225] 930 **555**	

Flow (L/min)

[PSI]
MPA

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMV 400 [25.56 in^3/rev] 419 cm^3/rev.

GPM L/min	[1015] 7	[1450] 10	[2030] 14	[2320] 16	[2610] 18	Max cont. [2900] 20	[3045] 21	Max int. [3480] 24
[7.9] 30	[3467] 392 **71**	[5236] 592 **70**	[7181] 812 **68**	[8800] 995 **63**	[9286] 1050 **60**	[10,436] 1180 **56**	[10,569] 1195 **52**	[12,249] 1385 **47**
[15.9] 60	[3555] 402 **146**	[5430] 614 **142**	[7270] 822 **138**	[9021] 1020 **132**	[9463] 1070 **127**	[10,790] 1220 **124**	[10,922] 1235 **120**	[12,603] 1425 **118**
[23.8] 90	[3502] 396 **240**	[5359] 606 **238**	[7208] 815 **232**	[8977] 1015 **228**	[9419] 1065 **222**	[10,701] 1210 **217**	[10,834] 1225 **212**	
[27.7] 105	[3449] 390 **270**	[5306] 600 **266**	[7119] 805 **261**	[8932] 1010 **258**	[9392] 1062 **254**	[10,657] 1205 **250**	[10,790] 1220 **248**	
[31.7] 120	[3396] 384 **294**	[5253] 594 **290**	[7058] 798 **286**	[8888] 1005 **284**	[9330] 1055 **280**	[10,613] 1200 **276**	[10,701] 1210 **272**	
Max cont [39.6] 150	[3317] 375 **370**	[5147] 582 **365**	[7005] 792 **360**	[8862] 1002 **358**	[9198] 1040 **355**			
Max int. [50.2] 190	[3184] 360 **485**	[5076] 574 **480**	[6960] 787 **475**	[8729] 987 **472**	[9065] 1025 **470**			

Flow (L/min)

[PSI]
MPA

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMV 500 [31.60 in^3/rev] 518 cm^3/rev.

GPM L/min	[1015] 7	[1450] 10	[2030] 14	[2320] 16	[2610] 18	Max cont. [2900] 20	[3045] 21	Max int. [3480] 24
[7.9] 30	[3909] 442 **57**	[5970] 675 **55**	[8826] 998 **53**	[10,436] 1180 **52**	[11,143] 1260 **50**	[12,470] 1410 **48**	[13,133] 1485 **44**	[15,557] 1759 **40**
[15.9] 60	[4024] 455 **117**	[6058] 685 **115**	[9065] 1025 **111**	[10,701] 1210 **106**	[11,188] 1265 **101**	[12,780] 1445 **97**	[13,354] 1510 **95**	[15,742] 1780 **90**
[23.8] 90	[3980] 450 **186**	[5996] 678 **184**	[9021] 1020 **183**	[10,657] 1205 **180**	[11,143] 1260 **178**	[12,824] 1450 **173**	[13,443] 1520 **170**	[15,795] 1786 **166**
[27.7] 105	[3936] 445 **205**	[5943] 672 **202**	[8950] 1012 **198**	[10,613] 1200 **194**	[11,099] 1255 **192**	[12,788] 1446 **187**	[13,381] 1513 **186**	
[31.7] 120	[3891] 440 **240**	[5908] 668 **238**	[8888] 1005 **235**	[10,560] 1194 **232**	[11,055] 1250 **230**	[12,373] 1399 **226**	[13,354] 1510 **225**	
Max cont [39.6] 150	[3847] 435 **294**	[5864] 663 **290**	[8844] 1000 **286**	[10,489] 1186 **282**	[11,020] 1246 **278**			
Max int. [50.2] 190	[3785] 428 **373**	[5819] 658 **368**	[8782] 993 **362**					

Flow (L/min)

[PSI]
MPA

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMV 630 [40.63 in^3/rev] 666 cm^3/rev.

GPM L/min	[1015] 7	[1450] 10	[2030] 14	[2320] 16	[2610] 18	Max cont. [2900] 20	[3045] 21	Max int. [3480] 24
[7.9] 30	[5395] 610 **43**	[7783] 880 **41**	[11,320] 1280 **38**	[12,417] 1404 **36**	[14,292] 1616 **34**	[15,742] 1780 **31**	[16,300] 1843 **30**	[17,564] 1986 **29**
[15.9] 60	[5439] 615 **90**	[7853] 888 **87**	[11,816] 1336 **84**	[12,488] 1412 **82**	[14,398] 1628 **81**	[15,919] 1800 **77**		
[23.8] 90	[5377] 608 **140**	[7765] 878 **138**	[11,771] 1331 **136**	[12,576] 1422 **134**	[14,504] 1640 **132**	[16,008] 1810 **128**		
[27.7] 105	[5306] 600 **164**	[7712] 872 **162**	[11,727] 1326 **158**	[12,514] 1415 **155**	[14,433] 1632 **153**	[15,831] 1790 **149**		
[31.7] 120	[5262] 595 **186**	[7650] 865 **183**	[11,586] 1310 **180**	[12,426] 1405 **177**	[14,372] 1625 **174**	[15,742] 1780 **171**		
Max cont [39.6] 150	[5218] 590 **235**	[7562] 855 **232**	[11,515] 1302 **228**	[12,364] 1398 **224**				
Max int. [50.2] 190	[5183] 586 **298**	[7482] 846 **292**						

Flow (L/min)

[PSI]
MPA

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

PERFORMANCE DATA

YMV 800 [48.87 in³/rev] 801 cm³/rev.

Flow (L/min)	GPM L/min	[1015] 7	[1450] 10	[2030] 14	Max cont. [2320] 16
	[7.9] 30	[6987] 790 **35**	[10,056] 1137 **33**	[13,991] 1582 **30**	[15,831] 1790 **28**
	[15.9] 60	[7093] 802 **68**	[10,100] 1142 **66**	[14,062] 1590 **62**	[16,008] 1810 **60**
	[23.8] 90	[7031] 795 **110**	[10,038] 1135 **107**	[13,974] 1580 **102**	[15,919] 1800 **100**
	[27.7] 105	[6960] 787 **129**	[9994] 1130 **125**	[13,938] 1576 **120**	[15,848] 1792 **117**
	[31.7] 120	[6916] 782 **146**	[9941] 1124 **142**	[13,699] 1549 **136**	[15,565] 1760 **132**
Max cont	[39.6] 150	[6863] 776 **184**	[9781] 1106 **180**	[13,522] 1529 **176**	
Max int.	[50.2] 190	[6792] 768 **233**	[9728] 1100 **229**		

[PSI]
MPa

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YMV 1000 [60.40 in³/rev] 990 cm³/rev.

Flow (L/min)	GPM L/min	[1015] 7	[1450] 10	[2030] 14	Max cont. [2320] 16
	[7.9] 30	[8649] 978 **28**	[12410] 1410 **27**	[12511] 1980 **26**	[20075] 2270 **24**
	[15.9] 60	[8773] 992 **58**	[12576] 1422 **56**	[17821] 2015 **55**	[20129] 2280 **51**
	[23.8] 90	[8129] 987 **87**	[12603] 1425 **85**	[17715] 2003 **82**	[20129] 2276 **76**
	[27.7] 105	[8694] 983 **101**	[12541] 1418 **98**	[17635] 1994 **94**	[19837] 2243 **87**
	[31.7] 120	[8623] 975 **113**	[12461] 1409 **109**	[17582] 1988 **105**	[19669] 2224 **100**
Max cont	[39.6] 150	[8499] 961 **140**	[12099] 1368 **136**	[16830] 1903 **123**	
Max int.	[50.2] 190	[8340] 943 **170**	[11833] 1338 **158**		

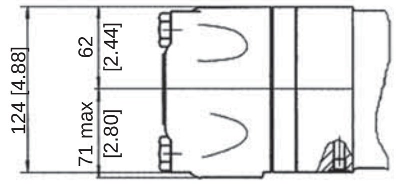
[PSI]
MPa

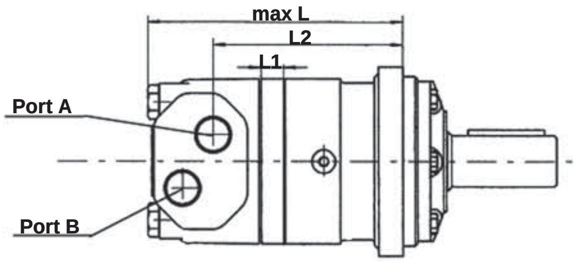
TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

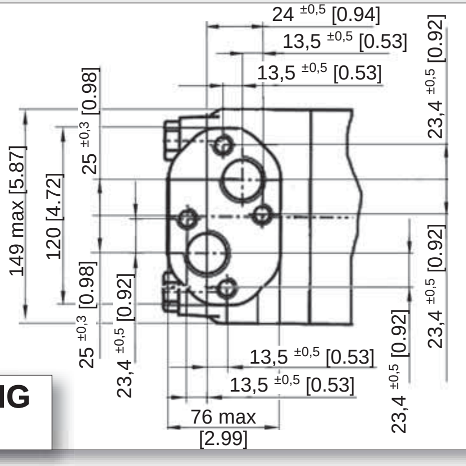
Max cont.

Max int.

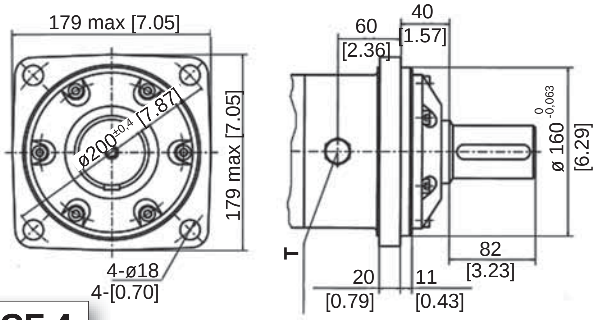
YMV MOUNTING DATA



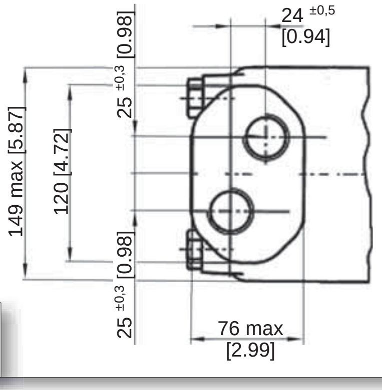




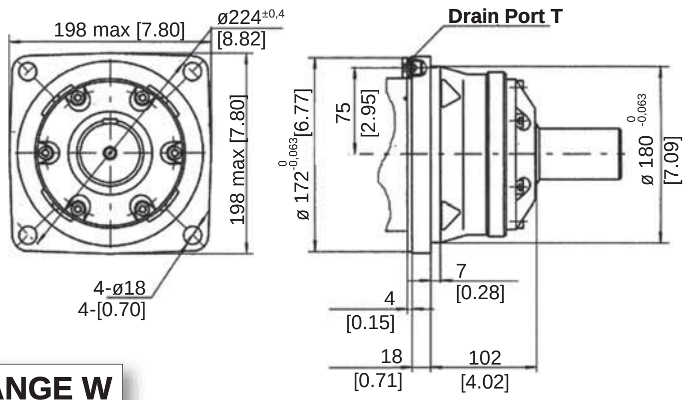
PORTING D, M



FLANGE 4



PORTING S, G, M5



FLANGE W

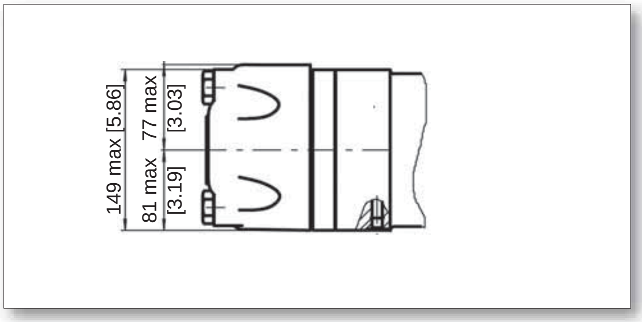
	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMV315	[8.55]	[0.79]	[6.36]	217	20	161.5
YMV400	[8.82]	[1.06]	[6.63]	224	27	168.5
YMV500	[9.13]	[1.38]	[6.95]	232	35	176.5
YMV630	[9.61]	[1.85]	[7.42]	244	47	188.5
YMV800	[10.04]	[2.28]	[7.85]	255	58	199.5

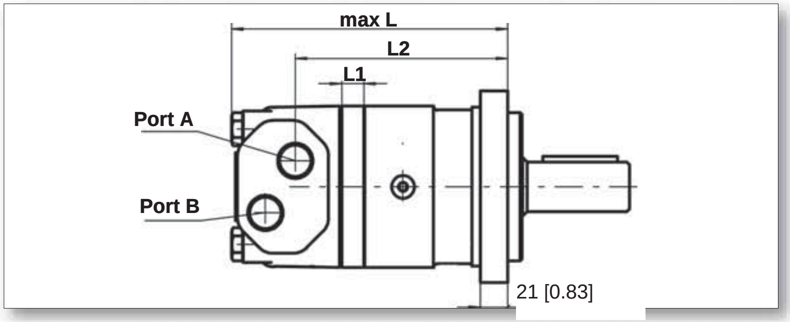
	[INCHES]			MILLIMETERS		
MODEL	**L**	**L1**	**L2**	**L**	**L1**	**L2**
YMVW315	[5.85]	[0.79]	[3.68]	148.5	20	93.5
YMV400	[6.12]	[1.06]	[3.96]	155.5	27	100.5
YMV500	[6.44]	[1.38]	[4.27]	163.5	35	108.5
YMV630	[6.91]	[1.85]	[4.74]	175.5	47	120.5
YMV800	[7.34]	[2.28]	[5.18]	186.5	58	131.5

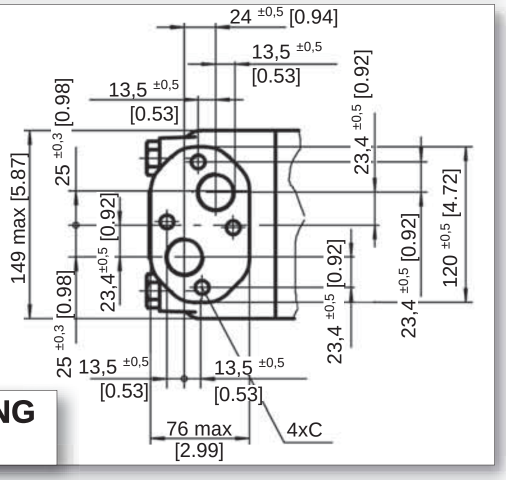
PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	G	DEPTH	M5	DEPTH
PORTS - A and B	G 1	18 mm	M33 X 2	18 mm	1-5/16-12UN	18 mm	G 1	18 mm	M33 X 2	18 mm
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	9/16-18UNF	12 mm	G 1/4	12 mm	M14X1.5	12 mm
BOLTS - C	4-M12	10 mm	4-M12	10 mm	-	-	-	-	-	-

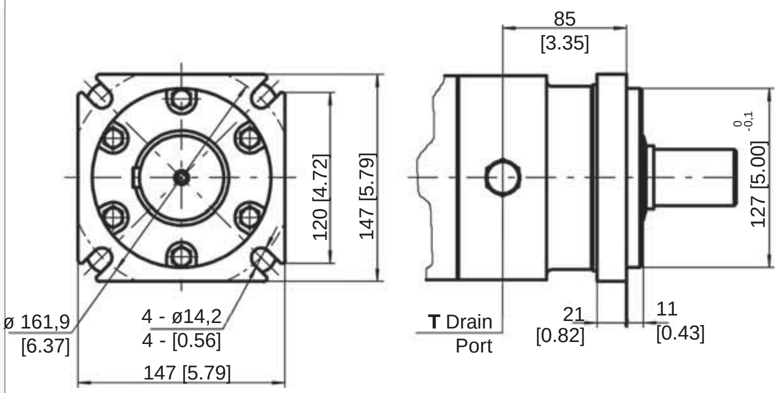
YMVE MOUNTING DATA



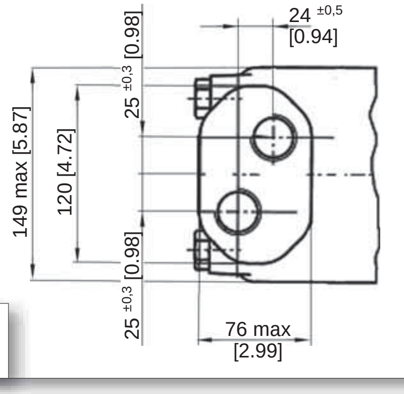




PORTING D, M



FLANGE K6



PORTING S, G, M5

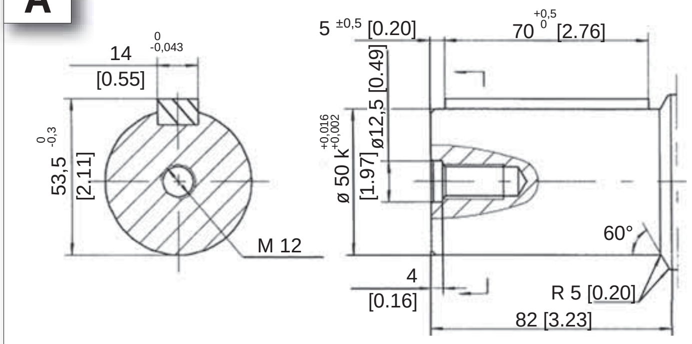
	[INCHES]			MILLIMETERS		
MODEL	L	L1	L2	L	L1	L2
YMVE315	[9.69]	[0.79]	[7.44]	246	20	189
YMVE400	[9.96]	[1.06]	[7.72]	253	27	196
YMVE500	[10.28]	[1.38]	[8.03]	261	35	204
YMVE630	[10.75]	[1.85]	[8.50]	273	47	216
YMVE800	[11.18]	[2.28]	[8.94]	284	58	227

PORT & DRAIN PORT ORDERING CODES

ORDER CODE	D	DEPTH	M	DEPTH	S	DEPTH	G	DEPTH	M5	DEPTH
PORTS - A and B	G 1	18 mm	M33 X 2	18 mm	1-5/16-12UN	18 mm	G 1	18 mm	M33 X 2	18 mm
TANK PORT - T	G 1/4	12 mm	M14 X1.5	12 mm	9/16-18UNF	12 mm	G 1/4	12 mm	M14X1.5	12 mm
BOLTS - C	4-M12	10 mm	4-M12	10 mm	-	-	-	-	-	-

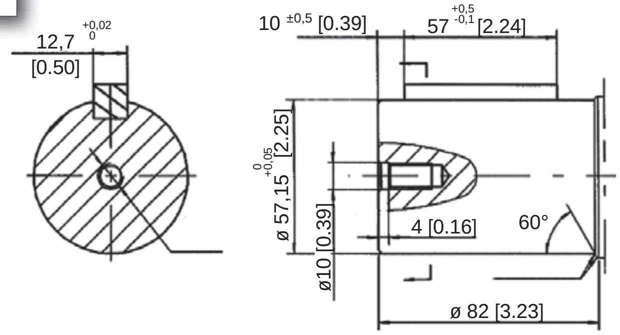
MOTOR SHAFT EXTENSIONS

A



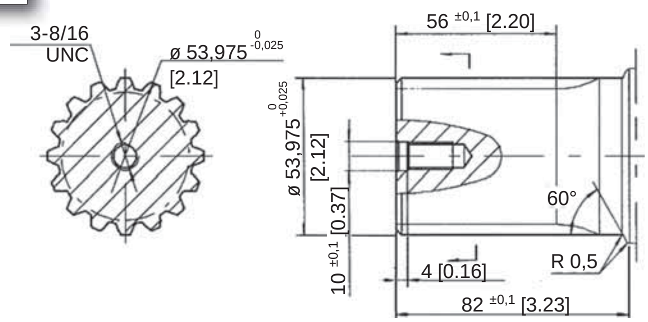
Shaft A: 50mm Keyed
Parallel key 14x9x70

C



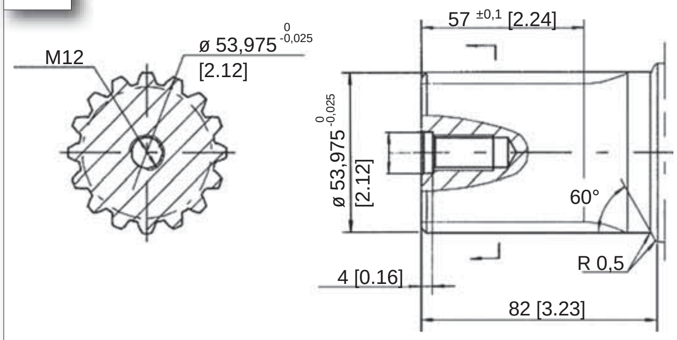
Shaft C: 21/4” Keyed
Parallel key 12.7x12.7x57

B



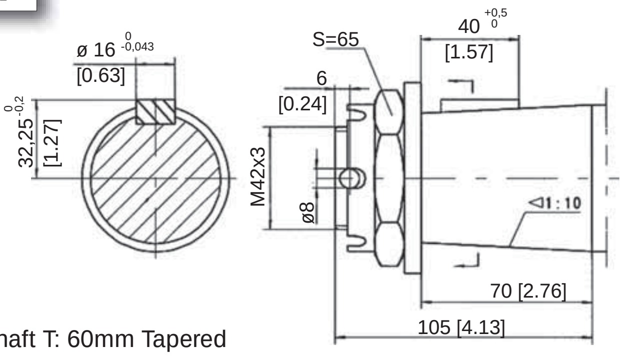
Shaft B: 2 1/8”-16 Splined
16-DP 8/16

BD



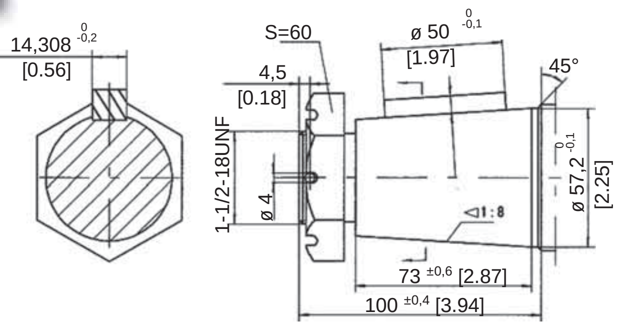
Shaft BD: 2 1/8’-16 Splined
16-DP 8/16

T



Shaft T: 60mm Tapered
Parallel key B16x10x32
Tightening torque: 750±50Nm

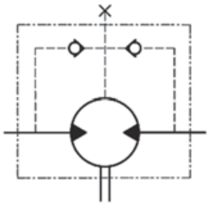
T1

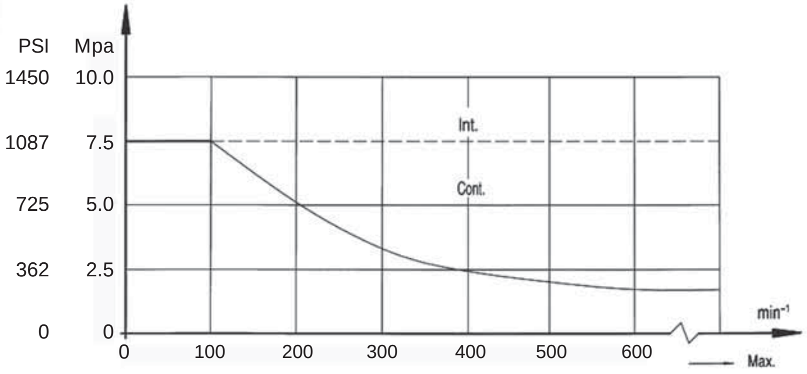


Shaft T1: 21/4” Tapered
Parallel key 14.308x14.308x50
Tightening torque: 750±50Nm

ADDITIONAL DATA

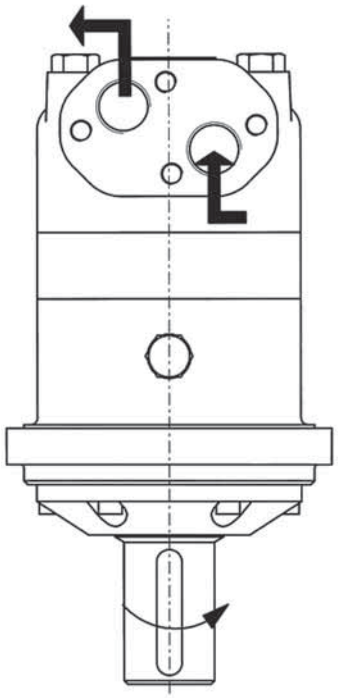
PERMISSIBLE SHAFT SEAL PRESSURE





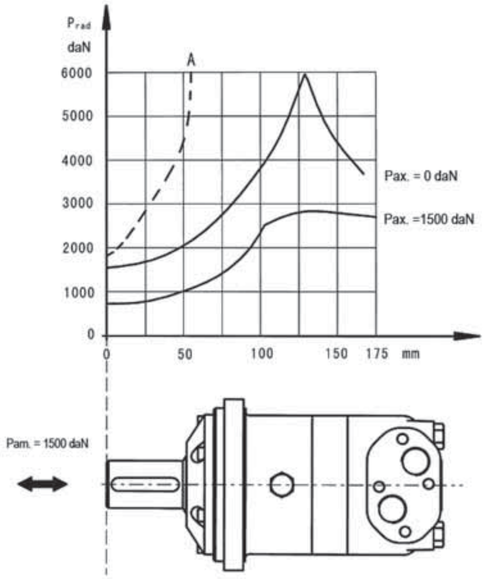
IN APPLICATIONS WITH OUT A DRAIN LINE, THE PRESSURE EXERTED ON THE SHAFT SEAL WILL EXCEED THE PRESSURE IN THE RETURN LINE. IN APPLICATIONS USING A DRAIN LINE, THE PRESSURE ON THE OUTPUT SHAFT SEAL CAN EQUAL THE PRESSURE IN DRAIN LINE.

DIRECTION OF SHAFT ROTATION



YMV

AXIAL AND RADIAL FORCES



The output shaft runs in tapered bearings that permit high axial and radial forces, Curve “A” shows max radial shaft load, Any shaft loads exceeding the values quoted in the curve will involve a risk of breakage, The two other curve sapply to a B10 bearing life of 3000 hours at 200 RPM.

ORDERING INFORMATION

	1	2	3	4	5	6	7
YMV							

1	2		3		4		5		6		7	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**PORT AND DRAIN PORT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
315	**4**	4-Ø14.5 Square-flange, pilot Ø160×11	**A**	Shaft:50mm Keyed , parllel key 14×9×70	**D**	G1 Manifold 4×M12, G1/4	**NONE**	STANDARD	**OO**	NO PAINT	**NONE**	STANDARD
400	**W**	4-Ø18 Wheel-flange Ø224, pilot Ø180×10	**BD**	Shaft: 2 1/8” Splined 16-DP8/16	**M**	M33×2 Manifold 4×M12, M14×1.5	**R**	OPPOSITE	**NONE**	BLUE	**FR**	FREE RUNNING
500	**K6**	4-ø14.2 Square flange Pilot ø 161.9	**B**	Shaft: 2 1/8” Splined 16-DP8/16	**S**	1-5/16-12UN, 9/16-18UNF			**B**	BLACK	**LL**	LOW LEAKAGE
630			**C**	Shaft: 2 1/4” Keyed parllel key 12.7×12.7×57	**G**	G1,G1/4			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
800			**T**	60mm Tapered parllel key B16×10×32	**M5**	M33×2, M14×1.5					**CRS**	CORROSIVE RESISTANT SHAFT
			T1	2 1/4” Tapered parllel key 14.308×14.308×50							**HPS**	HIGH PRESSURE SEAL
											HTS	HIGH TEMP SEAL

Ordering Code:
All options have been determined with letters,numbers or combinations.All boxes must be filled with proper codes.If specification is not in the table,please contact us with your requirements.

YME2

The **YME2** series motors incorporate the advanced **GEROLOR** gear set which reduces internal friction to a minimum and a **“COMMUTATOR VALVE”** distributions system which is internally balanced to reduce friction,leakage and permit better speed control.Producing higher efficiency, smoother rotation, higher speed and pressure.

This series also has many sizes and options to make it very flexible for many applications,The output shaft is supported by needle bearings for high radial and axial load for heavy duty applications,

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output ower	
commutator Distribution	YME2	[in.^{3}/rev]	[4.08-22.57]	[PSI]	[2900]	RPM	[HP]	[23.99]
		cm^3/rev.	66.8-370	MPa	20	842	Kw	17.9

YME2 SERIES QUICK REFERENCE GUIDE

Displacements				
[in.^{3}/rev]	cm^3/rev.			
[4.08]	66.8	FLOW UP TO	75 LPM	[19.82 GPM]
[4.97]	81.3	PRESSURE UP TO	20 MPa	[2900 PSI]
[6.20]	101.6	TORQUE UP TO	613 Nm	[5421 lb.-in.]
[7.75]	127	POWER UP TO	17,9 Kw	[24 HP]
[9.60]	157.2	SPEED UP TO	842 RPM	
[11.82]	193.6			
[13.80]	226			
[15.69]	257			
[17.57]	287.8			
[19.20]	314.5			
[22.58]	370			

Shaft Seals: High pressure shaft seals permit the parallel or series application without the need of a drain line.

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and longer life for the motors and other components.

Special Motors: These motors have a variety of special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

* Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
* Oil filter of 10 - 20 micron
* Oil viscosity 42 - 74 mm^2 at 40^o C
* Different shafts are used when there is a radial load or not. Check data pages
* For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

DISTRIBUTION TYPE			YME2 65	YME2 80	YME2 100	YME2 125	YME2 160	YME2 200	YME2 230	YME2 250	YME2 295	YME2 315	YME2 375
GEOMETRIC DISPLACEMENT		[in³./rev.]	[4.08]	[4.97]	[6.20]	[7.75]	[9.60]	[11.82]	[13.80]	[15.69]	[17.57]	[19.20]	[22.58]
		cm³/rev.	66.8	81.3	101.6	127	157.2	193.6	226	257	287.8	314.5	370
MAX. SPEED RPM		RATED	490	410	330	265	210	175	195	170	155	135	120
		CONT.	667	543	439	350	283	229	247	216	196	178	152
		INT	842	689	553	441	355	289	328	287	254	235	199
MAX. TORQUE [IN. LB.] N*M	RATED	[IN. LB.]	[973]	[1203]	[1459]	[1893]	[2317]	[2759]	[2812]	[2910]	[3078]	[3219]	[3290]
		N*M	**110**	**136**	**165**	**214**	**262**	**312**	**318**	**329**	**348**	**364**	**372**
	CONT.	[IN. LB.]	[1114]	[1389]	[1689]	[2167]	[2715]	[3378]	[3343]	[3370]	[3476]	[3962]	[3883]
		N*M	**126**	**157**	**191**	**245**	**307**	**382**	**378**	**381**	**393**	**448**	**439**
	INT.	[IN. LB.]	[1557]	[1901]	[2370]	[2963]	[3732]	[4599]	[4670]	[4802]	[4838]	[5191]	[5421]
		N*M	**176**	**215**	**268**	**335**	**422**	**520**	**528**	**543**	**547**	**587**	**613**
MAX. OUTPUT [HP] KW	RATED	[HP]	[7.4]	[8.2]	[7.9]	[8.3]	[8.2]	[7.8]	[8.6]	[8.0]	[7.8]	[7.0]	[6.7]
		KW	**5.5**	**6.1**	**5.9**	**6.22**	**6.1**	**5.8**	**6.4**	**6**	**5.8**	**5.2**	**5**
	CONT.	[HP]	[11.1]	[11.8]	[10.6]	[11.9]	[11.9]	[12.0]	[13.3]	[12.5]	[11.7]	[10.7]	[10.2]
		KW	**8.3**	**8.8**	**7.9**	**8.9**	**8.9**	**9**	**9.9**	**9.3**	**8.7**	**8**	**7.6**
	INT.	[HP]	[18.6]	[19.3]	[18.1]	[18.9]	[20.9]	[21.0]	[24.0]	[22.1]	[20.9]	[19.2]	[18.8]
		KW	**13.9**	**14.4**	**13.5**	**14.1**	**15.6**	**15.7**	**17.9**	**16.5**	**15.6**	**14.3**	**14**
MAX. PRESSU-RE DROP [PSI] MPA	RATED	[PSI]	[1813]	[1813]	[1813]	[1813]	[1813]	[1813]	[1595]	[1450]	[1305]	[1305]	[1160]
		MPA	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**11**	**10**	**9**	**9**	**8**
	CONT.	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[2030]	[1740]	[1595]	[1450]	[1450]	[1305]
		MPA	**14**	**14**	**14**	**14**	**14**	**14**	**12**	**11**	**10**	**10**	**9**
	INT.	[PSI]	[2755]	[2755]	[2755]	[2755]	[2755]	[2755]	[2393]	[2248]	[2103]	[1958]	[1813]
		MPA	**19**	**19**	**19**	**19**	**19**	**19**	**16.5**	**15.5**	**14.5**	**13.5**	**12.5**
	PEAK	[PSI]	[2900]	[2900]	[2900]	[2900]	[2900]	[2900]	[2610]	[2610]	[2465]	[2320]	[2320]
		MPA	**20**	**20**	**20**	**20**	**20**	**20**	**18**	**18**	**17**	**16**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[8.9]	[8.9]	[8.9]	[8.9]	[8.9]	[8.9]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]
		L/MIN	**34**	**34**	**34**	**34**	**34**	**34**	**45**	**45**	**45**	**45**	**45**
	CONT.	[GPM]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]	[15.0]	[15.0]	[15.0]	[15.0]	[15.0]
		L/MIN	**45**	**45**	**45**	**45**	**45**	**45**	**57**	**57**	**57**	**57**	**57**
	INT.	[GPM]	[15.1]	[15.1]	[15.1]	[15.1]	[15.1]	[15.1]	[19.82]	[19.82]	[19.82]	[19.82]	[19.82]
		L/MIN	**57**	**57**	**57**	**57**	**57**	**57**	**75**	**75**	**75**	**75**	**75**

- Rated speed and rated torque: Output value of speed and torque under rated flow and rated pressure.
- Continuous pressure: Max. value of operating motor continuously.
- Intermittent pressure: Max. value of operating motor in 6 seconds per minute.
- Peak pressure: Max. value of operating motor in 0.6 second per minute.

PERFORMANCE DATA

YME2 65

[4.08 in^3/rev] 66.8 cm^3/rev.

Flow (L/min)		[507] 3.5	[1015] 7	Max cont. [1522] 10.5	[2030] 14	Max int. [2755] 19	[PSI] MPa
GPM L/ min	[0.5] 2	[230] 26 **22**	[477] 54 **16**	[734] 83 **4**			
	[1.3] 5	[239] 27 **69**	[495] 56 **62**	[769] 87 **53**	[1.043] 118 **42**		
	[2.6] 10	[256] 29 **145**	[531] 60 **141**	[805] 91 **132**	[1.088] 123 **122**	[1.512] 171 **95**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[265] 30 **221**	[548] 62 **216**	[831] 94 **207**	[1.114] 126 **196**	[1.556] 176 **149**	
	[5.3] 20	[248] 28 **295**	[513] 58 **290**	[805] 91 **279**	[1.079] 122 **261**	[1.538] 174 **232**	
	[6.6] 25	[212] 24 **368**	[486] 55 **365**	[796] 90 **352**	[1.070] 121 **341**	[1.521] 172 **312**	
	[9.0] 34	[194] 22 **501**	[477] 54 **493**	[787] 89 **478**	[1.052] 119 **457**	[1.512] 171 **423**	
Max cont	[11.9] 45	[177] 20 **667**	[460] 52 **660**	[752] 85 **642**	[1.017] 115 **621**	[1.486] 168 **587**	Max cont.
Max int.	[15.1] 57	[133] 15 **842**	[407] 46 **835**	[707] 80 **814**	[990] 112 **789**	[1.441] 163 **735**	Max int.

YME2 100

[6.20 in^3/rev] 101.6 cm^3/rev.

Flow (L/min)		[507] 3.5	[1015] 7	Max cont. [1522] 10.5	[2030] 14	Max int. [2755] 19	[PSI] MPa
GPM L/ min	[0.5] 2	[354] 40 **15**	[725] 82 **11**	[1.114] 126 **4**			
	[1.3] 5	[363] 41 **44**	[734] 83 **36**	[1.327] 150 **28**	[1.822] 206 **12**		
	[2.6] 10	[371] 42 **97**	[805] 91 **95**	[1.220] 138 **94**	[1.565] 177 **81**	[2.034] 230 **54**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[371] 42 **147**	[805] 91 **144**	[1.220] 138 **137**	[1.636] 185 **124**	[2.273] 257 **93**	
	[5.3] 20	[336] 38 **195**	[778] 88 **192**	[1203] 136 **182**	[1.592] 180 **169**	[2.158] 244 **138**	
	[6.6] 25	[345] 39 **244**	[787] 89 **241**	[1.256] 142 **230**	[1.689] 191 **221**	[2.370] 268 **194**	
	[9.0] 34	[274] 31 **331**	[699] 79 **328**	[1.158] 131 **323**	[1.583] 179 **308**	[2.211] 250 **273**	
Max cont	[11.9] 45	[186] 21 **439**	[619] 70 **436**	[1.052] 119 **433**	[1.486] 168 **419**	[2.131] 241 **383**	Max cont.
Max int.	[15.1] 57	[88] 10 **553**	[531] 60 **545**	[964] 109 **534**	[1.397] 158 **527**	[2.052] 232 **491**	Max int.

YME2 80

[4.96 in^3/rev] 81.3 cm^3/rev.

Flow (L/min)		[507] 3.5	[1015] 7	Max cont. [1522] 10.5	[2030] 14	Max int. [2755] 19	[PSI] MPa
GPM L/ min	[0.5] 2	[292] 33 **18**	[619] 70 **14**	[937] 106 **4**			
	[1.3] 5	[309] 35 **55**	[637] 72 **51**	[982] 111 **44**	[1.327] 150 **25**		
	[2.6] 10	[318] 36 **121**	[663] 75 **118**	[1.008] 114 **113**	[1.371] 155 **107**	[1.901] 215 **88**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[327] 37 **181**	[681] 77 **178**	[1.026] 116 **171**	[1.388] 157 **162**	[1901] 215 **148**	
	[5.3] 20	[309] 35 **242**	[654] 74 **238**	[990] 112 **231**	[1.335] 151 **223**	[1.822] 206 **205**	
	[6.6] 25	[309] 35 **303**	[628] 71 **298**	[955] 108 **289**	[1.309] 148 **275**	[1,786] 202 **261**	
	[9.0] 34	[274] 31 **411**	[610] 69 **407**	[929] 105 **396**	[1.282] 145 **382**	[1.751] 198 **373**	
Max cont	[11.9] 45	[203] 23 **543**	[548] 62 **537**	[884] 100 **521**	[1.229] 139 **513**	[106] 12 **501**	Max cont.
Max int.	[15.1] 57	[159] 18 **689**	[486] 55 **681**	[867] 98 **665**	[1.185] 134 **649**	[1.645] 186 **618**	Max int.

YME2 125

[7.75 in^3/rev] 127 cm^3/rev.

Flow (L/min)		[507] 3.5	[1015] 7	Max cont. [1522] 10.5	[2030] 14	Max int. [2755] 19	[PSI] MPa
GPM L/ min	[0.5] 2	[460] 52 **12**	[1.327] 150 **9**	[1.397] 158 **3**			
	[1.3] 5	[486] 55 **35**	[990] 112 **31**	[1.503] 170 **22**	[1.954] 221 **15**	[2.565] 290 **10**	
	[2.6] 10	[504] 57 **78**	[1.035] 117 **75**	[1.592] 180 **69**	[2.140] 242 **63**	[2.962] 335 **46**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[495] 56 **116**	[1.044] 118 **113**	[1.592] 180 **109**	[2.167] 245 **99**	[2.927] 331 **76**	
	[5.3] 20	[486] 55 **155**	[1.035] 117 **153**	[1.574] 178 **147**	[2.140] 242 **136**	[2.927] 331 **110**	
	[6.6] 25	[460] 52 **593**	[982] 111 **188**	[1.565] 177 **182**	[2.105] 238 **172**	[2.874] 325 **151**	
	[9.0] 34	[380] 43 **264**	[929] 105 **262**	[1.495] 169 **254**	[2.043] 231 **244**	[2.883] 326 **220**	
Max cont	[11.9] 45	[336] 38 **350**	[840] 95 **348**	[1.406] 159 **346**	[1.937] 219 **331**	[2.777] 314 **301**	Max cont.
Max int.	[15.1] 57	[186] 21 **441**	[1.556] 176 **439**	[1.247] 141 **431**	[2.476] 280 **417**	[2.671] 302 **384**	Max int.

PERFORMANCE DATA

YME2 160

[9.59 in³/rev] 157.2 cm³/rev.

				Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2755] 19	[PSI] MPA
GPM L/ min	[0.5] 2	[566] 64 **10**	[1.167] 132 **8**	[1.760] 199 **2**			
	[1.3] 5	[601] 68 **28**	[1.220] 138 **26**	[1.839] 208 **19**	[2.485] 281 **10**		
	[2.6] 10	[628] 71 **62**	[1.300] 147 **60**	[1.954] 221 **56**	[2.680] 303 **53**	[3.706] 419 **38**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[637] 72 **93**	[1.309] 148 **91**	[1.990] 225 **87**	[2.715] 307 **79**	[3.767] 426 **61**	
Flow (L/min)	[5.3] 20	[628] 71 **126**	[1.309] 148 **123**	[1.972] 223 **118**	[2.697] 305 **110**	[3.732] 422 **95**	
	[6.6] 25	[548] 62 **157**	[1.238] 140 **155**	[1.928] 218 **152**	[2.618] 296 **141**	[3.670] 415 **129**	
	[9.0] 34	[495] 56 **214**	[1.185] 134 **211**	[1.866] 211 **206**	[2.538] 287 **197**	[3.608] 408 **181**	
Max cont	[11.9] 45	[416] 47 **283**	[1.123] 127 **281**	[1.813] 205 **275**	[2.485] 281 **266**	[3.458] 391 **241**	Max cont.
Max int.	[15.1] 57	[318] 36 **355**	[858] 97 **352**	[1.610] 182 **346**	[2.299] 260 **336**	[3.272] 370 **311**	Max int.

YME2 200

[11.81 in³/rev] 193.6 cm³/rev.

				Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[2030] 14	[2755] 19	[PSI] MPA
GPM L/ min	[0.5] 2	[707] 80 **9**	[1.441] 163 **7**	[2.167] 245 **3**			
	[1.3] 5	[778] 88 **23**	[1.574] 178 **21**	[2.352] 266 **18**	[3.113] 352 **12**		
	[2.6] 10	[787] 89 **49**	[1.601] 181 **48**	[2.432] 275 **43**	[3.343] 378 **39**	[4.572] 517 **27**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[805] 91 **76**	[1.663] 188 **73**	[2.476] 280 **68**	[3.378] 382 **63**	[4.599] 520 **44**	
Flow (L/min)	[5.3] 20	[787] 89 **101**	[1.610] 182 **98**	[2.432] 275 **95**	[3.308] 374 **86**	[4.572] 517 **69**	
	[6.6] 25	[690] 78 **127**	[1.503] 170 **125**	[2.397] 271 **121**	[3.325] 376 **113**	[4.581] 518 **101**	
	[9.0] 34	[566] 64 **173**	[1.397] 158 **171**	[2.370] 268 **165**	[3.210] 363 **156**	[4.440] 502 **143**	
Max cont	[11.9] 45	[451] 51 **229**	[1.388] 157 **227**	[2.229] 252 **221**	[3.104] 351 **212**	[4.369] 494 **196**	Max cont.
Max int.	[15.1] 57	[318] 36 **289**	[1.220] 138 **286**	[2.043] 231 **279**	[2.918] 330 **271**	[4.148] 469 **256**	Max int.

YME2 230

[13.79 in³/rev] 226 cm³/rev.

				Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[1740] 12	[2392] 16.5	[PSI] MPA
GPM L/ min	[0.5] 2	[858] 97 **7**	[1.689] 191 **4**	[2.476] 280 **2**			
	[1.3] 5	[893] 101 **18**	[1.760] 199 **14**	[2.662] 301 **8**	[3.078] 348 **4**		
	[2.6] 10	[911] 103 **43**	[1.893] 214 **42**	[2.874] 325 **40**	[3.343] 378 **36**	[4.661] 527 **29**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[920] 104 **65**	[1.901] 215 **63**	[2.892] 327 **59**	[3.316] 375 **52**	[4.670] 528 **47**	
Flow (L/min)	[5.3] 20	[893] 101 **86**	[1.857] 210 **84**	[2.839] 321 **81**	[3.281] 371 **75**	[4.634] 524 **66**	
	[6.6] 25	[840] 95 **108**	[1.778] 201 **106**	[2.795] 316 **102**	[3.219] 364 **94**	[4.519] 511 **87**	
	[9.0] 34	[725] 82 **147**	[1.663] 188 **145**	[2.724] 308 **141**	[3.166] 358 **135**	[4.431] 501 **128**	
	[11.9] 45	[486] 55 **197**	[1.397] 158 **195**	[2.441] 276 **191**	[2.910] 329 **186**	[4.289] 485 **176**	
Max cont	[15.1] 57	[168] 19 **247**	[1.150] 130 **244**	[2.264] 256 **240**	[2.662] 301 **230**	[3.989] 451 **221**	Max cont.
Max int.	[19.8] 75		[575] 65 **328**	[1.618] 183 **323**	[2.211] 250 **311**	[3.546] 401 **303**	Max int.

YME2 250

[15.68 in³/rev] 257 cm³/rev.

				Max cont.		Max int.	
		[507] 3.5	[1015] 7	[1522] 10.5	[1595] 11	[2247] 15.5	[PSI] MPA
GPM L/ min	[0.5] 2	[990] 112 **6**	[1.831] 207 **3**	[2.733] 309 **1**			
	[1.3] 5	[1.017] 115 **18**	[1.928] 218 **14**	[2.830] 320 **8**	[3.078] 348 **4**		
	[2.6] 10	[999] 113 **39**	[2.078] 235 **38**	[3.166] 358 **35**	[3.352] 379 **31**	[4.802] 543 **23**	TORQUE [LB-IN] TORQUE (N•M) SPEED (RPM)
	[4.0] 15	[999] 113 **58**	[2.069] 234 **56**	[3.157] 357 **53**	[3.369] 381 **45**	[4.793] 542 **3**	
Flow (L/min)	[5.3] 20	[982] 111 **77**	[2.061] 233 **75**	[3.148] 356 **72**	[3.325] 376 **65**	[4.785] 541 **48**	
	[6.6] 25	[964] 109 **97**	[2.016] 228 **95**	[3.131] 354 **89**	[3.281] 371 **81**	[4.705] 532 **69**	
	[9.0] 34	[805] 91 **131**	[1.884] 213 **128**	[3.060] 346 **123**	[3.219] 364 **116**	[4.608] 521 **103**	
	[11.9] 45	[787] 89 **174**	[1.866] 211 **172**	[3.051] 345 **165**	[3.193] 361 **157**	[4.581] 518 **135**	
Max cont	[15.1] 57	[646] 73 **216**	[1.839] 208 **213**	[2.998] 339 **205**	[3.025] 342 **197**	[4.307] 487 **184**	Max cont.
Max int.	[19.8] 75		[654] 74 **287**	[1.751] 198 **284**	[2.662] 301 **278**	[3.900] 441 **267**	Max int.

PERFORMANCE DATA

YME2 295
[17.56 in^3/rev] 287.8 cm^3/rev.

Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	Max cont. [1595] 11	Max int. [2102] 14.5
	[1.3] 5	**[1.070]** 121 15	**[2.149]** 243 14	**[3.254]** 368 10	**[4.502]** 509 5
	[2.6] 10	**[1.105]** 125 33	**[2.237]** 253 31	**[3.369]** 381 27	**[4.678]** 529 20
	[4.0] 15	**[1.141]** 129 51	**[2.308]** 261 50	**[3.476]** 393 47	**[4.838]** 547 41
	[5.3] 20	**[1.123]** 127 68	**[2.291]** 259 67	**[3.449]** 390 63	**[4.820]** 545 55
	[6.6] 25	**[1.114]** 126 86	**[2.255]** 255 84	**[3.414]** 386 80	**[4.767]** 539 69
	[9.0] 34	**[1.088]** 123 116	**[2.193]** 248 114	**[3.361]** 380 110	**[4.696]** 531 98
	[11.9] 45	**[1.017]** 115 154	**[2.069]** 234 153	**[3.255]** 368 148	**[4.616]** 522 136
Max cont	[15.1] 57	**[955]** 108 196	**[2.007]** 227 194	**[3.175]** 359 187	**[4.546]** 514 176
Max int.	[19.8] 75		**[1.866]** 211 254	**[3.086]** 349 246	**[4.475]** 506 231

[PSI]
MPa

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YME2 315
[19.19 in^3/rev] 314.5 cm^3/rev.

Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	Max cont. [1595] 11	Max int. [1957] 13.5
	[1.3] 5	[1.203] 136 **11**	[2.485] 281 **8**	[3.776] 427 **3**	
	[2.6] 10	[1.230] 139 **30**	[2.583] 287 **29**	[3.874] 438 **26**	[5.076] 574 **20**
	[4.0] 15	[1.247] 141 **47**	[2.609] 295 **46**	[3.962] 448 **43**	[5.191] 587 **40**
	[5.3] 20	[1.220] 138 **62**	[2.538] 287 **61**	[3.909] 442 **58**	[5.191] 587 **53**
	[6.6] 25	[1.158] 131 **78**	[2.476] 280 **75**	[3.812] 431 **71**	[5.014] 567 **66**
	[9.0] 34	[1.035] 117 **106**	[2.379] 269 **104**	[3.741] 423 **98**	[4.926] 557 **91**
	[11.9] 45	[1.088] 114 **141**	[2.237] 253 **138**	[3.511] 397 **132**	[4.731] 535 **125**
Max cont	[15.1] 57	[760] 86 **178**	[1.937] 219 **173**	[3.387] 383 **168**	[4.466] 505 **162**
Max int.	[19.8] 75		[955] 108 235	[2.538] 287 231	[3.679] 416 219

[PSI]
MPa

TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

YME2 375
[22.57 in^3/rev] 370 cm^3/rev.

Flow (L/min)	GPM L/min	[507] 3.5	[1015] 7	Max cont. [1305] 9	Max int. [1812] 12.5
	[1.3] 5	**[1.335]** 151 10	**[2.786]** 315 7	**[3.644]** 412 3	
	[2.6] 10	**[1.371]** 155 25	**[2.865]** 324 24	**[3.776]** 427 21	**[5.359]** 606 18
	[4.0] 15	**[1.433]** 162 40	**[2.927]** 331 39	**[3.882]** 439 37	**[5.421]** 613 32
	[5.3] 20	**[1.397]** 158 53	**[2.883]** 326 52	**[3.838]** 434 49	**[5.324]** 602 45
	[6.6] 25	**[1.335]** 151 67	**[2.795]** 316 65	**[3.750]** 424 62	**[5.209]** 589 58
	[9.0] 34	**[1.247]** 141 91	**[2.733]** 309 89	**[3.688]** 417 85	**[5.129]** 580 80
	[11.9] 45	**[1.220]** 138 121	**[2.653]** 300 119	**[3.608]** 408 115	**[5.059]** 572 107
Max cont	[15.1] 57	**[1.044]** 118 152	**[2.485]** 281 150	**[3.476]** 393 144	**[4.864]** 550 136
Max int.	[19.8] 75		**[2.282]** 258 199	**[3.263]** 369 191	**[4.581]** 518 183

[PSI]
MPa

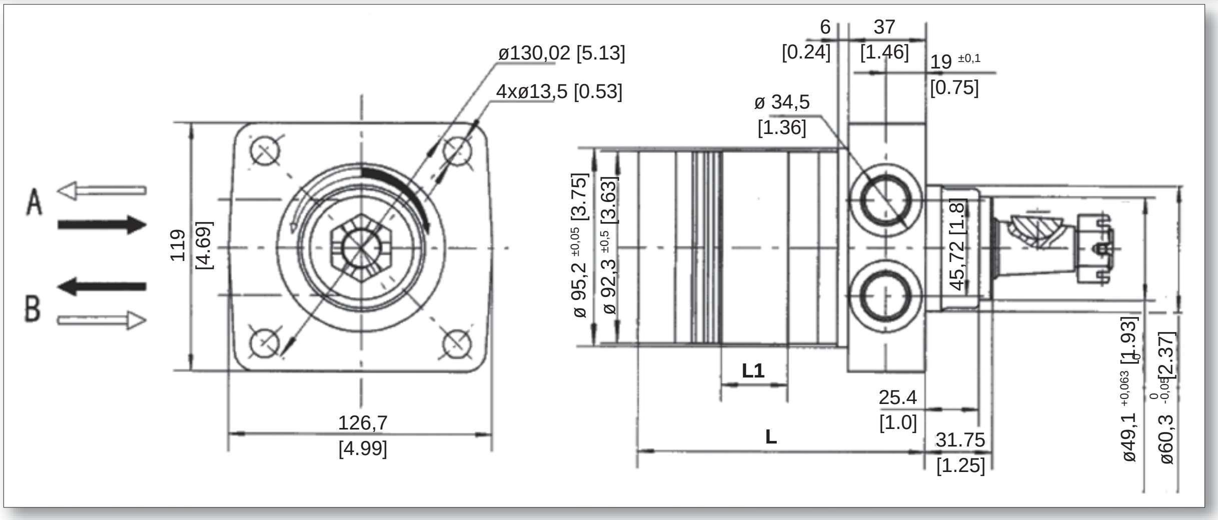
TORQUE [LB-IN]
TORQUE (N•M)
SPEED (RPM)

Max cont.

Max int.

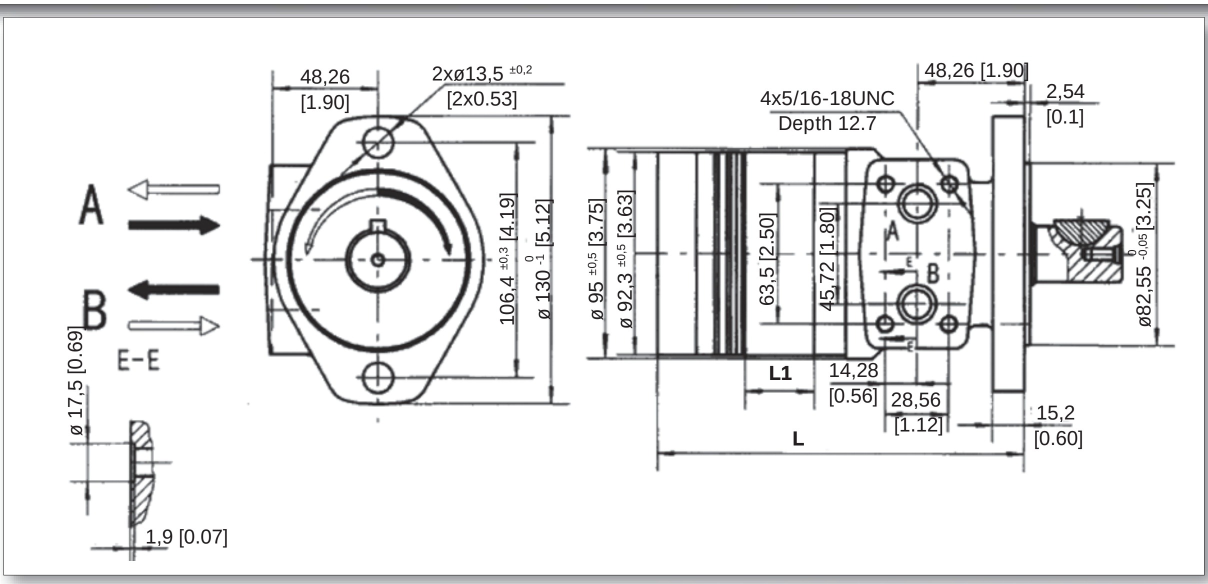
DIMENSION AND MOUNTING DATA

Code: Wheel Mount WS: 7/8-14 O-RING - WD: G1/2 - WM: M22X1.5



DISPLACEMENTCM³/REV	65	80	100	125	160	200	230	250	295	315	375
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[4.69]	[4.80]	[4.96]	[5.16]	[5.37]	[5.67]	[5.91]	[6.14]	[6.38]	[6.61]	[7.09]
L (mm)	119	122	126	131	136.5	144	150	156	162	168	180
WEIGHT (lb)	[16]	[16]	[17]	[18]	[18]	[19]	[20]	[21]	[22]	[23]	[24]
WEIGHT (kg)	7.4	7.5	7.8	8	8.3	8.7	9.2	9.6	10	10.3	10.8

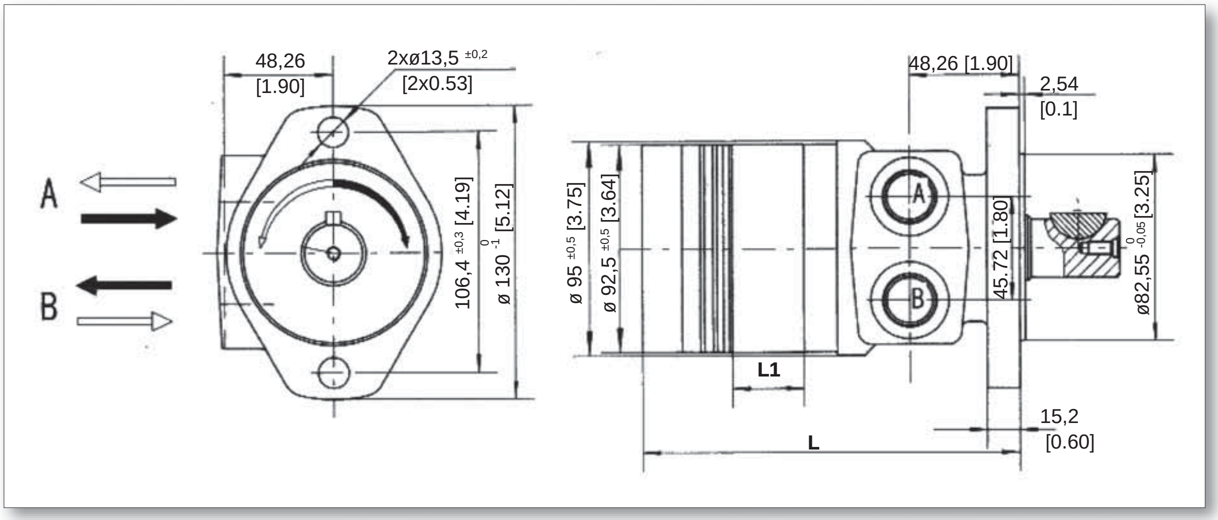
Code: HM Manifold • A. B Port 1/2”



DISPLACEMENTCM³/REV	65	80	100	125	160	200	230	250	295	315	375
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[5.87]	[5.98]	[6.14]	[6.34]	[6.56]	[6.85]	[7.09]	[7.32]	[7.56]	[7.80]	[8.27]
L (mm)	149	152	156	161	166.5	174	180	186	192	198	210
WEIGHT (lb)	[14]	[14]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]	[21]
WEIGHT (kg)	6.4	6.5	6.8	7	7.3	7.7	8.2	8.6	9	9.3	9.8

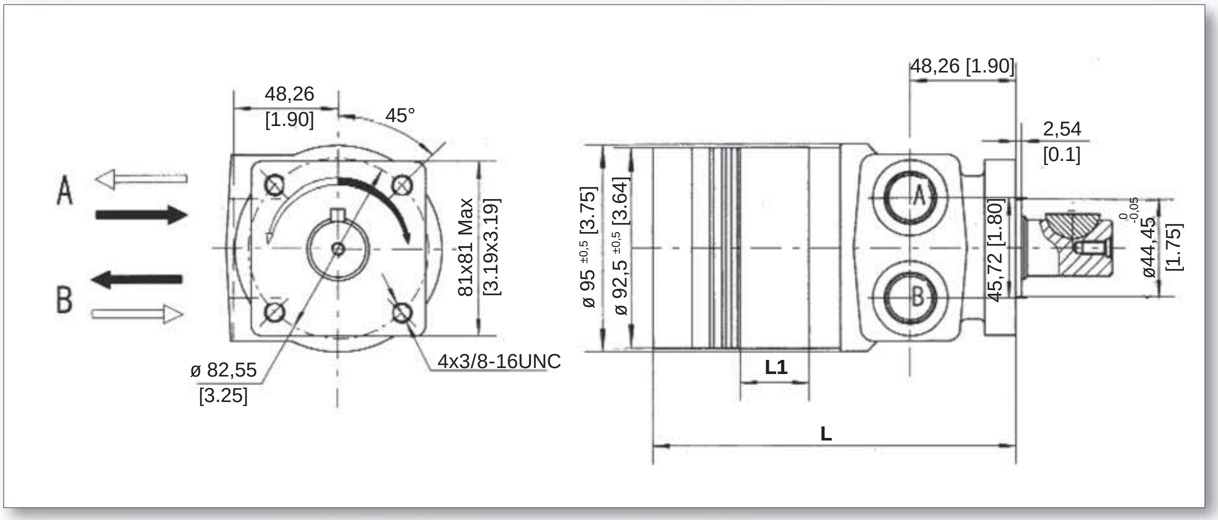
DIMENSION AND MOUNTING DATA

Code: Port A. B • HS 7/8-14 UNF • HP 1/2-14NPTF • HD G1/2 • HG M22x1,5



DISPLACEMENTCM^3/REV	65	80	100	125	160	200	230	250	295	315	375
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[5.87]	[5.98]	[6.14]	[6.34]	[6.56]	[6.85]	[7.09]	[7.32]	[7.56]	[7.80]	[8.27]
L (mm)	149	152	156	161	166.5	174	180	186	192	198	210
WEIGHT (lb)	[14]	[14]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]	[21]
WEIGHT (kg)	6.4	6.5	6.8	7	7.3	7.7	8.2	8.6	9	9.3	9.8

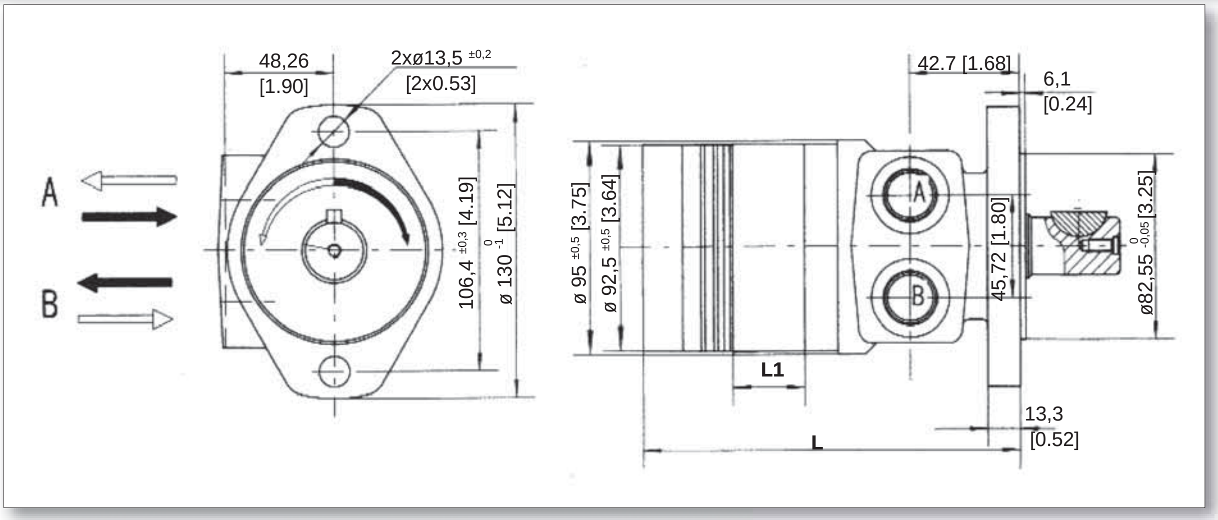
Code: Port A. B • H4S 7/8-14 UNF • H4P 1/2-14NPTF • H4D G1/2 • H4G M22x1,5



DISPLACEMENTCM^3/REV	65	80	100	125	160	200	230	250	295	315	375
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[5.87]	[5.98]	[6.14]	[6.34]	[6.56]	[6.85]	[7.09]	[7.32]	[7.56]	[7.80]	[8.27]
L (mm)	149	152	156	161	166.5	174	180	186	192	198	210
WEIGHT (lb)	[14]	[14]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]	[21]
WEIGHT (kg)	6.4	6.5	6.8	7	7.3	7.7	8.2	8.6	9	9.3	9.8

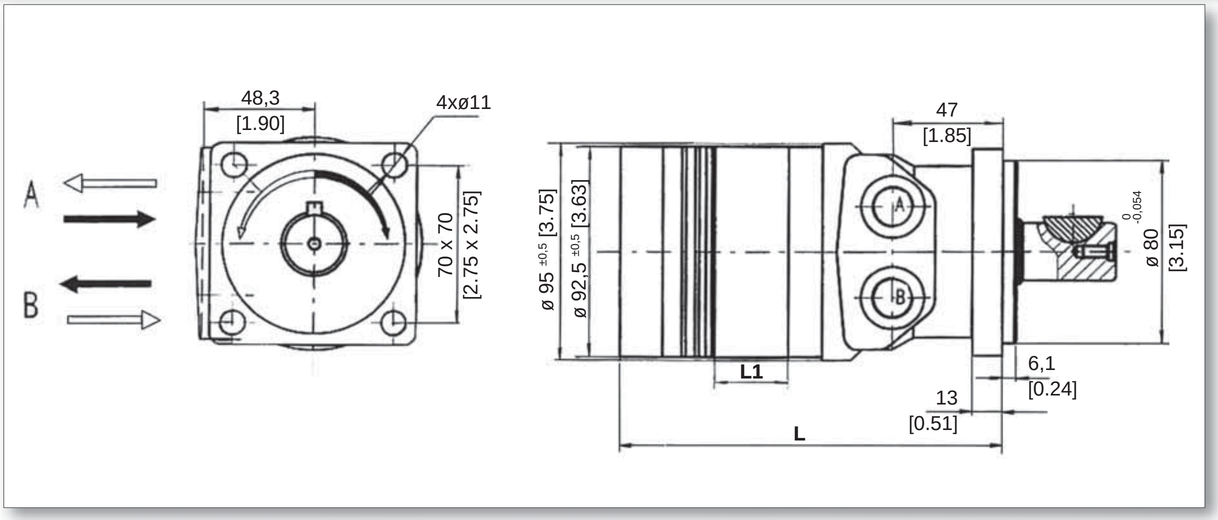
DIMENSION AND MOUNTING DATA

Code: Port A. B • HS1 7/8-14 UNF • HP1 1/2-14NPTF • HD1 G1/2 • HG1 M22x1,5



DISPLACEMENTCM^3/REV	**65**	**80**	**100**	**125**	**160**	**200**	**230**	**250**	**295**	**315**	**375**
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[5.75]	[5.87]	[6.02]	[6.22]	[6.44]	[6.73]	[6.97]	[7.20]	[7.44]	[7.67]	[8.15]
L (mm)	146	149	153	158	163.5	171	177	183	189	195	207
WEIGHT (lb)	[14]	[14]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]	[21]
WEIGHT (kg)	6.4	6.5	6.8	7	7.3	7.7	8.2	8.6	9	9.3	9.8

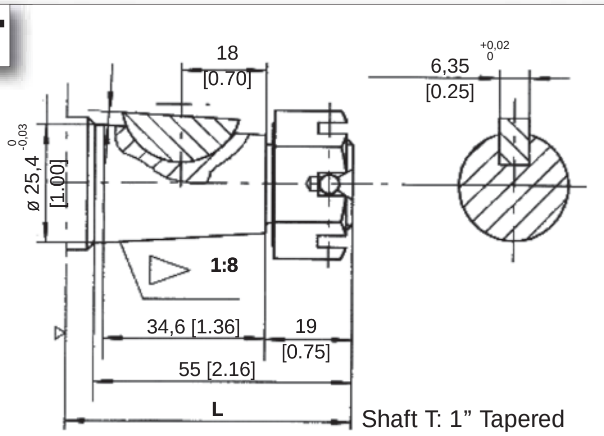
Code: B • A, B Port M18x1,5



DISPLACEMENTCM^3/REV	**65**	**80**	**100**	**125**	**160**	**200**	**230**	**250**	**295**	**315**	**375**
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[5.75]	[5.87]	[6.02]	[6.22]	[6.44]	[6.73]	[6.97]	[7.20]	[7.44]	[7.67]	[8.15]
L (mm)	146	149	153	158	163.5	171	177	183	189	195	207
WEIGHT (lb)	[14]	[14]	[15]	[15]	[16]	[17]	[18]	[19]	[20]	[20]	[21]
WEIGHT (kg)	6.4	6.5	6.8	7	7.3	7.7	8.2	8.6	9	9.3	9.8

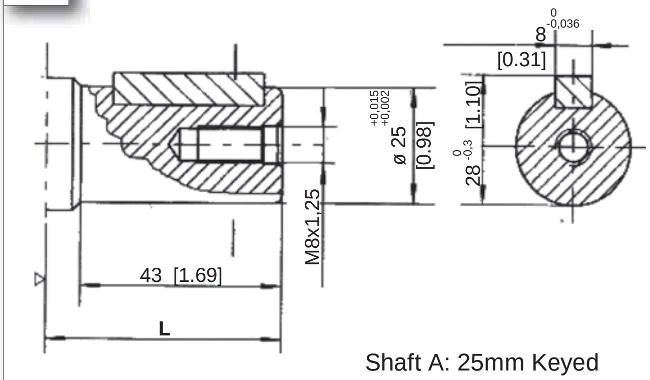
SHAFT EXTENSION

T



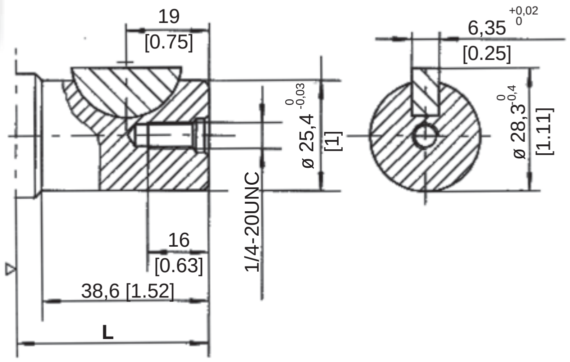
Shaft T: 1” Tapered
Woodruff key 1”x.25

A



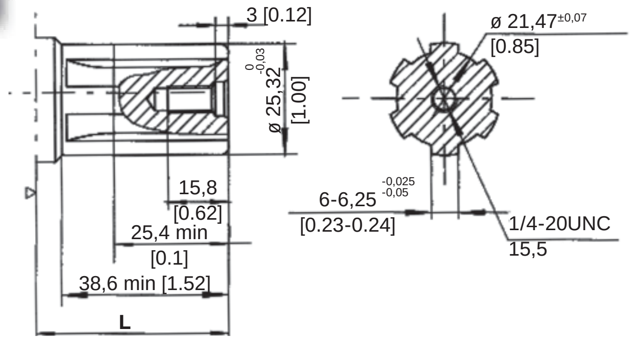
Shaft A: 25mm Keyed
Parallel key ø8x7x32

K



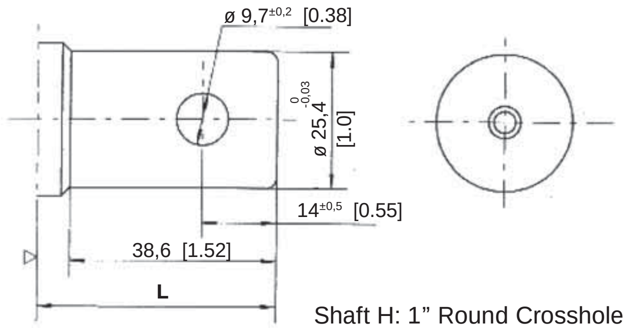
Shaft K: 1” Woodruff Keyed
Woodruff key 1”x.25

S



Shaft S: Splined SAE 6B

H



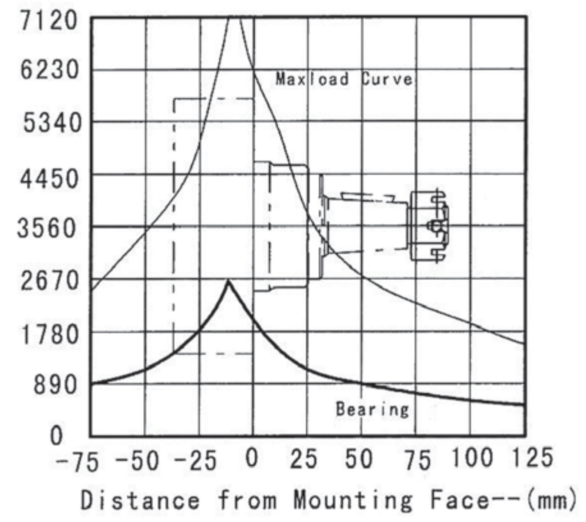
Shaft H: 1” Round Crosshole
Cross hole .38

DIMENSION L

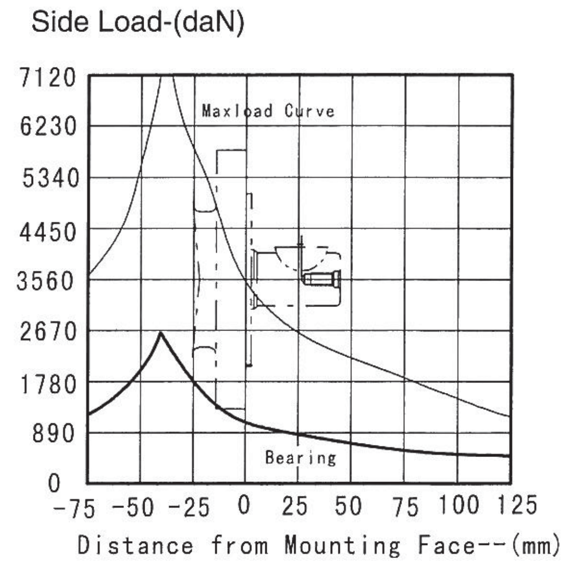
SHAFT / MOUNTING	T	A	K	S	H
WS	90.2 [3.55]	78.2 [3.08]	73.9 [2.91]	73.9 [2.91]	73.9 [2.91]
HS/HP	62.3 [2.45]	50.4 [1.98]	44.7 [1.76]	44.7 [1.76]	44.7 [1.76]
H4S/H4P					
HM					

PERMISSIBLE SHAFT LOADS

YME2 FOR WHEEL MOUNTING



YME2 FOR OTHER MOUNTING



The bearing curve represents allowable bearing loads for an L_{10} bearing life at $3x10^6$ revolutions.
The maximum load curve is defined by bearing static load capacity, this curve shold not be exceeded at any time including shock loads.

ORDERING INFORMATION

	1	2	3	4	5	6	7
YME2							

1	2		3		4		5		6	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**ROTATION DIRECTION**		**PAINT**		**UNUSUALLY FUNCTION**	
65	**WS**	4-Ø13.5 Wheel-flange, pilot Ø60.3x7 Port 7/8-14 O-ring	**T**	SHAFT: 1” TAPERED WOODRUFF KEY 1X.25	**NONE**	STANDARD	**00**	NO PAINT	**NONE**	STANDARD
80	**WD**	4-Ø13.5 Wheel-flange, pilot Ø60.3x7 Port G 1/2	**A**	SHAFT: 25MM KEYED PARALLEL KEY 8X7X32	**R**	REVERSE	**NONE**	BLUE	**FR**	FREE RUNNING
100	**VM**	4-Ø13.5 Wheel-flange, pilot Ø60.3x7 Port M22x1,5	**K**	SHAFT: 1” WOODRUFF KEYED WOODRUFF KEY 1”X.25			**B**	BLACK	**LL**	LOW LEAKAGE
125	**HM**	2-Ø13.5 Rhomb-flange, pilot Ø82.5x2.54 Port 1/2 Manifold mount 4x5/8-18	**S**	SHAFT: 1”SAE 6B SPLINED			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
160	**HS**	2-Ø13.5 Rhomb-flange, pilot Ø82.5x2.54 Port 7/8-14 O-ring	**H**	SHAFT: 1” ROUND CROSSHOLE CROSSHOLE .38					**CRS**	CORROSION RESISTANT SHAFT
200	**HP**	2-Ø13.5 Rhomb-flange, pilot Ø82.5x2.54 Port 1/2-14 NPFT Pipe							**HPS**	HIGH PRESSURE SEAL
230	**HD**	2-Ø13.5 Rhomb-flange, pilot Ø82.5x2.54 Port G1/2							**HTS**	HIGH TEMP SEAL
250	**HG**	2-Ø13.5 Rhomb-flange, pilot Ø82.5x2.54 Port M22x1.5								
295	**H4S**	4-3/8-16 Square-flange, pilot Ø44.4x2.54= Port 7/8-14 O-ring								
315	**H4P**	4-3/8-16 Square-flange, pilot Ø44.4x2.54= Port 1/2-14 NPFT Pipe								
375	**H4D**	4-3/8-16 Square-flange, pilot Ø44.4x2.54= Port G1/2								
	H4G	4-3/8-16 Square-flange, pilot Ø44.4x2.54= Port M22x1.5								

YMJ

The **YMJ** series motors incorporate the advanced **GEROLOR** gear set which reduces internal friction to a minimum and a **“COMMUTATOR VALVE”** distributions system which is internally balanced to reduce friction,leakage and permit better speed control. Producing higher efficiency, smoother rotation,higher speed and pressure.

This series also has many sizes and options to make it very flexible for many applications,The output shaft is supported by needle bearings for high radial and axial load for heavy duty applications,

SPECIFICATIONS

Distribution Type	Model	Displacement		Max. Operating Pressure		Speed Range	Max. Output Power	
Commutator Distribution	YMJ	[in.^{3}/rev]	[4.08-22.57]	[PSI]	[2900]	RPM	[HP]	[23.99]
		cm^3/rev.	66.8-370	MPa	20	842	Kw	17.9

YMJ SERIES QUICK REFERENCE GUIDE

Displacements				
[in.^{3}/rev]	cm^3/rev.			
[4.08]	66.8	FLOW UP TO	75 LPM	[19.82 GPM]
[4.97]	81.3	PRESSURE UP TO	20 MPa	[2900 PSI]
[6.20]	101.6	TORQUE UP TO	613 Nm	[5421 lb.-in.]
[7.75]	127	POWER UP TO	17,9 Kw	[24 HP]
[9.60]	157.2	SPEED UP TO	842 RPM	
[11.82]	193.6			
[13.80]	226			
[15.69]	257			
[17.57]	287.8			
[19.20]	314.5			
[22.58]	370			

Shaft Seals: High pressure shaft seals permit the parallel or series application without the need of a drain line.

Low Speed Valving: These motors are manufactured following strict procedures to reduce tolerances between all components to permit lower speed, higher efficiency and smoother rotation at very low speeds. These motors are not for high speed or low pressure applications.

Free Wheeling: These motors are created for applications where free wheeling is required or could be beneficial to the best results of the application and longer life for the motors and other components.

Special Motors: These motors have a variety of special options like nickel plated shafts or housings for corrosive environments and applications.

APPLICATION GUIDELINES:

For optimum results the following working conditions are recommended:

- Oil temperature should be between 20^o - 60^o C [68^o - 180^o F]
- Oil filter of 10 - 20 micron
- Oil viscosity 42 - 74 mm^2 at 40^o C
- Different shafts are used when there is a radial load or not. Check data pages
- For longer life we suggest the motor at start up, run for a shorter period of time (one hour) at no more than 30% of rated speed and pressure.

SPECIFICATION DATA

For individual motor performance chart consult equivalent YME2 series data.

DISTRIBUTION TYPE			YMJ 65	YMJ 80	YMJ 100	YMJ 125	YMJ 160	YMJ 200	YMJ 230	YMJ 250	YMJ 295	YMJ 315	YMJ 375
GEOMETRIC DISPLACEMENT		[in^3./rev.]	[4.08]	[4.97]	[6.20]	[7.75]	[9.60]	[11.82]	[13.80]	[15.69]	[17.57]	[19.20]	[22.58]
		cm^3/rev.	66.8	81.3	101.6	127	157.2	193.6	226	257	287.8	314.5	370
MAX. SPEED RPM		RATED	490	410	330	265	210	175	195	170	155	135	120
		CONT.	667	543	439	350	283	229	247	216	196	178	152
		INT	842	689	553	441	355	289	328	287	254	235	199
MAX. TORQUE [IN. LB.] N*M	RATED	[IN. LB.]	[973]	[1203]	[1459]	[1893]	[2317]	[2759]	[2812]	[2910]	[3078]	[3219]	[3290]
		N*M	**110**	**136**	**165**	**214**	**262**	**312**	**318**	**329**	**348**	**364**	**372**
	CONT.	[IN. LB.]	[1114]	[1389]	[1689]	[2167]	[2715]	[3378]	[3343]	[3370]	[3476]	[3962]	[3883]
		N*M	**126**	**157**	**191**	**245**	**307**	**382**	**378**	**381**	**393**	**448**	**439**
	INT.	[IN. LB.]	[1557]	[1901]	[2370]	[2963]	[3732]	[4599]	[4670]	[4802]	[4838]	[5191]	[5421]
		N*M	**176**	**215**	**268**	**335**	**422**	**520**	**528**	**543**	**547**	**587**	**613**
MAX. OUTPUT [HP] KW	RATED	[HP]	[7.4]	[8.2]	[7.9]	[8.3]	[8.2]	[7.8]	[8.6]	[8.0]	[7.8]	[7.0]	[6.7]
		KW	**5.5**	**6.1**	**5.9**	**6.22**	**6.1**	**5.8**	**6.4**	**6**	**5.8**	**5.2**	**5**
	CONT.	[HP]	[11.1]	[11.8]	[10.6]	[11.9]	[11.9]	[12.0]	[13.3]	[12.5]	[11.7]	[10.7]	[10.2]
		KW	**8.3**	**8.8**	**7.9**	**8.9**	**8.9**	**9**	**9.9**	**9.3**	**8.7**	**8**	**7.6**
	INT.	[HP]	[18.6]	[19.3]	[18.1]	[18.9]	[20.9]	[21.0]	[24.0]	[22.1]	[20.9]	[19.2]	[18.8]
		KW	**13.9**	**14.4**	**13.5**	**14.1**	**15.6**	**15.7**	**17.9**	**16.5**	**15.6**	**14.3**	**14**
MAX. PRESSU-RE DROP [PSI] MPA	RATED	[PSI]	[1813]	[1813]	[1813]	[1813]	[1813]	[1813]	[1595]	[1450]	[1305]	[1305]	[1160]
		MPA	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**12.5**	**11**	**10**	**9**	**9**	**8**
	CONT.	[PSI]	[2030]	[2030]	[2030]	[2030]	[2030]	[2030]	[1740]	[1595]	[1450]	[1450]	[1305]
		MPA	**14**	**14**	**14**	**14**	**14**	**14**	**12**	**11**	**10**	**10**	**9**
	INT.	[PSI]	[2755]	[2755]	[2755]	[2755]	[2755]	[2755]	[2393]	[2248]	[2103]	[1958]	[1813]
		MPA	**19**	**19**	**19**	**19**	**19**	**19**	**16.5**	**15.5**	**14.5**	**13.5**	**12.5**
	PEAK	[PSI]	[2900]	[2900]	[2900]	[2900]	[2900]	[2900]	[2610]	[2610]	[2465]	[2320]	[2320]
		MPA	**20**	**20**	**20**	**20**	**20**	**20**	**18**	**18**	**17**	**16**	**16**
MAX. FLOW [GPM] L/MIN	RATED	[GPM]	[8.9]	[8.9]	[8.9]	[8.9]	[8.9]	[8.9]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]
		L/MIN	**34**	**34**	**34**	**34**	**34**	**34**	**45**	**45**	**45**	**45**	**45**
	CONT.	[GPM]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]	[11.8]	[15.0]	[15.0]	[15.0]	[15.0]	[15.0]
		L/MIN	**45**	**45**	**45**	**45**	**45**	**45**	**57**	**57**	**57**	**57**	**57**
	INT.	[GPM]	[15.1]	[15.1]	[15.1]	[15.1]	[15.1]	[15.1]	[19.82]	[19.82]	[19.82]	[19.82]	[19.82]
		L/MIN	**57**	**57**	**57**	**57**	**57**	**57**	**75**	**75**	**75**	**75**	**75**

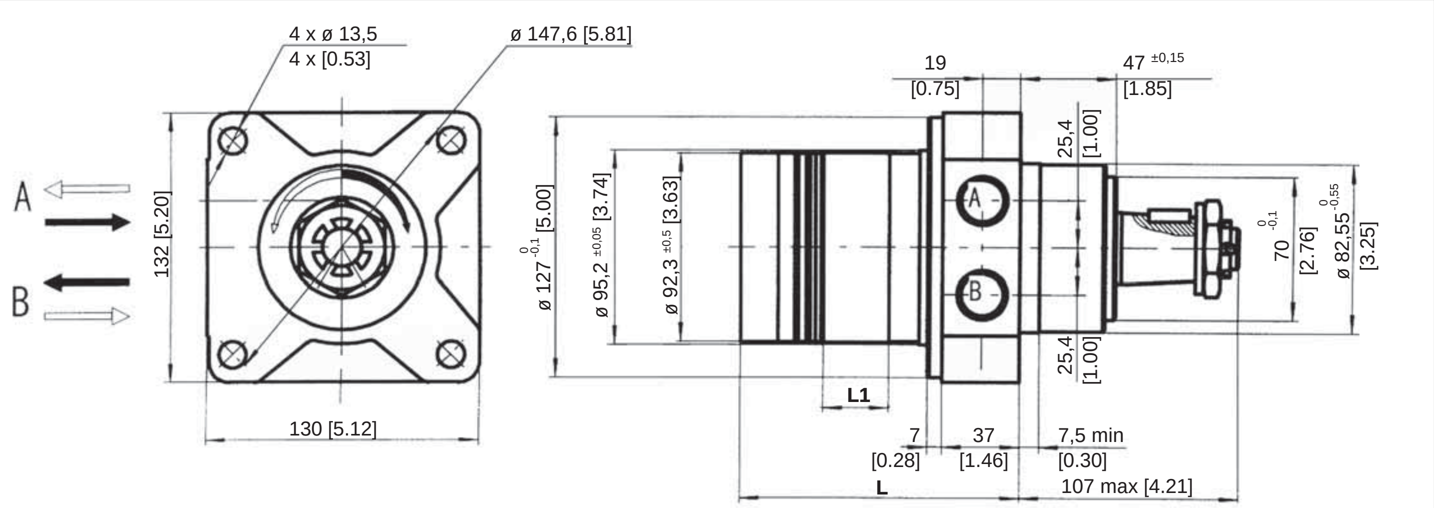
• Rated speed and rated torque:	Output value of speed and torque under rated flow and rated pressure.
• Continuous pressure:	Max. value of operating motor continuously.
• Intermittent pressure:	Max. value of operating motor in 6 seconds per minute.
• Peak pressure:	Max. value of operating motor in 0.6 second per minute.

DIMENSION AND MOUNTING DATA

Code: WS **Ports A & B** **7/8-14 O-ring**

Code: WD **Ports A & B** **G1/2**

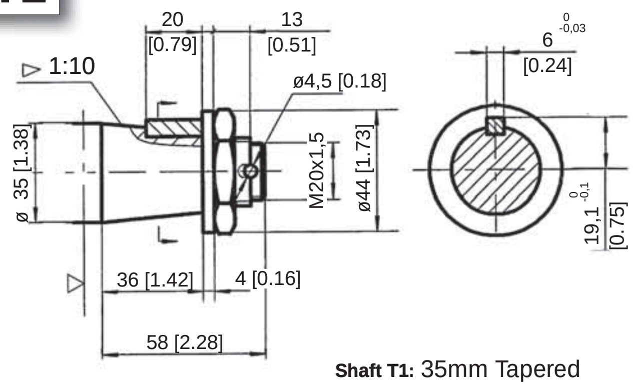
Code: WM **Ports A & B** **M22X1.5**



DISPLACEMENTCM³/REV	65	80	100	125	160	200	230	250	295	315	375
L1 (inches)	[0.51]	[0.63]	[0.79]	[0.98]	[1.20]	[1.50]	[1.73]	[1.97]	[2.20]	[2.44]	[2.91]
L1 (mm)	13	16	20	25	30.5	38.1	44	50	56	62	74
L (inches)	[4.53]	[4.65]	[4.80]	[5.00]	[5.22]	[5.51]	[5.75]	[5.98]	[6.22]	[6.46]	[6.85]
L (mm)	115	118	122	127	132.5	140	146	152	158	164	174
WEIGHT (lb)	[19.8]	[20.0]	[22.8]	[23.3]	[23.9]	[24.8]	[25.9]	[26.8]	[27.72]	[28.3]	[29.4]
WEIGHT (KG)	9	9.1	10.4	10.6	10.9	11.3	11.8	12.2	12.6	12.9	13.4

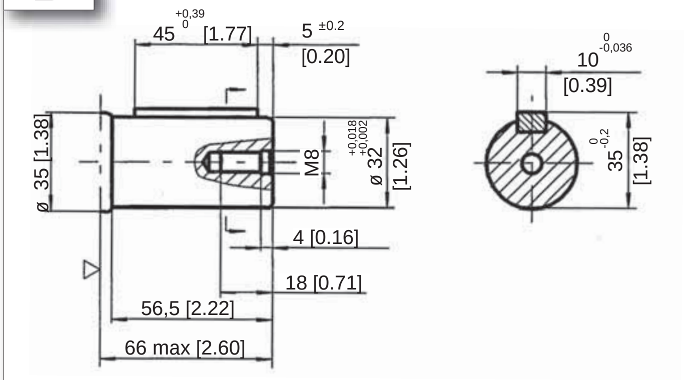
SHAFT EXTENSION

T1



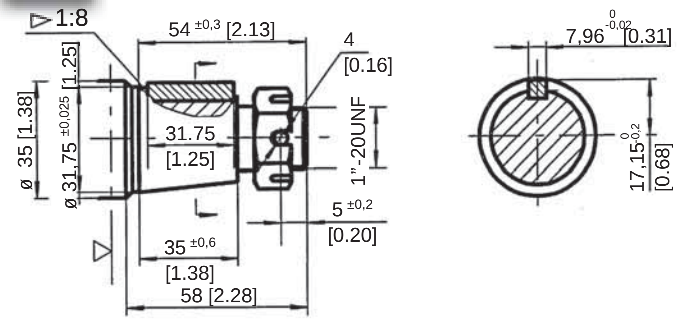
Shaft T1: 35mm Tapered
Parallel Key b6x6x20
Tightening torque: 200±10Nm

B



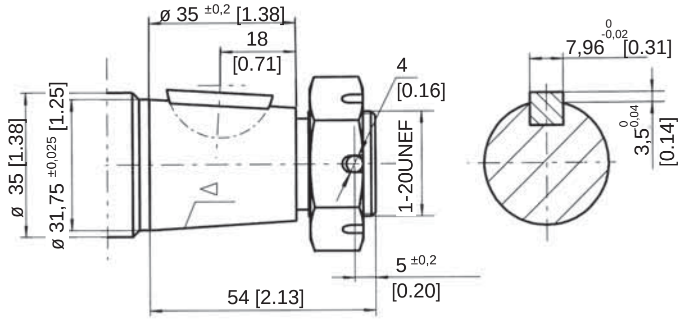
Shaft B: 32mm Keyed
Parallel key ø10x8x45

T3



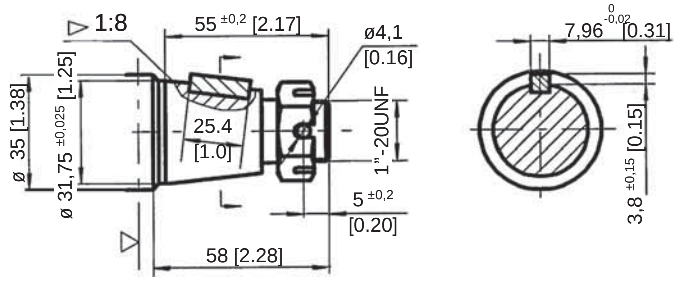
Shaft T3: 1.25” Tapered
Parallel Key .31x.31x1.25
Tightening torque: 200±10Nm

T2



Shaft T2: 1.25” Tapered
Woodruff Key 1.0x.31

T4



Shaft T4: 1.25” Tapered
Parallel Key .31x.31x1.25
Tightening torque: 200±10N

ORDERING INFORMATION

	1	2	3	4	5	6
YMJ						

1	2		3		4		5		6	
DISP.	**FLANGE**		**OUTPUT SHAFT**		**ROTATION DIRECTION**		**PAINT**		**SPECIAL OPTIONS**	
65	**WS**	Wheel Flange: Pilot 3.25x.28 Ports 7/8-14 o-ring 4-13.5 Bolt Holes	**T1**	SHAFT: 35MM Tapered Parallel Key B6X6X20	**NONE**	STAN-DARD	**00**	NO PAINT	**NONE**	STANDARD
80	**WD**	Wheel Flange: Pilot 3.25x.28 Ports G1/2 4-13.5 Bolt Holes	**T2**	SHAFT: 1.25 Tapered Woodruff Key 1.0x.31	**R**	REVERSE	**NONE**	BLUE	**FR**	FREE RUNNING
100	**WM**	Wheel Flange: Pilot 3.25x.28 Ports M22x1.5	**T3**	SHAFT: 1.25 Tapered Parallel Key .31x.31x1.25			**B**	BLACK	**LL**	LOW LEAKAGE
125			**T4**	SHAFT: 1.25 Tapered Parallel Key .31x.31x1.0			**S**	SILVER GRAY	**LSV**	LOW SPEED VALVE
160			**B**	SHAFT: 32mm Keyed Parallel Key 10x8x45					**CRS**	CORROSION RESISTANT
200									**HPS**	HIGH PRESSURE SEAL
230									**HTS**	HIGH TEMP SEAL
250										
295										
315										
375										

Ordering Code:

All options have been determined with letters or numbers or combinations. All boxes must be filled with proper code.If specification is not in the table, please contact us with your specific requirements.

YZDQ2

YZDQ2 SERIES HYDRAULIC BRAKE

ZDQ2 series brake is a wet disc hydraulic brake. The hydraulic disk brake uses spring pressure to apply the brake, and hydraulic pressure to release.

CHARACTERISTIC FEATURES:

- ZDQ2 series incoporates an advance friction disc and spring design: For long life, low noise, high
- reliability
- 4 tapped drain ports,which makes this unit adaptable to many different positions and applications.
- Flange mountable to **YMP,YMR, YMS** series hydraulic motor

YZDQ2 SERIES HYDRAULIC BRAKE

YZDQ2 series hydraulic brakes is shipped without oil and is lubricated during normal operation. Normal operation is to have the brake pressurized in the released position with the vehicle hydraulic system running. Any function which reduced the hydraulic system pressure below the release pressure of the brake will allow the springs to apply the brake.

YZDQ2 series hydraulic brakes are designed for use in heavy duty applications on vehicles in the construction, material handling, agricultural, mining, sanitation and timber industries. They are also used in a wide veriety of winch and hydrostatic drive system applications.

YZDQ2 SERIES HYDRAULIC BRAKE

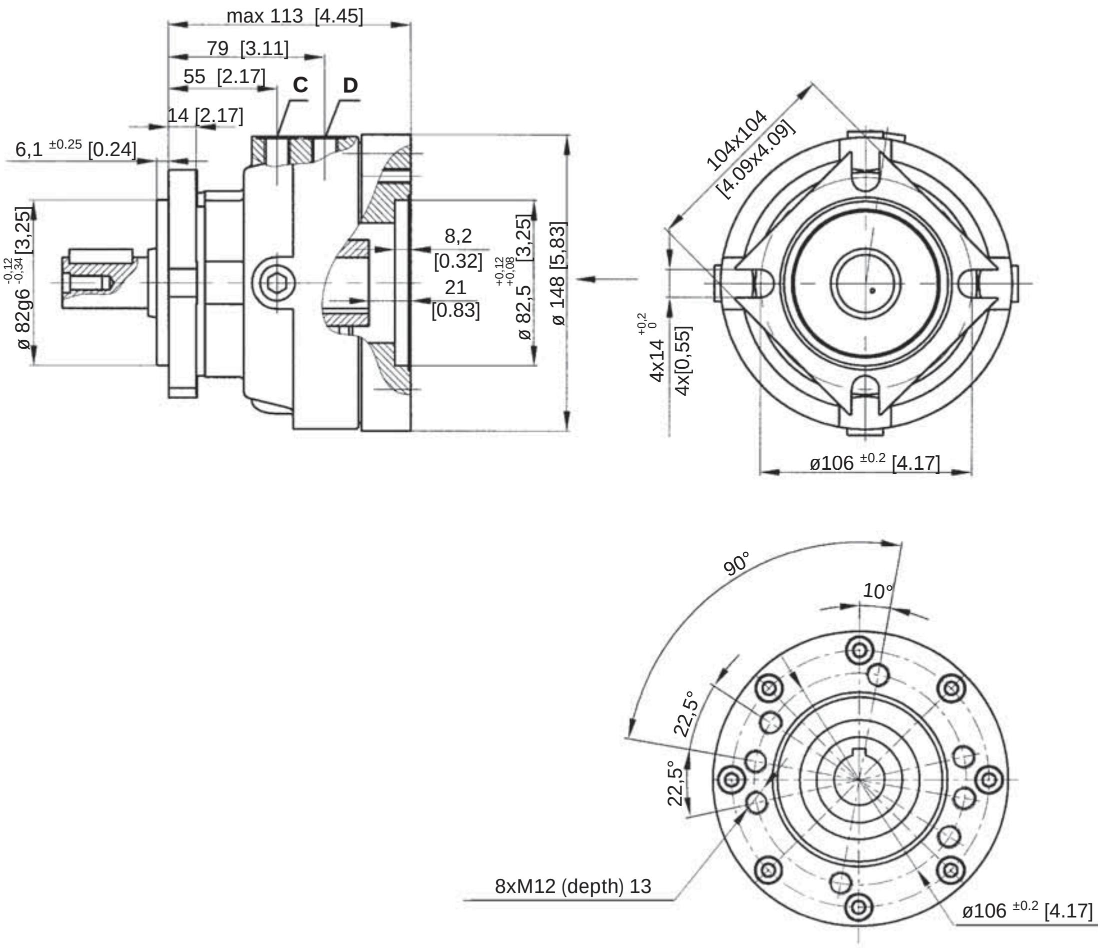
For optimum results the following working conditions are recommended:

1. Assembly: for YZDQ2,that the brake be cycled before normal opperation to insure proper lubrication.
2. Fluid type: mineral based-HM (GB/T763.2-87) (ISO6743/4) of HLP (DIN51524)
3. Oil Temperature range between 20 - 60C [68-180F]
4. Viscosity range: 42 ~ 74 mm^2/s at 40°C
5. Filtration: nominal filtration of 25 micron, ISO code 20/16
6. Maintenance: change oil after the first 50 ~ 100h; then after every 500 ~ 1000h

YZDQ2

MOUNTING DATA

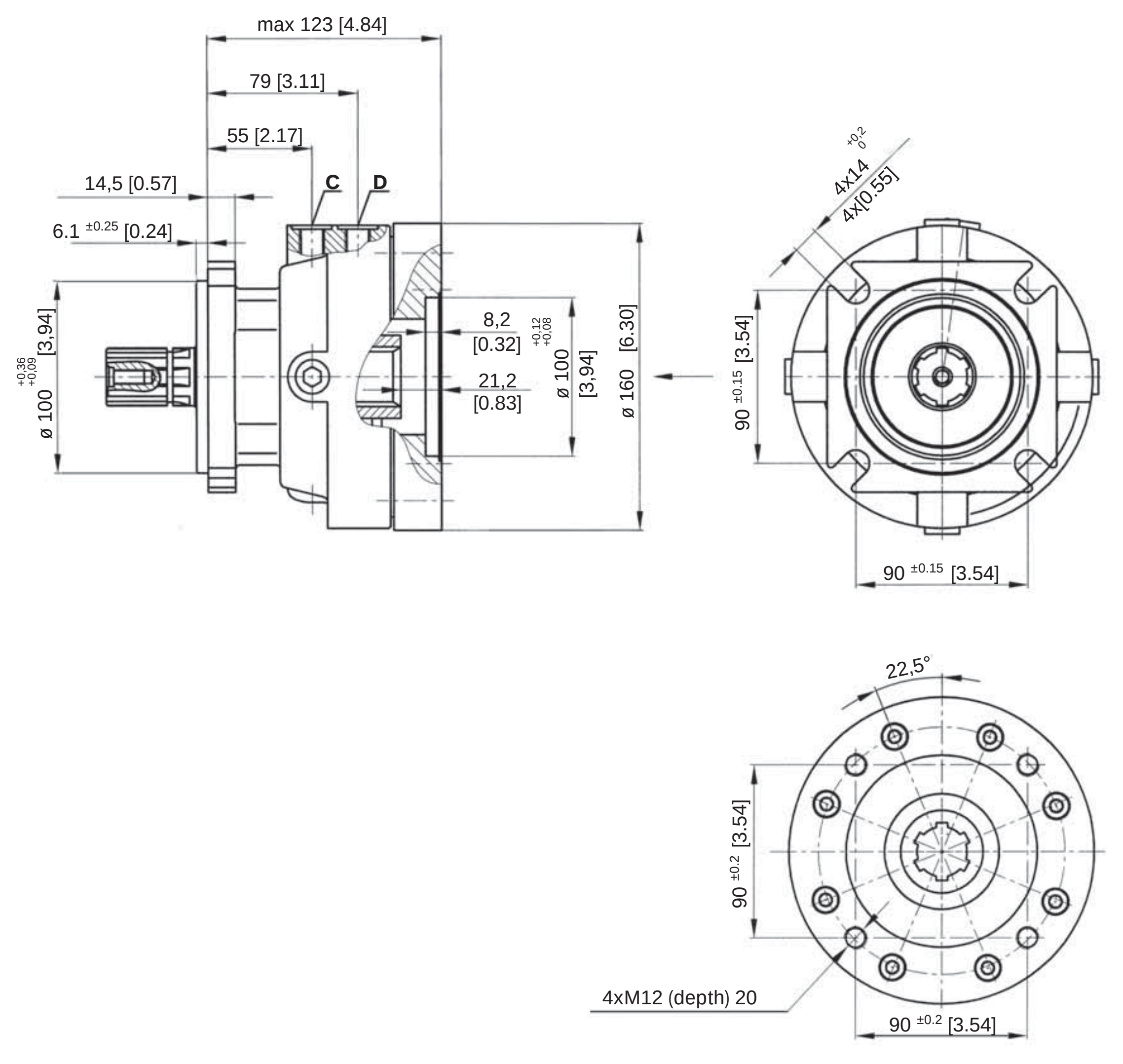
YZDQ2-1



C	Drainage tap	G 1/4, 9 mm depth
D	Brake release port	G 1/4, 9 mm depth

MOUNTING DATA

YZDQ2-2



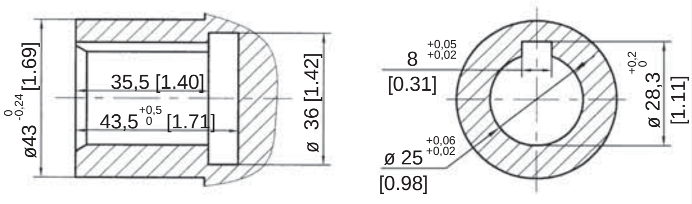
C	Drainage tap	G 1/4, 9 mm depth
D	Brake release port	G 1/4, 9 mm depth

334

INPUT AND OUTPUT SHAFT DATA

INPUT SHAFTS

A



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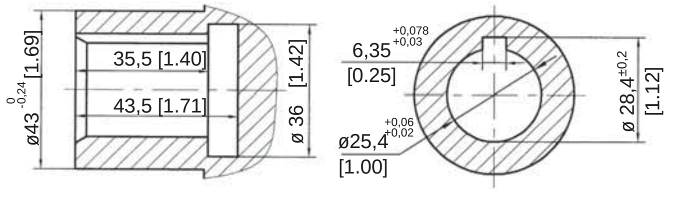

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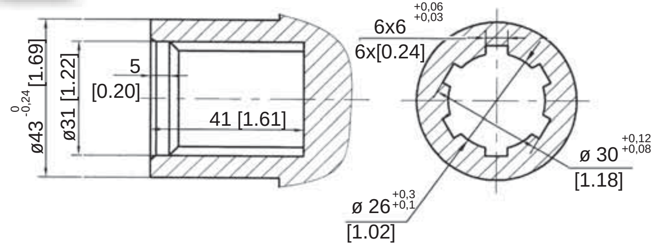

OUTPUT SHAFTS

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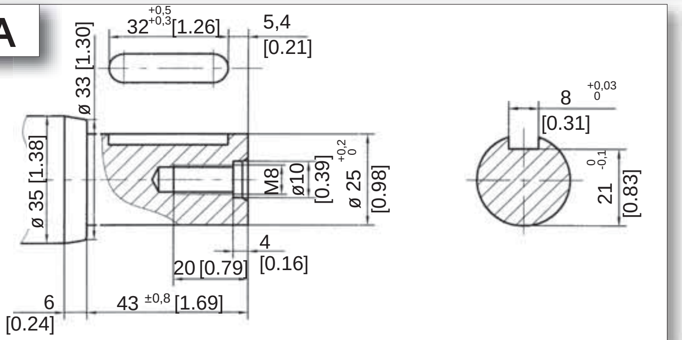

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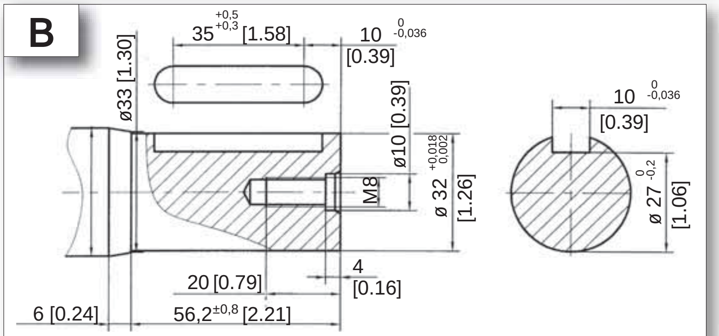

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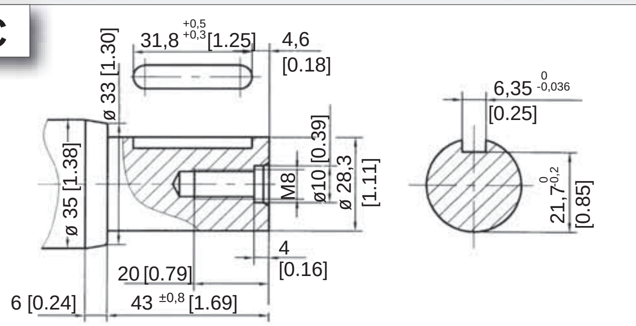

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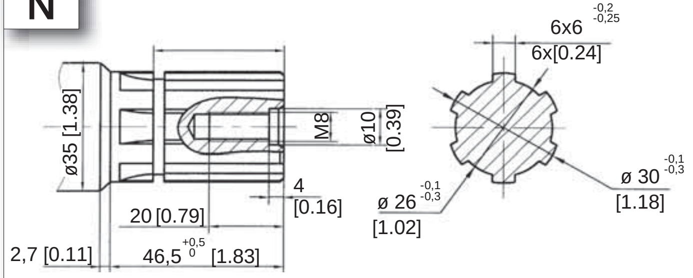
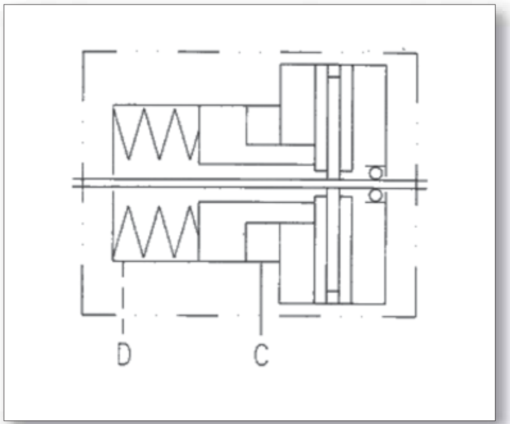


SPECIFICATIONS

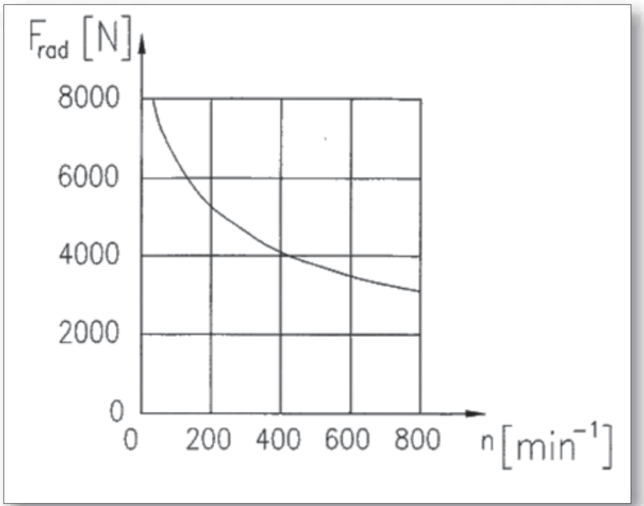
SCHEMATIC

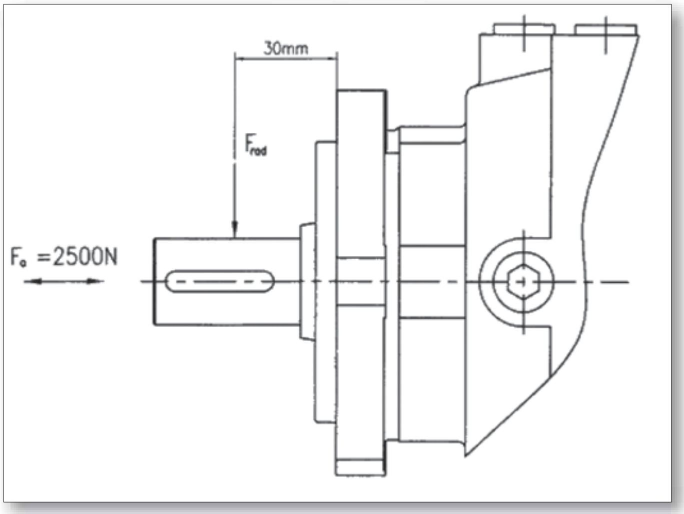


SPECIFICATION		YZDQ2-1		YZDQ2-2
Min static torque*	Nm [lb-in]	200-230 [1768-2034]	410 ~ 450 [3626-3979]	410 ~ 450 [3626-3979]
Min Opening Pressure	Mpa [PSI	1.7 ~ 2.3 [246-333]		
Max Opening Pressure	Mpa [PSI]	30 [4350]		
Min oil quantity for brake releasing	cm^3 [in^3]	7 ~ 8 [.43-.49]		
Oil Volume	cm^3 [in^3]	50 ~ 120 [3-7.3]		
Max pressure in drain space	Mpa PSI	0.05 [7.2]		
Weight	Kg [Lbs]	9 [19.80]		9.5 [20.9]

* Static torque is obtained at working pressure - 0 Mpa

LOAD CURVES





ORDERING INFORMATION

	1	2	3	4	5	6
YZDQ2						

1	2		3		4		5		6	
CODE.	TORQUE		INPUT SHAFT		OUTPUT SHAFT		PAINT		SPECIAL OPTIONS	
1	210	Torque: 200-230Nm 1768-2034 lb/in	A	25MM Keyed Parallel Key 8x7x32	A	25mm Keyed Parallel Key 8x7x32	oo	No Paint	Omit	Standard
	430	Torque:410-450Nm 3626-3980 lb/in	C	1” Keyed Parallel Key .25x.25x1.25	B	32mm Keyed Parallel Key 10x8x45	N	Blue		
					C	1” Keyed Parallel Key .25x.25x1.26	B	Black		
							S	Silver		
2	430	Torque:410-450Nm 3626-3980 lb/in	N	Splined 6-30x26x6	N	Splined 6-30x26x6				

Ordering code:

All options have been determined with letters, numbers or combinations. All boxes must be filled with proper codes. If specification is not in the table , please contact us with your specific requirements.

LSHT HYDRAULIC MOTOR DATA SHEET

Date: ______________________________
Company ____
Contact ______________________________ Phone ______________________________
Machine ______________________________ Model ______________________________

Existing Motor Mfg ______________________________
Code ______________________________
Model # ______________________________

Quantity ______________________________
Type: GEROTOR ______________________________ GEROLLER ______________________________
Valve Design: SPOOL ______________________________ DISC ______________________________
Displacement ______________________________ Cu in/rev
Max oil flow ______________________________ GPM
Max working pressure ______________________________ PSI
Nominal oil flow ______________________________ GPM Porting ______________________________
Nominal working pressure ______________________________ PSI Shaft ______________________________
Speed ______________________________ RPM cont Mnt Flange ______________________________
______________________________ RPM int
RPM peak

Is a drain line available? ☐ Yes ☐ No
Type of flow circulation ☐ Closed Loop ☐ Open Loop
Free-wheeling required ☐ Yes ☐ No

Max torque ______________________________ lb/in
Max fluid temp ______________________________ F
Additional application info. ____

Duty Cycle	% of Time	Torque lb/in	% of Time	Speed Rpm	% of Time
1					
2					
3					
4					

For Internal use: ______________________________ Date: ______________________________
Selection ____
Reviewed by ____
Approved by ____

STAINLESS SPRAY JET
CJ510
ID - 1/2"
ORFICE - 0.070
THREAD - 1/2" NPT
LENGTH - 4"

12' LONG GALVANIZED WASH TROUGHS

INTERNAL SLOPE PLATE - 1/8"
NOT SHOWN FOR CLARITY

INTERNAL SLOPE PLATE - 1/8"
NOT SHOWN FOR CLARITY

ALL WELDS - 1/2" WITH 0.35 WIRE

STANTON SYSTEMS

50 Richard Road Ivyland, PA 18974

215.956.9800

Spare Parts List

L J157	Coupling for Conveyor (1)	$ 227. each
L J110	Coupling Spider (1)	$ 99. each
FLB 1 615	Flange Bearings (2)	$ 101. each
PBB 1 310	Pillow Block Bearings (4)	$ 95. each
1 S 350	Shafting (3)	$ 199. each
C27S	27" Scrapers, Rubber(6 pieces per set)	$ 625. Total
CPP1	Hydraulic Power Pak , Conveyor	$ 2350.each
CDP1	Hydraulic Drive Motor , Conveyor	$ 975. each
Chk1	Hydraulic Hose kit w/ fittings , guage	$ 610. each
FL 215	Float Switch (1)	$ 240. each
WFV 750	Water Fill Valve	$ 179. each
WTRPMP	Water Pump	$ 8875. Each
30HPMTR	Motor – 30HP	$ 4217. Each
30HP PACKING	Packing (Seal Kit, 1 Set; 6 pieces per set)	$ 230. Per Kit
STRT LGC	Electric Starter & Logic	$ 5675. Each
POLY 260SYSTEM	Polymer Pump System (1) Includes Cabinet	$ 3980. each
C131	Polymer Pump	$ 2155. each
Polymer	55 Gallon Drum	$ 1395. each
OPTI	Opti Eye Set	$ 575. each
75 HP Motor		$ 5590. each
75 Hp Pump		$ 15,800. each
75 HP Soft Starter		$ 7620. each
100 HP Motor		$ 6170. each
100 HP Pump		$ 16,400. each
100 HP Soft Starter		$ 9540. each

Maintenance Log

Motor and Pump:

Load Grease Zerks on Motor 4 times a Year in Heavy conditions " or "
3 times a Year in Moderate conditions
Change motor oil once a year

Circle each yearly interval at completion of maintenance

Oil	**2015**	**2015**	**2015**	**2015**
Oil	**2016**	**2016**	**2016**	**2016**
Oil	**2017**	**2017**	**2017**	**2017**
Oil	**2018**	**2018**	**2018**	**2018**

Spray Jets:

Inspect Spray Jets for Clogging 4 Times a Year

2015	**2015**	**2015**	**2015**
2016	**2016**	**2016**	**2016**
2017	**2017**	**2017**	**2017**
2018	**2018**	**2018**	**2018**

Opti Eyes: At every maintenance interval shown above, face lens on Opti Eye should be cleaned with a wet towel.

Appendix B – West Texas A&M University Engineering Senior Design: Spring and Summer 2014

Undercarriage and Wheel Wash

For
United States Department of Homeland Security

Presented to the Civil Engineering Faculty of the WTAMU School of Engineering and Computer Science

By
Sehyun Ahn, Vanessa Brown, Colton Duck, Anthony Helmberger, Texi Schaeffer, Brent Turner, Jared Wesley, and Chris Wiseman

Abstract

The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) commissioned this project to design an undercarriage and wheel wash for vehicles entering and exiting livestock operations. Use of an undercarriage and wheel wash will reduce the likelihood of an infectious virus, such as foot and mouth disease (FMD), traveling among operations. The wash is designed to remove dirt and manure buildup from a vehicle both as they enter and as they exit the premise. The wash is designed to service passenger vehicles and large tractor-trailer vehicles entering or exiting the feedlot. The wash has a grate-like design with W6x12 steel beams spaced every four inches apart perpendicular to the direction of travel. This allows space for five rows of PVC pipe, outfitted with twenty size 6.5 nozzles each, to be placed between the beams to spray the undercarriage of the vehicle. The wash will also have two sets of pipe on each side to spray the wheels and wheel wells. One side sprayer on each side will be fifty-five inches tall with five nozzles and the other will be fifty inches tall with four nozzles. The nozzles on all the pipes will be offset to ensure maximum coverage. The bottom nozzles have a zero degree fan angle while the side nozzles have a fifteen degree fan angle. Spacing between the beams also allows for the water to drain between the beams and into a concrete trough. Water collected in the trough will be pumped to a water treatment system produced by Custom Applied Technology Corp (CATEC) Custom Water Recovery Systems. The CWR-15DXP model will be used. This model not only disinfects using ozone, but also filters out particles larger than 10 µm. This water will be clean enough to be pumped back into the wash system and reused, reducing the impact the wash has on the environment and water supply.

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Nomenclature

M	Maximum Bending Moment	lb-ft
c	Distance to Neutral Axis	in
I	Moment of Inertia	in^4
σ	Bending Stress	psi
τ	Shear Stress	psi
V	Transverse Shear Force	lb
A	Cross-Sectional Area	in^2
n	Factor of Safety	
σ_{All}	Allowable Stress	psi
q_e	Effective Bearing Pressure	psf
q_a	Allowable Bearing Pressure	psf
γ_{soil}	Unit Weight of Soil	$\frac{\mathrm{lb}}{\mathrm{ft}^3}$
$\gamma_{\mathrm{concrete}}$	Unit Weight of Concrete	$\frac{\mathrm{lb}}{\mathrm{ft}^3}$
b	Width of Footing	ft
q_u	Design Bearing Pressure	psf
M_u	Factored Moment at Face of Wall	in-lb/ft
a	Wall Thickness	ft
d	Depth to Steel Reinforcement	in
V_u	Shear at Distance d from Wall	lb/ft
ϕ	Reduction Factor	
V_c	Critical Shear	lb/ft
λ	Modification Factor for Strength	
f'_c	Compressive Strength of Concrete	psi

Definitions

TCEQ- Texas Commission on Environmental Quality; regulatory agency for natural resource conservation and environmental protection (2 Texas Water Code 5.012, 1991).

TAHC - Texas Animal Health Commision

TDA - Texas Department of Agriculture

TXDOT- Texas Department of Transportation

TXDMV- Texas Department of Motor Vehicles

ACI- American Concrete Institute

ASTM- American Society for Testing and Materials

EPA- Environmental Protection Agency

FMD- Foot and Mouth Disease

FHWA- Federal HIghway Administration

CAFO- Concentrated Animal Feeding Operation; livestock are kept in a confined area and provided with feed instead of being allowed to graze (Environmental Protection Agency, 2014).

High Plains- Area consisting of the Texas Panhandle and parts of New Mexico, Colorado, Oklahoma, Kansas, and Nebraska

AASHTO- American Association of State Highway and Transportation Officials

NRCS- Natural Resources Conservation Service

LRFD- Load and Resistance Factor Design; defined by the American Concrete Institute

PVC Pipe- Polyvinyl chloride pipe; used to transfer water from the storage tank to the nozzles

MUTCD- Manual on Uniform Traffic Control Devices

RCRA- Resource Conservation and Recovery Act

BOD - Biological Oxygen Demand

WB-62- Interstate Semitrailer with 62 foot wheelbase (AASHTO 2011)

DO - Dissolved Oxygen

Introduction

A concentrated animal feeding operation (CAFO) is a large fenced area in which cattle or swine are kept and fed so that they yield the highest amount of product, such as beef, pork, etc., as possible. The livestock coming out of feedlots are not only important to the feedlots themselves, but are also assets to the agricultural industry and the overall economy. Dairies are another key part of the economy and agricultural industry as they produce milk for the population. As such, it is a good investment for government agencies and owners of CAFOs to find ways to protect these assets. The government has funded research on disease prevention to help protect livestock. Diseases can be contracted in two different ways: contacting an infected area and inhaling the virus. When a disease is introduced into a CAFO, it is possible for the virus to survive in moist organic material, such as manure and mud. These organics also tend to collect in the undercarriage of vehicles. Once the infected material is on the undercarriage it is possible for the vehicle to transfer the infection from feedlot to feedlot. The purpose of this project is to design an undercarriage wash which removes the majority of infectious material from the undercarriage of vehicles entering a livestock operation. This will help reduce the likelihood of a disease spreading among multiple locations.

Possible Livestock Diseases

There are a number of diseases that could infect a feedlot population. Not only can these diseases be detrimental to that specific feedlot operation, but they could also spread to other operations if not controlled. The disease that will be targeted for this project is foot and mouth disease (FMD). Although there has not been a major outbreak of this disease in the United States since 1929, FMD has been classified as a security threat by the U.S. Department of Homeland Security because of its ability to easily spread through the livestock population. Although FMD seldom kills the animal, it causes severe morbidity among a high percentage of its hosts. The uncontrolled spread of FMD through the animal population would be a catastrophic blow to the agriculture industry, the largest industry in the United States' economy.

Previous Wash Designs

Wheel and undercarriage wash systems used specifically for transport vehicles in the CAFO industry have not been found in research, however, wheel wash systems for large vehicles in mining and transportation industries somewhat common. The washing system designed will be similar to washes for mining and transportation vehicle washes, although a few specifications will need to be considered. Cattle transport trucks fall under the heaviest AASHTO axle loading category; therefore, the magnitude of the weight of a fully loaded cattle truck will need to be considered when designing the structure of the wash. A sanitizing and disinfecting component will also be looked into being used in order to eliminate bacterial and viral particles that may be attached to a vehicle via organic matter. Another consideration that must be observed is that vehicles entering and exiting this wheel and undercarriage wash station will have live cargo on them. All processes on this wash system must be safe to use around animals.

Approach

Structural Analysis/Design

The first step for the structural portion of the project was to determine the loads applied to the wash. Both dead and live loads had to be considered. The live load was due to the vehicles driving across the wash. Maximum live load was determined from the axle load limits of 20,000 pounds for single axle, 34,000 pounds for tandem, and a gross weight of 80,000 pounds set by FHWA. Initially, the unfactored live load was taken as 60,000 pounds. However, it was determined that the entire truck would not be on the wash at one time, and 20,000 pounds per axle would suffice for the design live load. The dead loads are due to the weight of the wash itself. Since there are several different structural safety factors, depending on what structure is being built, it was necessary to determine a common safety factor. To remain consistent throughout, the LRFD Load factors and AASHTO impact factors were used during the design process. The only exception to this was the design of the steel structural I-beam and in the design of the elastomeric bearings. It is common practice to design a structural system where the ductile material fails first, since ductile materials fail more slowly and noticeably than brittle ones (Nilson & Darwin, 2010). Because all of the other steel members were embedded in concrete it was decided to have the steel I-beams reach failure before anything else. This was accomplished by applying a 1.2 factor of safety rather than the LRFD Load factors. On top of using the AASHTO safety factors, the bearings were also designed using the Texas Department of Transportation regulations.

The first thing chosen to hold the vehicles was a steel cattle guard. A bending stress analysis was done on one of the 3.5 in. pipes in the cattle guard to determine if it would be able to hold the full weight of the largest truck's axle. The pipe was treated as a beam that was simply supported. In actuality two pipes would have shared the load because the wheels would be touching two pipes at a time. However, in order to ensure that the the cattle guard could hold the required weight it was necessary to do the worst case scenario. The pipe had a small moment of inertia and was determined to be incapable of holding the required weight. Wide flange I-beams were chosen to replace the cattle guard in the system.

An elastomeric bearing was designed to hold the I-beam in place. It will keep the beam from uplifting off its supports and allow the beam to rotate (Texas Department of Transportation, 2010). The bearing was designed according to AASHTO and Texas Department of

Transportation standards. Values were selected for the length and width of each bearing based on the allowed room. Thickness of the reinforcement was then picked and then checked. The size, shape, and strength were then checked. The main things looked at in the design of the bearing were rotation, deflection, and slippage. AASHTO has regulations that are in place to ensure that the pad will not slip due to insufficient dead load. There are also regulations on the amount of rotation the beam is allowed to have. AASHTO does not allow for any uplift in the bearing. However, the Texas Department of Transportation has done research into the amount of uplift allowed for the bearing and has determined its own standards (Texas Department of Transportation, 2010). Basically, research and experimental data has shown that some uplift in the bearing does not affect the life of the system. These standards were used in the rotation analysis of the bearing.

The I-beam was designed by looking at it as a simply supported beam in flexure, since the conditions produced by the bearing fit that of a simple support (Beer, 2012). It was determined that several beams would be able to hold the required factored load, of those several, the three considered are as follows: W12X16, W10X15, and W6X12. The W6X12 I-beam was selected based upon the economic impact. It would be over $1,000 less expensive to purchase and galvanize the W6X12 beam than it would be either of the other two. The W6X12 also fit within the required factor of safety, meaning it would fail earlier than the other two. The stresses in the beam were then found and used to determine the fatigue life of the beam. It was found that the fatigue life of the beam was theoretically infinite. This means that the beam will fail after 1 million cycles (Budynas & Nisbett, 2011). Since it is unknown how many cycles after 1 million the beam will fail, it is recommended that the beam be monitored after six and a half years.

Once the beams and bearings were designed, the supports could be designed. This process began by determining the deadweight produced because of the I-beams. Because of the layout of the I-beams, it was determined that a reinforced concrete beam would be the easiest and most economical to manufacture and use to support the I-beams. Since the beam was going to be made out of concrete, the ACI recommendations were taken into account during the design. The max moment caused by the service loads was used to determine the depth and width of the concrete beam. The minimum reinforcement ratio for the concrete beam was determined by determining the largest amount of steel possible, while still allowing the beam to fail like a ductile material (ACI Committee 318, 2011). Steel reinforcement was then selected based on the reinforcement ratio. It was not necessary to check for the development length of the steel reinforcement in the beam since the reinforcement will span 18 ft.

The supports for the concrete beams were designed once the beams were chosen. For the first support, the beams were treated as walls and wall footings were then designed. The first step in designing the wall footings was to determine the width required for the soil to be able to support the loads. However, the width was determined to be 9 ft, which would make the footings overlap each other, requiring them to support more load. So the next choice for concrete beam supports was to use a column and column footing design. Since the column would be short, no more than 3 ft, it was designed to handle mostly compression forces and the reinforcement in the corners was not required to be very large. The footing was designed for bending and shearing forces. It was possible to use a 4.5 ft square footing that contained minimum reinforcement. However, upon investigation it was determined that the overall height of the system would be too high. In order to counter this, the option of burying everything up to half of the beam was looked at. It was determined however, that this would be too complex of a design that would require high costs in labor and excavation. The next design simply took out the column and designed a footing that had the beam sitting directly on it. This took out the concrete load due to the column and allowed the footing size to be reduced. However, by placing the beam directly on the footing it increased the shear stresses in the footing and it was crucial to look at the punching shear caused by this. Concrete structures in direct contact have a tendency to punch right through (Nilson & Darwin, 2010). This can be likened to pencil punching a hole through a piece of paper. The design also had to account for bending in the footing due to the offset location of the beam. Bending would be caused by the beam pushing down and the soil pushing up. The development length for the steel was too long for the footing. In order to counter this, each of the reinforcing bars were designed to be bent at 90 degree angles. All of the concrete needed to be buried in order to maintain a low system height. Since the concrete beam was designed to withstand flexure in one direction, the soil below the beam could not expand and create a negative moment. In order to ensure this, the soil below the beam will be backfilled with gravel. It was determined that this design would be structurally adequate and also would be easier to implement.

Structural support for the water filtration system and water tank system was the final portion of structural design. A on ground slab was chosen for each of these systems. Tensile forces in the slab were reduced and kept at a minimum by centering the systems and making their respective slabs slightly bigger than the systems. This allowed the concrete slab to be considered in compression only. (Meaning the concrete would not require reinforcement). By making the slab only slightly bigger than the system punching shear in the concrete could be neglected. Once it was determined that the concrete could maintain the loads produced by the systems, the final step was to determine if the soil could maintain the loads distributed over the area.

Pipe Design

The first step in determining the pipe size and system flow rate was to determine the force required to remove the soil and manure build-up on the bottom of the vehicles. The cohesive properties of the soil and manure are responsible for holding the particles together. These same properties allow the soil to adhere to the vehicle. The cohesive force between the soil particles is greater than the cohesive force between the soil and the vehicle. It is difficult to determine the cohesive force that holds the soil to the vehicle without performing complicated experiments. Since the cohesion within the soil is greater than the cohesion between the soil and vehicle, the force that will overcome the cohesion within the soil to break the particles apart will also knock the soil off the vehicle. Only clay soils, the dominant soil for the High Plains region, have cohesive forces. A typical range of values for cohesion are shown in Table 1 (Geotechnicalinfo.com, 2012).

Table 1: Values of Cohesion for Various Conditions

Soil Type	**Cohesion ($\mathrm{lb/ft^2}$)**
Compacted clay	1350-2150
Saturated clay	230-460

The soil on the vehicle will not likely be either fully compacted or saturated, but rather somewhere in between. To ensure the most cohesive soil particles will be removed, the highest value of cohesion (2150 $\mathrm{lb/ft^2}$) will be used to obtain the maximum force necessary. The force required to separate the soil particles must be, at minimum, equal to the cohesive force. The force that separates the soil particles is the force caused by the water jet striking the soil. Therefore, the force of the water jet must be equal to or greater than the cohesive force of the soil. The cohesive force is equal to the cohesive strength of the soil divided by the area the force is applied to. In this case, the area the force is applied to is equal to the cross-sectional area of the water jet. Setting the two forces equal to each other yields the velocity of the water jet required at impact with the vehicle. Using kinematics and the velocity at impact, the velocity at the nozzle exit was calculated. This calculation is based on the assumption that the water jet leaves the nozzle and travels three feet straight up in the air before contacting the bottom of the vehicle. Next, the flow rate from one nozzle was calculated using the velocity just after the nozzle orifice and the area of the water jet. The area of the water jet is equal to the area of the orifice for a zero degree spray nozzle. The principle of conservation of mass was used to calculate the flow rate required in the entire system. The flow rate in must be equal to the total flow rate out, the sum of flow rates from the nozzles. The velocity and flow rate calculations are summarized in Table 2. The detailed calculations are shown in Appendix A.2.

Table 2: Velocity and Flow Rate Throughout System

Velocity at impact	5.87 ft/s
Velocity exiting nozzle	15.1 ft/s
Flow rate through nozzle	0.151 gpm
Flow rate entering system	17.8 gpm

Once the needed flow rate and water velocity were determined, the pipe system could be designed. Piping networks for plumbing and industrial use can be made of a number of materials. It was necessary to make sure that the pipe was made out of a material that had enough strength to withstand the needed pressure to get the desired velocity, but also a material that came in a small enough size to be able to be placed around the already existing steel and concrete structure. Pipes of all types were considered when design began for the pipe network, however polyvinyl chloride pipe was chosen.

Polyvinyl chloride (PVC) pipe is a type of plastic pipe that has a variety of applications. PVC is the material of choice for the piping system because of its versatile properties and cost effectiveness. PVC pipe comes in a variety of schedules, which is the measuring system for wall thickness. This means that a number of the specifications for PVC pipe, including shear strength and outside and inside diameter, are dependent on what schedule is being used. Schedule 40 (Sch 40) PVC is the most common schedule of PVC on the market and can easily be found at any home improvement or hardware store. Sch 40 meets all ASTM specifications required for plastic piping. Unless otherwise stated, all pipes and joints in the undercarriage and wheel wash will be 0.5" Sch 40 PVC pipe, which has an inside diameter of 0.602", an outside diameter of 0.840" and a maximum PSI rating of 600 PSI (Georg Fischer Harvel LLC, 2014).

After determining the pipe type and configuration, the head loss throughout the system was calculated (Appendix A.2). The head loss consists of static and dynamic head loss. The static head loss is due to the elevation change the water must overcome. The dynamic head loss is due to the friction in the pipes and disturbances at the joints. The Darcy-Weisbach equation was used to calculate the dynamic head loss (Wurbs & James, 2002). The entrance coefficients for tee and elbow joints were taken from (Cengel & Cimbala, 2014). A surface roughness of $5 * 10^{-6}$ft was used in conjunction with the Moody Diagram to find the friction factor for the pipes (The Engineering ToolBox, 2014; Wurbs & James, 2002). A breakdown of head loss by branch of the system is given in Table 3. The static head loss for the bottom sprayers is negative because the sprayers are located below the supply tank so the water does not have to overcome an increase in elevation. The supply line has no static head loss because it is at the same elevation as the supply tank. The total head loss for the system is 56.8 feet. The pump chosen to supply water to the system must be able to overcome at least 56.8 feet of head.

Table 3: Head Loss in Pipe System

Pipe Section	Static Head Loss (ft)	Dynamic Head Loss (ft)
Bottom Sprayers	-4.65	4.02
Short Side Sprayers (50 in)	6.48	0.058
Tall Side Sprayers (55 in)	7.30	0.11
Supply Pipe	0	43.5

The pump must also be able to supply the required power for the flow rate and head loss. The pump must provide 276.4 Watts at 70% efficiency to meet the flow rate and head loss requirements (Appendix A.2). Most pumps available from a home improvement store cannot produce the required flow rate or overcome the head of the system. Industrial grade pumps had to be considered to meet the system requirements. This significantly increased the price range of the pumps. Odessa Pumps in Amarillo was contacted to obtain more information about the pumps they offer. Odessa Pumps carries a Grundfos CRE 5-22 A-FGJ-A-E-HQQE vertical, centrifugal pump that meets the needs of the system and has an energy-efficient motor.

A concern during the design process was protecting the pipes from the sub-freezing temperatures experienced in High Plains winters. Multiple possible solutions were identified.

The pipes could be buried in the ground to insulate them. They could also be wrapped in pipe sleeves, thick foam sleeves used to insulate pipe. These options, however, are not practical for the design of the sprayers. The third option is to wrap the pipe in electric heating cable which uses a preset thermostat to turn on when temperatures drop below a set point. The electric heating cable is the most practical solution to keep the pipes warm and leave the nozzles exposed.

Water Collection and Treatment

With water being in short supply in the High Plains, it is very important to conserve as much water as possible. Thus, it is necessary to collect and reuse the water. Not all of the water will be able to be collected as some will evaporate and some will stay on the vehicles as they leave the wash bay. The water that is collected will need to be treated to remove bacteria and soil particles before it can be reused. To maximize the amount of water captured for treatment, a concrete drainage trough was designed. The trough has a capacity of 508 gallons (Appendix A.2). The area to the side of the trough will be filled with gravel and covered with a 0.014-inch thick pond liner to direct the water into the drain.

The selection of the most appropriate water treatment method began with research on feedlots. The treatment system depended on the number of cattle trucks, feed trucks, and employee vehicles going in and out of the feedlot every day. Since no one site was selected for the design, the largest single feedlot in Texas, Bar G Feed yard, was used as a base point for design. All information about Bar G was obtained from the assistant manager, Mr. Kevin Bunch. The daily number of vehicle washes needed was found to be approximately 420 washes. That includes washing each vehicle once as it enters the lot and once as it leaves the lot. This method was chosen as the best route for prevention of spreading disease.

To determine the appropriate recycling speed needed, an approximate amount of water per wash was found after consulting with many different truck wash facilities. A safe estimation of 100 gallons per wash was determined. The average truck wash facility is around 180 feet, and the wash lasts approximately 5 minutes (The Truck Wash Industry). After performing a simple calculation, the average flow rate for a truck wash was found to be approximately 5 gallons per minute. After finding this number, focus turned to finding the best water treatment method.

Many treatment systems were analyzed before choosing the best system for the project. After exploring different systems with bioreactors, chlorine disinfection and ozone disinfection, one system was found to be effective and affordable. Ozone treatment for water disinfection was selected because it eliminates viruses and bacteria better than chlorine, and it utilizes a shorter contact time as well (Wastewater Technology Fact Sheet: Ozone Disinfection,1999). The bioreactor systems that were found would have worked for the design, but each system was significantly more expensive than the ozone treatment system. One of the main concerns in using ozone as a treatment process is the production of toxic byproducts such as bromate. To address this issue, the system found includes an active carbon filter to reduce the oxidant demand, and as a result it removes the bromate (DBP: Bromate Fact Sheet, 2009).

Transportation/Surveying

The first step of designing the undercarriage wheel wash was determining what vehicles would be serviced by the wash and limiting the wash to certain vehicles to ensure safety and cost efficiency of the wash. Referencing the FHWA, TXDOT, and AASHTO the wash was designed to service any vehicle from a passenger car (P) to an interstate semitrailer (WB-62). The WB-62 interstate semitrailer was chosen as the maximum design vehicle due to the size and weight limits set by TXDMV.

The following maximum dimensions may be operated on Texas' highways without a permit:

- Width – 8'6"
- Height – 14'
- Length (includes any front/rear overhang):

Table 4: TXDMV Texas Size/ Weight Limits

Vehicle Type	Length Limit
Single motor vehicle	45 feet
Truck-tractor	Unlimited
Semitrailer, of two-vehicle combination	59 feet

Two- or Three-Vehicle combination other than truck-tractor & semitrailer[1]	65 feet
Each trailer or semitrailer of a twin-trailer combination	28.5 feet
Traditional boat/auto transporter combination[1]	65 feet
Commercial truck & stinger-steered semitrailer transporting autos/boats[1]	75 feet
Front overhang	3 feet
Rear overhang	4 feet

- Weight:
    - Gross - 80,000 pounds maximum
    - Single axle - 20,000 pounds
    - Tandem axle group - 34,000 pounds
    - Triple axle group - 42,000 pounds
    - Quad axle group - 50,000 pounds

[1] Length limit may not be increased with a permit

[2] The basis for maximum legal weight is the number of axles. This information, in conjunction with the Permissible Weight Table, is used to determine maximum legal weight for a vehicle. (Texas Size and Weight Limits, 2014)

Geotechnical

The ultimate bearing capacity was assumed at 2000 psf for clay soils in the design of the structure (International Building Code §18.1804, 2006). In order to find the ultimate bearing capacity one would use the Terzaghi Equation for ultimate bearing capacity. To calculate the ultimate bearing capacity you would use the Standard Proctor Test (ASTM D-698) to find the unit weight of soil. Next step is to find the friction angle and cohesion. This is done by the Direct Shear Test (ASTM D-3080) by plotting Nominal Shear Stress versus the Nominal Normal Stress to find the friction angle and cohesion. This will most likely have to be done in a Geotechnical Laboratory. This procedure can be found in Appendix C.

There will be 3.7 cubic yards of clay soil replaced around both of the concrete I-Beams to give the interior drainage area greater support. A sandy gravel or gravel will be used to replace the clay soil to help insure minimal shrinkage or expansion in that area and to avoid uneven horizontal pressures on the concrete beams.

The clay soil will need to be treated. Even though compacted clay has a low permeability, it lacks desirable properties like compressive strength and durability. Chemical soil stabilizations brings improved strength and durability without sacrificing the impermeability associated with clay soils and is cheaper than bringing in a more stable soil type. Clay soils can be treated with 15% fly ash or 3% cement powder to stabilize the soil. Then it will be compacted to 95% of the Proctor Test.

Proposed Design

Structural Design

The driving surface for the wash will consist of thirty W6X12 I-beams placed four inches apart. All of the I-beams will be galvanized. Each beam will be attached to reinforced concrete support beams by elastomeric bearings. The elastomeric bearings will be at total thickness of 1.7 inches, with the two outer sections being 0.25 inches thick, the inside layers are 0.15 inches, each inside layer is reinforced with 0.1 inch thick 12 gage steel, and each bearing will 6 inches by 6 inches. This is shown in Figure 3. The bearings will be attached with an adhesive. All the concrete beams will be 24 inches wide, 30 inches deep, with a depth to steel of 28 inches, and will be 20 feet long. Reinforcement inside of the concrete beams will be coated in epoxy. There will be 4 #13 bars 18 ft long with 3 inch spacing in between each. A # 4 stirrup will be spaced every 3ft starting from the center and working out. This is shown in Figure 3. Without exception, the concrete beams will be attached to the footings by wrapping the stirrups from the footing around the flexural reinforcement in the beam. Each footing will have 5 epoxy coated #4 bars in each direction. All of the #4 bars will be bent at 90 degree angles and have 3 inches of spacing on each side. There will be 3 #3 stirrups spaced at 10 inches placed in each direction in the footing. This is detailed in Figure 3. All of the concrete supports will be covered in soil, with 6 inches of the concrete beam protruding from the ground. The soil around the concrete beam will be backfilled with gravel.

The filtration system will be placed in the center of an unreinforced 72 inch by 18 inch concrete slab and the water supply tank will be centered on a 78 by 78 inch slab. Both slabs will be placed on ground. All of the ground for the systems must be leveled out.

Pipe System, Nozzles and Pump

Schedule 40, ½ inch PVC pipe will be used to transport the water throughout the system. The PVC will be connected using threaded connections, where possible, and secured with PVC cement. There will be five rows of PVC, each running horizontally between the steel beams. Each row will have twenty size 6.5 nozzles with a zero degree fan angle. A fan angle of zero degrees is to be used because zero degree fan angles are the best nozzle type to use when trying to remove large chunks of mud and debris from a particular area. These nozzles will spray directly up to hit the undercarriage. The nozzles on each pipe are spaced 4.5 inches apart. Each pipe has the nozzles offset one inch from the previous pipe to ensure maximum coverage. Both sides of the wash will have two side sprayers. One side sprayer will be 55 inches tall with five nozzles and the other will be 50 inches tall with four nozzles. The nozzles will be size 6.5 with a 15 degree fan angle. A 15 degree fan angle is to be used for the side sprayers to ensure that the entire surface area of all wheels and wheel wells will be sprayed for debris removal. The nozzles are spaced every 11 inches and are offset from one another for maximum coverage. All of the pipes, bottom and side, will branch from a single main supply pipe. This supply pipe will be connected to the water supply tank via a pump.

Electric heating cable will be used to warm the pipes and prevent them from freezing. The cable is wrapped around the pipes and plugged into a preset thermostat which allows the cable to turn on when the temperature drops below 38 °F. Electric heating cable, tape to attach the cable, and preset thermostats are available at most home improvement stores in the plumbing section. Easy Heat produces these products to meet the appropriate standards. The Easy Heat electric heating cable is safe for use on both metal and plastic pipe and is easy to install.

Water will be supplied to the system from a Grundfos CRE 5-22 A-FGJ-A-E-HQQE vertical, centrifugal pump. The pump has in-line suction and discharge ports. It runs off a Grundfos Blueflux approved pump which meets energy-efficient pump requirements set in the legislature. The pump can run with fluid temperature ranging from -4 °F to 248 °F. This model can run 25 gpm at 363 psi and overcome 256 feet of head which easily meets the system requirements. Grundfos created the Grundfos GO mobile toolbox which allows the user to control a Grundfos GO enabled pump from a mobile device (Grundfos, 2014). This feature also allows the user to connect a laser trigger sensor that prompts the pump to turn on. The undercarriage wash will use this feature to trigger the system when a vehicle enters the area. A laser can be set up in front of the wash to start the wash with another laser after the wash to turn the pump off. The Grundfos pump will cost $5,500 and the GO tool can be downloaded for free. Pump data and efficiency curves can be found in detail in Appendix B.

Water Recovery System

The water recovery system selected for the design came from Custom Applied Technology Corp (CATEC) Custom Water Recovery Systems. The designated model is the CWR-15DXP, seen in Figure 1. The CWR-15DXP is designed with an ozone system to disinfect the water along with a series of filters to reduce the particle size to smaller than 10 μm. The system comes pre-plumbed and pre-wired for minimal installation maintenance (Model CWR-15 Industrial Water Treatment System). The recovery system is a closed-loop system requiring no new water besides the small amount of water lost in overspray.

The system comes with a sump pump that pumps water at 15 gallons per minute (gpm). This recycling speed meets the design requirements of at least 5 gpm. The ozone system comes with its own oxygen generator and air compressor to produce ozone. Two 750 gallon cone-bottom storage tanks will be attached to the system to hold the treated water.

Figure 1: CATEC CWR-15DXP with storage tanks

Table 5: CWR-15DXP Specifications

System Features	
	Powder Coated Aluminum Frame
	Fiberglass Filter Tanks
	Sch. 80 PVC, Solid Brass
	Ballast Tank
	71"w X 17"d X 68"h
	650 lbs
Filtration System	
	2 HP Filter Pump

	Brass Check Valve (2)
	Pump Basket Filter
	25 µm filter
	10 µm post filter (2)
	Pressure Relief Valve
	Weep System
	Hose Bib
	Automatic Fresh Water Bypass
Ozone System	
	¾ HP Recirculation Pump
	CAT-800 Ozone System (8 mg/hr)
	Onboard Oxygen Concentrator
	Onboard Air Compressor
	Timer and Override Controls
	Flow Control and Indicator
	Ozone Injection System
	Fiberglass Enclosure
Instrumentation	
	Filter Pump Control
	Ozone Pump Control
	Filter System Input Pressure Gauge
	Filter System Output Pressure Gauge
	Re-Pressurization Pressure Gauge
	Filter Differential Pressure Gauge
	Ozone Power Control w/ Indicator
	Adjustable Ozone Flow Meter

	Filtration System Hours Meter
	Onboard 115V AC Circuit Breaker

Waste Management

The waste produced by the wash will consist of soil primarily with a small amount of manure, oil and grease. Considering this information, most of the waste will be placed with the rest of the feedlot manure. To prevent any risk of disease, the waste will be placed in a dumpster and held for a week to ensure no infected manure exists in the waste. Different dumpster sizes were found to give options depending on feedlot sizes. The structural specifications are found in Appendix A.4 (Roll Off Containers, 2014). The TCEQ, TAHC and TDA were contacted in regards to a situation where infected manure might occur. The TCEQ confirmed that according to RCRA, infected manure does not qualify as a hazardous waste. The TDA and the TAHC had no regulations concerning disposal of infected manure. In such a situation the infected manure will be disposed at a municipal solid waste (MSW) landfill.

Transportation/ Surveying

The wash is to be sited in an area near the current entrance of the feed-yard, suggestively in a corner section of surrounding farmland currently owned and operated by the feed-yard. This location will allow for ease of access to the site for WB-62 semitrailer-trucks, while eliminating delay time for vehicles during the time of construction. The design layout of horizontal curves for WB-62 trucks turning at 90 degree shall be a Three-Centered Compound Curve with radii equal to 400-70-400 feet as shown on page 9-61 in the AASHTO Green Book.

Economics

The budget for this project is $100,000. The major costs for the project come from the water treatment system and building the structure (including the support footings and beams). The initial cost estimate of the undercarriage wash is $62,975.34 (Appendix A.3). This value does not include the price of galvanizing the steel beams, or the price of the ramps on and off the wash. The cost of the concrete and #18 steel reinforcements were estimated using similar products (Calculator.net, 2014). These prices do not consider the cost of labor will be expected to double to cost of the structural components (concrete and steel). A better economic analysis can be done once quotes have been received. Operation and maintenance cost must also be considered for the undercarriage wash. These costs are minimal compared to the initial cost. Weekly maintenance includes changing the water treatment system filter, cleaning the drain, and hauling off the sludge. The pipes in the system will need to be flushed monthly. The operation and maintenance costs over a year are $6672.00 (Appendix A.3).

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Appendix A- Calculations

A.1- Structural Calculations

Structural Concrete Calculations:
I-Beam Design:

This section is going through the basic MC/I equation to determine the maximum bending stress in the beam.

W6X12
c (in)= 3
I (in^4)= 22.1
F.S.= 1.2
Fy (ksi)= 50

σ= Mc/I
σ= (2P)*c*12/I
σ= 3.2579P

The Distortion Energy Failure Method is a way to combine all stresses on the beam and determine the maximum stress. However, since the beam is essentially only in bending and not expected to have torque or transverse forces on it the equation simplifies down to absolute strength over expected stress.

Distortion Energy Failure Method:
F.S.= Fy/s
Solving for P
P (kips)= 12.79 Max unfactored load
Load/axle= 25.58

W12X16
c (in)= 6
I (in^4)= 103
F.S.= 1.2
Fy (ksi)= 50

σ= Mc/I
σ= (2P)*c*12/I
σ= 1.40P

Distortion Energy Failure Method:

F.S.= Fy/s

Solving for P

P (kips)= 29.76 Max unfactored load

Load/axle= 59.52

W10X15

c (in)= 5

I (in^4)= 68.9

F.S.= 1.2

Fy (ksi)= 50

σ= Mc/I

σ= (2P)*c*12/I

σ= 1.74P

Distortion Energy Failure Method:

F.S.= Fy/s

Solving for P

P (kips)= 23.95 Max unfactored load

Load/axle 47.9

The affects of loading the wash cyclically needed to be looked at since the loading is cyclical in nature (a truck is on the wash, then nothing is on the wash). The Variable Load Fatigue Analysis takes the number of cycles and quantifies it as fatigue stress.

Variable Load Fatigue Failure Analysis (Shigley's Mechanical Engineering Design):

p (kips)= 15

σ_{max}= Mc/I

σ_{max} (ksi)= 4.07239819 Max Stress

$\sigma_a=\sigma_m$ The stress amplitude is equal to the stress midrange

σ_a (ksi)= 2.036199095

kf= 1 Notch Sensitivity Factor

$\sigma_a'=\sigma_m'=\sigma_a$

S'e= 25 0.5*Fy Endurance Limit

Endurance Limit Modyifing Factors:

A0.95= 0.112

kb= 1.111183147 Size factor

kd @100 °F= 1.008 Temperature Factor

Se= 28.0018153

Modified Goodman Equation:

n=	8.815181141

Since n is > 1 the beam has theoretical infinte life

The number of cycles for a therotical infinite life is greater than 10^6. This means this system will fail from fatigue some time after this (Shigley's Mechanical Engineering Design).

Number of Cycles=	1000000
days=	2500
years=	6.849315068

Pad Design:
Given:

L (ft)=	10 ft	
U.W. of Steel (lb/ft)=	15	
Ws (lb)=	120	UW*L

The first step in designing the elastomeric bearing is to develop pad dimensions based on spacing requirements. Then that design is checked.

Pad Information:

Elastomer=	60	
hro (in)=	0.25	Thickness of individual outer layers
nro=	2	Number of outer layers
hrot (in)=	0.5	Total thickness of outer layers
hri (in)=	0.15	Thickness of interior layers
nri=	10	Number of interior layers
hrti (in)=	1.5	Total thickness of interior layers
hrt (in)=	2	Total thickness of elastomer
hs (in)=	0.1	Thickness of reinforcement, 12 g steel
ns=	7	Number of steel layers
Fy (ksi)=	36	Yield strength of reinforcement
h (in)=	2.7	Height of Bearing Pad
L (in)=	6	Perpendicular to bridge long axis
W (in)=	6	Parallel to bridge long axis
Skew=	0	Skew angle of bridge

Wbridge (ft)= 0.333333333

AASHTO has regulations for the size proportions of the bearing. The shape factor was developed for those requirements.

Shape Factor (AASHTO LRFD 14.7.5.1):

A (in^2)= 36 L*W

Abi (in^2)= 3.6 2*hri*(L+W)

Si= 10 A/Abi Shape Factor

Fits recommended shape factor

10 < Si < 12

The lowest Shear strength of the bearing is used in order to be conservative.

Shear Modulus (AASHTO LRFD 14.7.6.2):

G73 (psi)= 130

Go (psi)= 175

Stablility Check (AASHOT LRFD 14.7.6.3.6):

hrt max= 2 L/3 governs

2 W/3

hrt max > hrt ok

Shear Check (AASHTO LRFD 14.7.6.3.4):

α in/(in*F°)= 0.000006 Coefficient of Thermal Expansion

ΔT (F°)= 105

Δsx= 0

Δsy (in)= 0.000105 α*(Wbridge/2)*ΔT Governs

hrt min (in)= 0.00021

Hrt > hrt min ok

Loads:

Span (ft)= 10

Beam DL (kips)= 0.06 Ws/2/1000

Bearing Pad Slip Check:

Δs Max (in)= 0.003809524

0.003704524

Live Load:

Truck LL (kips)= 12.5

Stresses:

σd=	0.001666667	DL/A	Dead Load Stress (ksi):
σL=	0.347222222	LL/A	Live Load Stress (ksi):
σs=	0.348888889	(LL+DL)/A	Total Load Stress (ksi):

Compressive Stress Check Txdot Standards BDM-LRFD:

σdmax (ksi)=	1.2	governs	1.2*G73*Si
or	1.56		

σdmax > σd so ok

σsmax (ksi)=	1.5	governs	1.5*G73*si
or	1.95		

σsmax > σs so ok

Compression Deflection (AASHTO LRFD 14.7.6.3.3)

εsi=	1.50%	Elastomer Strain for Service Loading
εdi (%)=	0.007165605	Elastomer Strain for Dead Load
εli (%)=	1.492834395	Elastomer Strain for Live Load

Since all of the layers are equal the following equations apply

δdi (in)=	0.01433121	Instantaneous Dead Load Compression
αcr=	0.25	Creep Deflection Factor
δlt (in)=	0.017914013	Long Term Compression Deflection
δL (in)=	0.029856688	Instantaneous Live Load Compression
δs (in)=	0.047770701	Service load deflection
δsimax (in)=	0.0105	Maximum Service load deflection
δsi (in)=	0.003582803	δs*(hri/hrt)

δsimax > δsi so ok

Rotation Txdot Standards BDM-LRFD:

E (ksi)=	29000	
I (in^4)=	22.1	
θDL (rad)=	0.00056171	rotation due to dead load
ΔLL (in)=	0.15	Deflection due to live load
θLL (rad)=	0.005	rotation due to live load

θ (rad)= 0.01056171 total rotation Sum rotations and add 0.005 rad (BDM-LRFD)
δmin (in)= 0.025348104 Deflection caused by rotation
δs > δmin so ok

Reinforcement Check (AASHTO LRFD 14.7.6.3.7):
hsmin (in)= 0.004361111 minimum allowable steel layer
hsmin < hs so ok

ΔFth (ksi)= 24
hsmin= 0.004340278
hsmin < hs so ok

Given:

DL (lbs)=	4,500	β1=	0.85
LL (lbs)=	26,000	εt=	0.005
f'c (psi)=	4,000	εu=	0.003
L (ft)=	20	fy (psi)=	60,000

Solve:

Reinforced Concrete Beam Design Calculations:
Wu (lb/ft)= 23500 (1.2*DL+1.6*LL)/2
Mu (Kip-in)= 14100000 1/8*Wu*(L^2)*12
Mu (lb-in)= 14100 Max moment due to factored loads

Steel Reinforcement:
ρ0.005= 0.0180625 0.85*β1*(f'c/fy)*(εu/(εu+0.005))

Max Ratios ACI Code:
ρmax= 0.020642857 0.85*β1*(f'c/fy)*(εu/(εu+0.005))

Determine width and Depth:
Mu=ΦMn= Φ*ρ*fy*b*(d^2)(1-0.59*(ρ*fy/f'c))
bd^2 (in^3)= 17177.62631

b (in)= 24
d (in)= 26.75321344 Actual= 28

Required Steel:

As (in^2)= 12.138 ρbd

Rebar No. 18= 3.0345 As/4 4 # 18

h (in) (2 inch cover)= 30

b,d,h= 24,28,30

Spacing (ACI-10.6.4):

S (in)= 10 15*(40,000/(2/3*60,000))-2.5*cc

Min Spacing (ACI-7.6.1):

S=2.257 in= **Use 1 row of 4 # 18 bars @ 3 in**

stirrup @ 3 ft intervals

# of stirrups= 6

Wall Design: # of beams= 30

Given:

DL (lbs)= 2,250 wall Width (in)= 12

LL (lbs)= 12,500

f'c (psi)= 4,000

L (ft)= 20

Solve:

qa (psf)= 2,000

qe (psf)= 1,650

b (ft)= 8.939393939

Column Design: Rebar lb/ft= 13.6 Stirrup lb/ft= 0.668

W of Steel= 1094.68

W of Concrete= 14377.5

d (in)= 12 Width of the Column

DL (lbs)= 8,861 (DL/4+Ws/2+Wc/2)

LL (lbs)= 13,000 LL/4

Wu (lb/ft)= 31433.308

Pn (lb)= 722936 0.85*f'c[(d^2)-4*0.49]+4*60,000

ΦPn=	469908.4	0.65*Pn

Tie Spacing (AIC-7.10.5):	db (in)=	0.375
S (in)=	6	16*db

Height of Column AIC :

I (in^4)=	1728	1/12*d^4
A (in^2)=	144	d^2
r (in)=	3.464101615	(I/A)^0.5
L (in)=	34.64101615	l/r=10
L (ft)=	2.886751346	
Height (ft)=	**1.5**	

Tie Spacing:
 # 3 tie every 3 in up to 5 ties

Footing Design:

Wc (lb)=	100.5	
Ws (lb)=	7.52	
DL (lb)=	8,969	DL+Wc+Ws
LL (lb)=	13,000	LL

Footing:

Soil Cover (ft)=	3.5		
Bearing Pressure (Psf)=	2,000		
qe (psf)=	1650		
A required (ft^2)=	13.31461212		
b (ft)=	3.648919309	actual=	4.5

Try 4.5 ft Square Footing:

Wu (lb/ft^2)=	1558.663309
Wu (kip/ft^2)=	1.558663309

Shearing:

Try (d=8)	b (in)=	54	a (in)=	12
d (in)=	8			
bo (in)=	104	4*(18+d)		
Vu1 (kips)=	27.2333117	Wu*((b/12)^2-((a+d)/12)^2)		
Vc (kips)=	210.4812011	4*λ*(f'c)^0.5*bo*d/1000		
ΦVc (kips)=	157.8609008	0.75*Vc		
ΦVc > Vu1 d=8 ok				

Vu2 (kips)=	7.59848363	Wu*(1.75-d/12)*4.5
Vc (kips)=	54.64415797	2*λ*(f'c)^0.5*b*12*d/1000
ΦVc (kips)=	40.98311848	
ΦVc > Vu2 d=8 ok		

Bending Moment:

Mu (kip-in)=	73.64684133	Wu*b*1.75/2*12	
a=2			
As (in^2)=	0.075768355		
As,min (in^2)=	1.366103949		
not less than			
As (in^2)=	1.44		Governs

8 # 4 bar in each direction

ldc (in)=	8
d= 8 ok	

Splice (in)=	15	0.0005*db*60000

1.5 ft into column

Redesigned Support:

Given:

DL (lbs)	4,500	β_1	0.85
LL (lbs)	25,000	ε_t	0.005
f'c (psi)	4,000	ε_u	0.003
L (ft)	20	fy (psi)	60,000

Solve:

Beam Design Calculations:

Wu (lb/ft)	22700	(1.2*DL+1.6*LL)/2
Mu (Kip-in)	13620000	1/8*Wu*(L^2)*12
Mu (lb-in)	13620	

Steel Reinforcement:

ρ0.005	0.0180625	0.85*β1*(f'c/fy)*(εu/(εu+0.005))

Max Ratios ACI Code:

ρmax	0.020642857	0.85*β1*(f'c/fy)*(εu/(εu+0.005))

Determine width and Depth:

Mu=ΦMn=	Φ*ρ*fy*b*(d^2)(1-0.59*(ρ*fy/f'c))			
bd^2 (in^3)	16592.85605			
b (in)	24			
d (in)	26.29389667	Actual	26.5	This gives over 2 inch clear cover

Required Steel:

As (in^2)	11.48775	ρbd	
Rebar No. 18	2.8719375	As/4	4 # 18
h (in) (2 inch cover)	28.5		

b,d,h **24,26.5,30**

Spacing (ACI-10.6.4):

S (in)	10	15*(40,000/(2/3*60,000))-2.5*cc

Min Spacing (ACI-7.6.1):

S=2.257 in **Use 1 row of 4 # 18 bars @ 4 in**

stirrup @ 3 ft intervals	
# of stirrups	6

Footing Design:

Wc (lb)	14377.5	Weight of beam concrete
Ws (lb)	1094.68	Weight of beam reinforcement
DL (lb)	8,861	DL/4+Wc/2+Ws/2
LL (lb)	6,250	LL/4

Bearing Pressure :

Soil Cover (ft)	2	
Bearing Pressure (Psf)	2,000	
qe (psf)	1800	
A required (ft^2)		8.39505

b (ft)	**2.897421267**	**actual**	**3**	Width of Footing

Try 3 ft Square Footing:

qu (lb/ft^2)	2292.589778

Shear and Moment:

Mu @ 1.5 ft (lb-ft)	7737.75
Max Shear (lb)	10317

Critical Shear happens at 1.5 ft as well

Factored Shear:

Try (d=8)

d (in)	8
Vu (lb)	5731.820444
ΦVc (lbs)	27322.07898

ΦVc> Vu so ok

Punching Shear:

Check at d/2 for all 3 sides

bo (ft)	6.333333333
Vu (lb)	9370.27294
Vc (lbs)	153813.1854
ΦVc (lbs)	115359.889

ΦVc> Vu so ok

Required Steel:

Mu/(Φbd^2)		44.77864583

Since it is so small a can be set
to 2 in order to determine As

a	2	
As (in^2)	0.245642857	
As,min (in^2)		0.910735966
As (in)	0.96	governs

5 # 4 bars in each direction with 4 in clear cover

3 #3 stirrups @ 10 in spacing

Development Length:

ld (in)	35.57562368
ld (ft)	2.964635306

Hook Devlopment Length:

ldh (in)	11.38419958	
minimum of 12 inches		governs

In accordance with ACI, there must be at least 3 inches in each direction around the reinforcement.

Filtration Slab Design:

Load (lbs)= 1000

17 inches by 71 inches

Area (in^2)= 1207
Stress (psi)= 0.828500414 Load/Area

Strength of Concrete (psi)= 4000
72 by 18 inch slab
Area (in^2)= 1296
Force= 5184000 area * strength of concrete
Concrete slab can support the compressive force of the filtration machine

Bearing Pressure (psi)= 2000
Area (in^2)= 1296
Force= 2592000
So soil can support the distributed concrete load

Water Tank Slab Design:

Load (lbs)= 18763

76 diameter tank

Area (in^2)= 4536.459792
Stress (psi)= 4.136044595 Load/Area

78 by 78 inch slab
Area (in^2)= 6084
Force= 24336000
Concrete slab can support the compressive force of the filtration machine

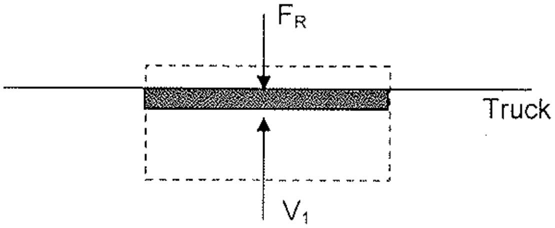
Area (in^2)= 6084
Force= 12168000
Concrete slab can support the compressive force of the filtration machine

A.2- Fluid Calculations

Force Required to Knock Dirt off Truck Bottom and Corresponding Velocity before Impact

Conservation of mass:

$$\sum \vec{F} = \sum_{out} \beta \dot{m} \vec{V} - \sum_{in} \beta \dot{m} \vec{V}$$



$$F_R = reaction\, force = force\ of\ water\ jet\ on\ vehicle$$

$\dot{m} = \rho_{H_2O} v_1 A_1$ where A_1 is the cross-sectional area of the water jet

Fan angle of nozzles = 0°, therefore diameter of jet equals diameter of nozzle orifice

$$A_1 = \frac{\pi}{4} d_{orifice}^2 \qquad \rho_{H_2O} = 62.4 \frac{lb}{ft^3} \qquad \beta = 1$$

$$\sum F_y = 0 - \beta \dot{m} v_1 = -F_R \quad \therefore \quad F_R = \beta \dot{m} v_1 = (\rho_{H_2O} v_1 A_1) v_1 = \rho_{H_2O} v_1^2 * \frac{\pi}{4} * d_{orifice}^2$$

The force holding the dirt together is called cohesion (c).

$$230 \frac{lb}{ft^2} \le c_{saturate\ clay} < 460 \frac{lb}{ft^2}$$

$$1350 \frac{lb}{ft^2} \le c_{compacted\ clay} < 2150 \frac{lb}{ft^2}$$

Clay on vehicles will be between compacted and saturated. The larger the value of cohesion is, the harder it is to separate soil particles. Select largest value of cohesion to ensure all dirt will be knocked off the vehicle. $c = 2150 \frac{lb}{ft^2}$

Force required to separate soil particles:

$F_{soil} = cA$ where A is the area the force is applied to

A is equal to the area of the jet because the jet will be applying the force.

$$F_{soil} = c * \frac{\pi}{4} d_{orifice}^2$$

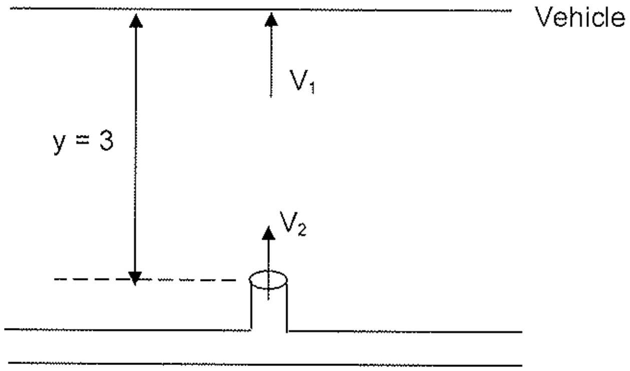
To knock the dirt off $F_R \ge F_{soil} \quad \therefore \quad at\ minimum\ F_R = F_{soil}$

$$\rho_{H_2O} v_1^2 * \frac{\pi}{4} * d_{orifice}^2 = c * \frac{\pi}{4} d_{orifice}^2$$

$$\rho_{H_2O} v_1^2 = c \qquad \left(62.4 \frac{lb}{ft^3}\right) v_1^2 = 2150 \frac{lb}{ft^2}$$

$$v_1^2 = 34.46 \qquad v_1 = \sqrt{34.46} = 5.87\, ft/s$$

Minimum Required Velocity and Flow Rate Leaving the Nozzle



$$v_2^2 = v_1^2 + 2ay = \left(5.87\frac{ft}{s}\right)^2 + 2\left(32.2\frac{ft}{s^2}\right)(3\,ft) = 227.657\,\left(\frac{ft}{s}\right)^2$$

$$v_2 = \sqrt{227.657} = 15.1\,ft/s$$

$$Q_2 = v_2 A_{orifice} = v_2\frac{\pi}{4}d_{orifice}^2 = \left(15.1\frac{ft}{s}\right)\left(\frac{\pi}{4}\right)\left(\frac{0.064\,in}{12\frac{in}{ft}}\right)^2 = 3.37 * 10^{-7}\frac{ft^3}{s}$$

$$\left(3.37 * 10^{-7}\frac{ft^3}{s}\right)\left(7.48\frac{gal}{ft^3}\right)\left(60\frac{s}{min}\right) = 0.15\,gpm$$

Minimum Required Flow Rate into System

Conservation of Mass:

$$Q_{in} = Q_{out} = Q_2 * \#\,of\,nozzles = \left(0.15\frac{gpm}{nozzle}\right)(118\,nozzles) = 17.7\,gpm$$

Head Loss in the Pipes

Dynamic Head Loss: caused by friction in the pipes and minor losses at connections (such as tee joints)

$$H_D = \frac{fl}{d}\frac{v^2}{2g} \qquad \frac{fl}{d} = K = K_{pipe} + K_{fitting} \qquad d_{pipe} = \frac{0.622\,in}{12\frac{in}{ft}} = 0.0518\,ft$$

$$K_{tee\,joint} = 0.9$$

Bottom Pipes: 20 nozzles per pipe so 20 tee joints per pipe; 5 pipes 10 ft long

$$l_{pipe,bottom} = 10\,ft \qquad v_{pipe,bottom} = \frac{20 * Q_2}{A_{pipe}} = \frac{20(3.37 * 10^{-4}\frac{ft^3}{s})}{\frac{\pi}{4} * (0.0518\,ft)^2} = 3.20\frac{ft}{s}$$

$$Re = \frac{vl\rho}{\mu} = \frac{\left[\left(3.20\frac{ft}{s}\right)(10\,ft)\left(62.4\frac{lb}{ft^3}\right)\right]}{2.034 * 10^{-5}\,\frac{lb * s}{ft^2}} = 9.82 * 10^7$$

$$\epsilon_{pvc} = 5 * 10^{-6}\,ft \qquad \frac{\epsilon}{D} = \frac{5*10^{-6}ft}{0.0518\,ft} = 9.65 * 10^{-5}\,ft/ft$$

From the Moody diagram, $f = 0.012$

$$K_{pipe} = \frac{fl}{d} = \frac{(0.012)(10\,ft)}{0.0518\,ft} = 2.32$$

$$K_{total,bottom} = (5\,pipes)(2.32 + \ 0.9 * 20) = 101.6$$

$$H_{D,bottom} = \frac{101.6\left(\left(1.597\frac{ft}{s}\right)^2\right)}{2 * 32.2\frac{ft}{s^2}} = 4.02\,ft$$

55 inch Side Pipes: 5 nozzles per pipe so 5 tee joints per pipe; 2 pipes 55 in (4.58 ft) long

$$l_{pipe,side\ long} = 4.58\,ft \qquad v_{pipe,side\ long} = \frac{5*Q_2}{A_{pipe}} = \frac{5(3.37*10^{-4}\frac{ft^3}{s})}{\frac{\pi}{4}*(0.0518\,ft)^2} = 0.80\frac{ft}{s}$$

$$Re = \frac{vl\rho}{\mu} = \frac{\left[\left(0.80\frac{ft}{s}\right)(4.58\,ft)\left(62.4\frac{lb}{ft^3}\right)\right]}{2.034 * 10^{-5}\,\frac{lb * s}{ft^2}} = 1.12 * 10^7$$

$$\epsilon_{pvc} = 5 * 10^{-6}\,ft \qquad \frac{\epsilon}{D} = \frac{5*10^{-6}ft}{0.0518\,ft} = 9.65 * 10^{-5}\,ft/ft$$

From the Moody diagram, $f = 0.012$

$$K_{pipe} = \frac{fl}{d} = \frac{(0.012)(4.58\,ft)}{0.0518\,ft} = 1.06$$

$$K_{total,side\ long} = (2\,pipes)(1.06 + \ 0.9 * 5) = 11.12$$

$$H_{D,side\ long} = \frac{11.12\left(\left(0.80\frac{ft}{s}\right)^2\right)}{2 * 32.2\frac{ft}{s^2}} = 0.11\,ft$$

50 inch Side Pipes: 4 nozzles per pipe so 4 tee joints; 2 pipes 50 in (4.17 ft) long

$$l_{pipe,side\ short} = 4.17\,ft \qquad v_{pipe,side\ short} = \frac{4*Q_2}{A_{pipe}} = \frac{4(3.37*10^{-4}\frac{ft^3}{s})}{\frac{\pi}{4}*(0.0518\,ft)^2} = 0.64\frac{ft}{s}$$

$$Re = \frac{vl\rho}{\mu} = \frac{\left[\left(0.64\frac{ft}{s}\right)(4.17\,ft)\left(62.4\frac{lb}{ft^3}\right)\right]}{2.034 * 10^{-5}\,\frac{lb * s}{ft^2}} = 8.19 * 10^6$$

$$\epsilon_{pvc} = 5 * 10^{-6}\,ft \qquad \frac{\epsilon}{D} = \frac{5*10^{-6}ft}{0.0518\,ft} = 9.65 * 10^{-5}\,ft/ft$$

From the Moody diagram, $f = 0.012$

$$K_{pipe} = \frac{fl}{d} = \frac{(0.012)(4.17\,ft)}{0.0518\,ft} = 0.966$$

$$K_{total,side\ short} = (2\,pipes)(0.966 + \ 0.9 * 4) = 9.13$$

$$H_{D,side\ short} = \frac{9.13\left(\left(0.64\frac{ft}{s}\right)^2\right)}{2 * 32.2\frac{ft}{s^2}} = 0.058\ ft$$

Supply Pipe: 0 nozzles; 5 tee joints; 1 elbow joint; 8 ft long

$$K_{elbow} = 1.5 \qquad l_{pipe,supply} = 8\ ft$$

$$v_{pipe,supply} = \frac{Q_{in}}{A_{pipe}} = \frac{(0.0398\ \frac{ft^3}{s})}{\frac{\pi}{4} * (0.0518\ ft)^2} = 18.9\ \frac{ft}{s}$$

$$Re = \frac{vl\rho}{\mu} = \frac{\left[\left(18.9\frac{ft}{s}\right)(8\ ft)\left(62.4\frac{lb}{ft^3}\right)\right]}{2.034 * 10^{-5}\ \frac{lb * s}{ft^2}} = 4.63 * 10^8$$

$$\epsilon_{pvc} = 5 * 10^{-6}\ ft \qquad \frac{\epsilon}{D} = \frac{5*10^{-6} ft}{0.0518\ ft} = 9.65 * 10^{-5}\ ft/ft$$

From the Moody diagram, $f = 0.012$

$$K_{pipe} = \frac{fl}{d} = \frac{(0.012)(8\ ft)}{0.0518\ ft} = 1.85$$

$$K_{total,supply} = 1.85 + \ 0.9 * 5 + 1.5 * 1 = 7.85$$

$$H_{D,supply} = \frac{7.85\left(\left(18.9\frac{ft}{s}\right)^2\right)}{2 * 32.2\frac{ft}{s^2}} = 43.5\ ft$$

Total Dynamic Head Loss: $H_{D,total} = \sum H_D = 4.02\ ft + 0.11\ ft + 0.058\ ft + 43.5\ ft = 47.7\ ft$

Static Head Loss: $H_S = discharge\ level - supply\ tank\ bottom\ level$ (relative to grade)

$$H_{S,total} = \sum H_{S\ pipes}$$

Bottom Sprayers: $H_{S,pipe} = -0.43\ ft - 0.5\ ft = -0.93\ ft$

$H_{S,bottom} = 5 * -0.93\ ft = -4.65\ ft$

Short Side Sprayers: $H_{S,side} = 3.74\ ft - 0.5\ ft = 3.24\ ft$

$H_{S,short\ side} = 2 * 3.24\ ft = 6.48\ ft$

Tall Side Sprayers: $H_{S,side2} = 4.15\ ft - 0.5\ ft = 3.65\ ft$

$H_{S,tall\ side} = 2 * 3.65\ ft = 7.30\ ft$

Total Static Head Loss: $H_{S,total} = -4.65 + 6.48 + 7.30 = 9.13\ ft$

Total Head: $H_{total,system} = H_{D,total} + H_{S,total} = 47.7\ ft + 9.13\ ft = 56.8\ ft$

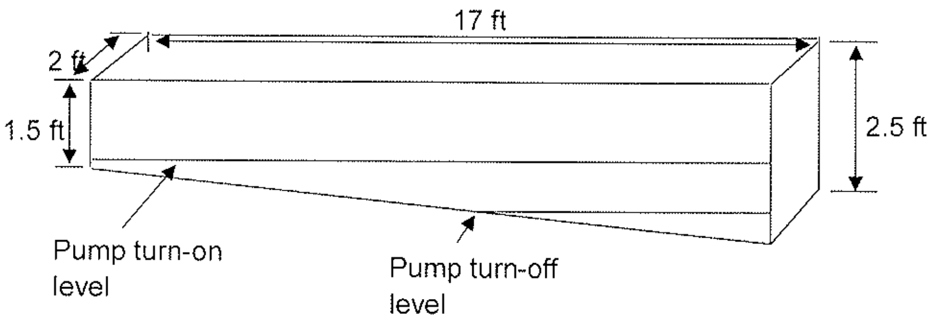
Required Pump Power

$$P = \frac{QH_{tot}g\rho}{efficiency} \qquad Q = (18.12\ gpm)\left(\frac{1\ min.}{60\ s}\right)\left(\frac{1\ m^3}{264.17\ gal}\right) = 0.00114\ m^3/s$$

$$H_{tot} = 56.8\ ft * \frac{1\ m}{3.28\ ft} = 17.3\ m \qquad P = \frac{\left(0.00114\frac{m^3}{s}\right)(17.3\ m)\left(9.81\frac{m}{s^2}\right)\left(1000\frac{kg}{m^3}\right)}{0.7} = 276.4\ W$$

Volume of Water in Drain Trough

Pump turns on when water is 14.75 inches (1.23 feet) deep and shuts off when water is 5 inches (0.417 feet) deep.



Water in trough at pump turn-on level:

$$V = lhw \quad or\ Aw$$

At turn-on level, water can be divided into two areas: a 17-ft by 0.229-ft rectangle and a 17-ft by 1-ft triangle.

$$A_1 = 17\,ft * 0.229\,ft = 3.90\,ft^2$$

$$A_2 = \left(\frac{1}{2}\right) * 17\,ft * 1\,ft = 8.5\,ft^2$$

$$V = (A_1 + A_2)w = (3.90\,ft^2 + 8.5\,ft^2)(2\,ft) = 24.8\,ft^3$$

$$V = (24.8\,ft^3) * \left(7.48\frac{gal}{ft^3}\right) = 185.4\,gallons$$

Water in trough at pump turn-off level:

Slope of drain bottom = 1 ft/17 ft = 0.0588 ft/ft

When water is 0.4167 ft deep, the length of the top surface is (0.4167 ft)/(0.0588 ft/ft) = 7.08 ft

$$V = \left(\frac{1}{2}\right) * 7.08\,ft * 0.4167\,ft * 2ft = 2.95\,ft^3$$

$$V = (2.95\,ft^3) * \left(7.48\frac{gal}{ft^3}\right) = 22.1\,gallons$$

Capacity of trough:

$$V = \left(\frac{1.5\,ft + 2.5\,ft}{2}\right) * 17\,ft * 2\,ft = 68\,ft^3 * \left(7.48\frac{gal}{ft^3}\right) = 508.6\,gallons$$

A.3- Economic Calculations

Table 6: Initial Costs

Item	**Unit Price**	**Number Needed**	**Total Initial Cost**
W6X12 Structural H Beam	$135	30, 10 ft beams	$4050.00
#4 Steel Reinforcement- Ties*	$2.50/100	8, ??ft long; 12 ?? ft long	$2.50
#4 Steel Reinforcement- Footing	$1.68	40, 1.5 ft long	$67.20
#18 Steel Reinforcement- Beam*	--------------	8, 20 ft long	$2,000.00
Elastomeric Bearing	\$1.38/in^{3}	3672 in^{3}	$5067.38
Concrete*	$3.64	60 bags for footings, 332 bags for beams	$1426.88
PVC Pipe	-----------		$819.78
Easy heat cable application tape (30 ft)	$9.49	2	$18.98
Easy heat preset thermostat	$21.99	1	$21.99
Easy heat cable (30 ft)	$43.99	2	$87.98
Size 6.5 Nozzles	$5.99	118	$706.82
14' x 20' Extra Large Fish Grade Pond Liner	$119.00	1	$119.00
Grundfos Centrifugal Pump	$5500.00	1	$5500.00
Concrete Water Catchment	$5500.00	1	$5500.00
Storage Tank- 2200 gal	$1178.95	1	$1178.95
Water Recovery System	$27,675.00	1	$27,650.00
Outdoor Protective Cover	$2,250.00	1	$2,250.00
Water Storage Tanks (750 gal)	$1,243.95	2	$2,487.90
20 cubic yd dumpster	$3,400.00	1	$3400.00
Gravel fill	$3.10	200 bags (3.7 cu. yds.)***	$620.00
Sum			**$62,975.34**

*Prices are estimates based on comparable items. Actual prices may vary.
***(Harmony Sand & Gravel, 2014).

Table 7: Operation and Maintenance Costs

Task	Cost	Frequency	Yearly Cost
Change filter	$6.00	weekly	$312.00
Clean drain**	$20.00	weekly	$1040.00
Haul off sludge	$100.00	weekly	$5200.00
Flush pipes**	$10.00	monthly	$120.00
Sum			**$6672.00**

**Cost is based on labor to perform the maintenance.

A.4- Dumpster Design Specifications:

10 yd Roll Off Container:
Understructure: 3" channel at 3.5 lbs per foot on 18" center
Cross Members Gussets: 2 gussets per cross alternate member
Main Rails/Floor Sills: 2" x 6" tubing 3/16" wall, with solid bull nose
Pull Hook: 1-1/2" width x 5-1/2" height x 2-1/2" eye opening (roll off)
Floor: 3/16" steel plate
Rear Rollers/Wheels: 8" diameter x 6" long with grease fitting
Nose/Guide Rollers: 4" diameter x 4" long with recessed grease fitting
Side/Front Walls: 10 gauge (Tubs), 12 gauge (Rectangles)
Top Rails: 4" x 3" x 3/16" tube
Hinges: 2 heavy-duty hinges with grease fittings
Door Sheet: 10 gauge (Tubs), 12 gauge (Rectangles)
Rear Door: 2-point latch and safety chain
Canvas Tie Down (Optional): Each side, front and door
Paint: Primer inside, and outside, 2.0 mils, industrial enamel finish
Inside Height: 3' 8"
Inside Length: 9' 9"
Inside Width: 7' 4"
Overall Cubic Capacity: 9.71
Outside Shipping Height: 4' 7"
Outside Shipping Length: 11' 3"
Outside Shipping Width: 8' 2

20 yd Roll Off Container:
Understructure: 3" channel at 3.5 lbs per foot on 18" center
Cross Members Gussets: 2 gussets per cross alternate member
Main Rails/Floor Sills: 2" x 6" tubing 3/16" wall, with solid bull nose
Pull Hook: 1-1/2" width x 5-1/2" height x 2-1/2" eye opening (roll off)
Floor: 3/16" steel plate
Rear Rollers/Wheels: 8" diameter x 6" long with grease fitting
Nose/Guide Rollers: 4" diameter x 4" long with recessed grease fitting
Side/Front Walls: 10 gauge (Tubs), 12 gauge (Rectangles)

Top Rails: 4" x 3" x 3/16" tube
Hinges: 2 heavy-duty hinges with grease fittings
Door Sheet: 10 gauge (Tubs), 12 gauge (Rectangles)
Rear Door: 2-point latch and safety chain
Canvas Tie Down (Optional): Each side, front and door
Paint: Primer inside, and outside, 2.0 mils, industrial enamel finish
Inside Height: 3' 8"
Inside Length: 19' 9"
Inside Width: 7' 4"
Overall Cubic Capacity: 19.67
Outside Shipping Height: 4' 7"
Outside Shipping Length: 21' 3"
Outside Shipping Width: 8' 2"

30 yd Roll Off Container:
Understructure: 3" channel at 3.5 lbs per foot on 18" center
Cross Members Gussets: 2 gussets per cross alternate member
Main Rails/Floor Sills: 2" x 6" tubing 3/16" wall, with solid bull nose
Pull Hook: 1-1/2" width x 5-1/2" height x 2-1/2" eye opening (roll off)
Floor: 3/16" steel plate
Rear Rollers/Wheels: 8" diameter x 6" long with grease fitting
Nose/Guide Rollers: 4" diameter x 4" long with recessed grease fitting
Side/Front Walls: 10 gauge (Tubs), 12 gauge (Rectangles)
Top Rails: 4" x 3" x 3/16" tube
Hinges: 2 heavy-duty hinges with grease fittings
Door Sheet: 10 gauge (Tubs), 12 gauge (Rectangles)
Rear Door: 2-point latch and safety chain
Canvas Tie Down (Optional): Each side, front and door
Paint: Primer inside, and outside, 2.0 mils, industrial enamel finish
Inside Height: 5' 10"
Inside Length: 19' 9"
Inside Width: 7' 4"
Overall Cubic Capacity: 31.29
Outside Shipping Height: 6' 9"
Outside Shipping Length: 21' 3"
Outside Shipping Width: 8' 2"

40 yd Roll Off Container:
Understructure: 3" channel at 3.5 lbs per foot on 18" center
Cross Members Gussets: 2 gussets per cross alternate member
Main Rails/Floor Sills: 2" x 6" tubing 3/16" wall, with solid bull nose
Pull Hook: 1-1/2" width x 5-1/2" height x 2-1/2" eye opening (roll off)
Floor: 3/16" steel plate
Rear Rollers/Wheels: 8" diameter x 6" long with grease fitting
Nose/Guide Rollers: 4" diameter x 4" long with recessed grease fitting
Side/Front Walls: 10 gauge (Tubs), 12 gauge (Rectangles)
Top Rails: 4" x 3" x 3/16" tube
Hinges: 2 heavy-duty hinges with grease fittings
Door Sheet: 10 gauge (Tubs), 12 gauge (Rectangles)
Rear Door: 2-point latch and safety chain
Canvas Tie Down (Optional): Each side, front and door

Paint: Primer inside, and outside, 2.0 mils, industrial enamel finish
Inside Height: 7' 8"
Inside Length: 19' 9"
Inside Width: 7' 4"
Overall Cubic Capacity: 40 Yds
Outside Shipping Height: 8' 6"
Outside Shipping Length: 21' 3"
Outside Shipping Width: 8' 2"

Appendix B- Design Drawings

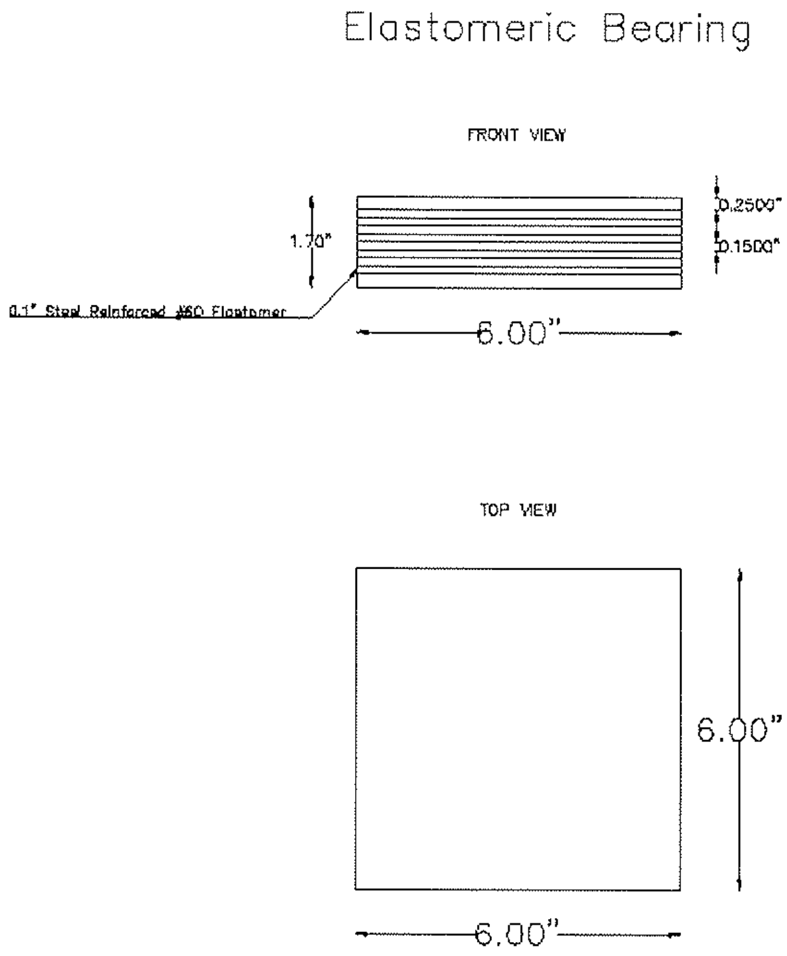


Figure 2: Elastomeric Bearing

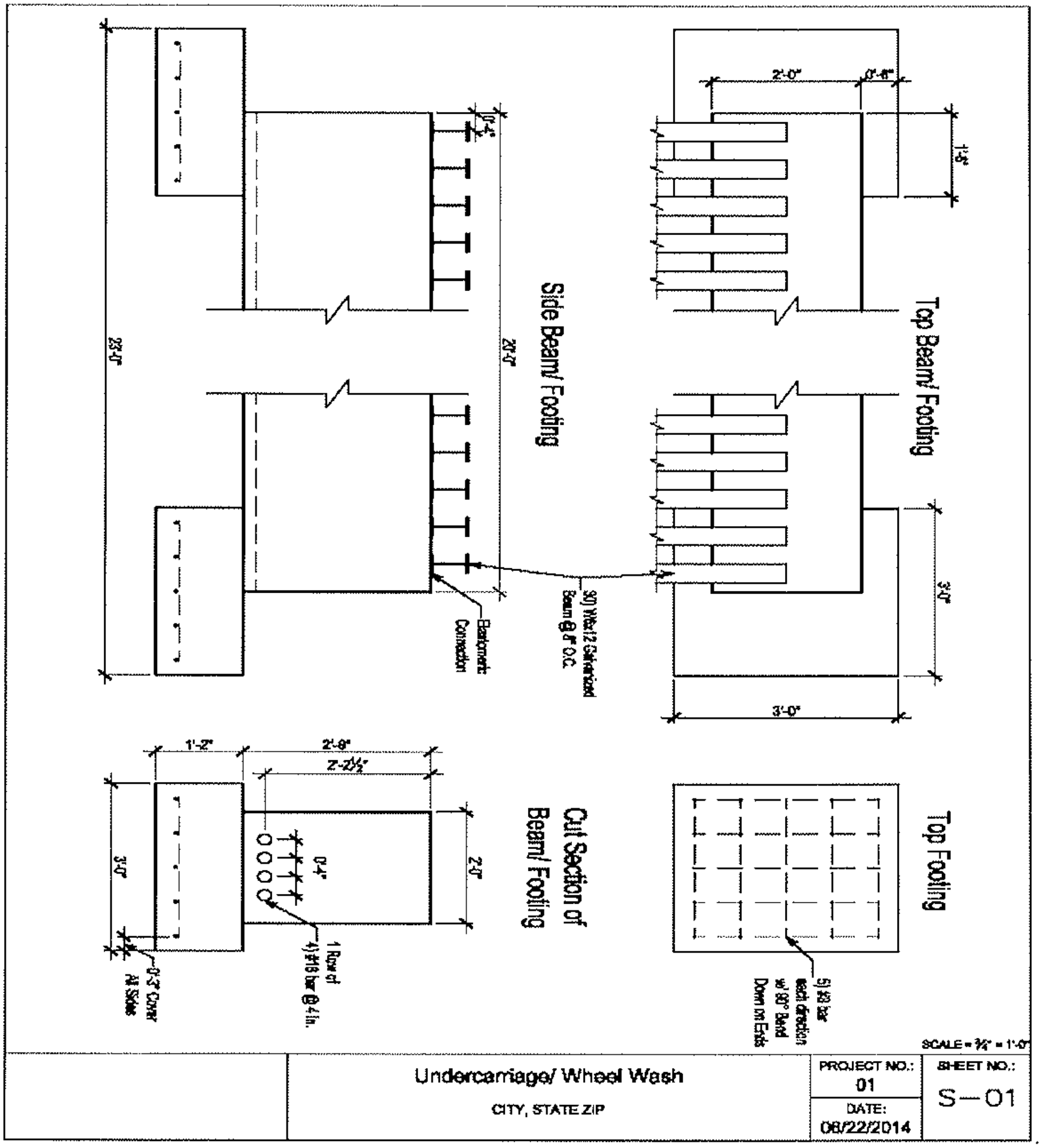


Figure 3: Concrete Cross-Sections

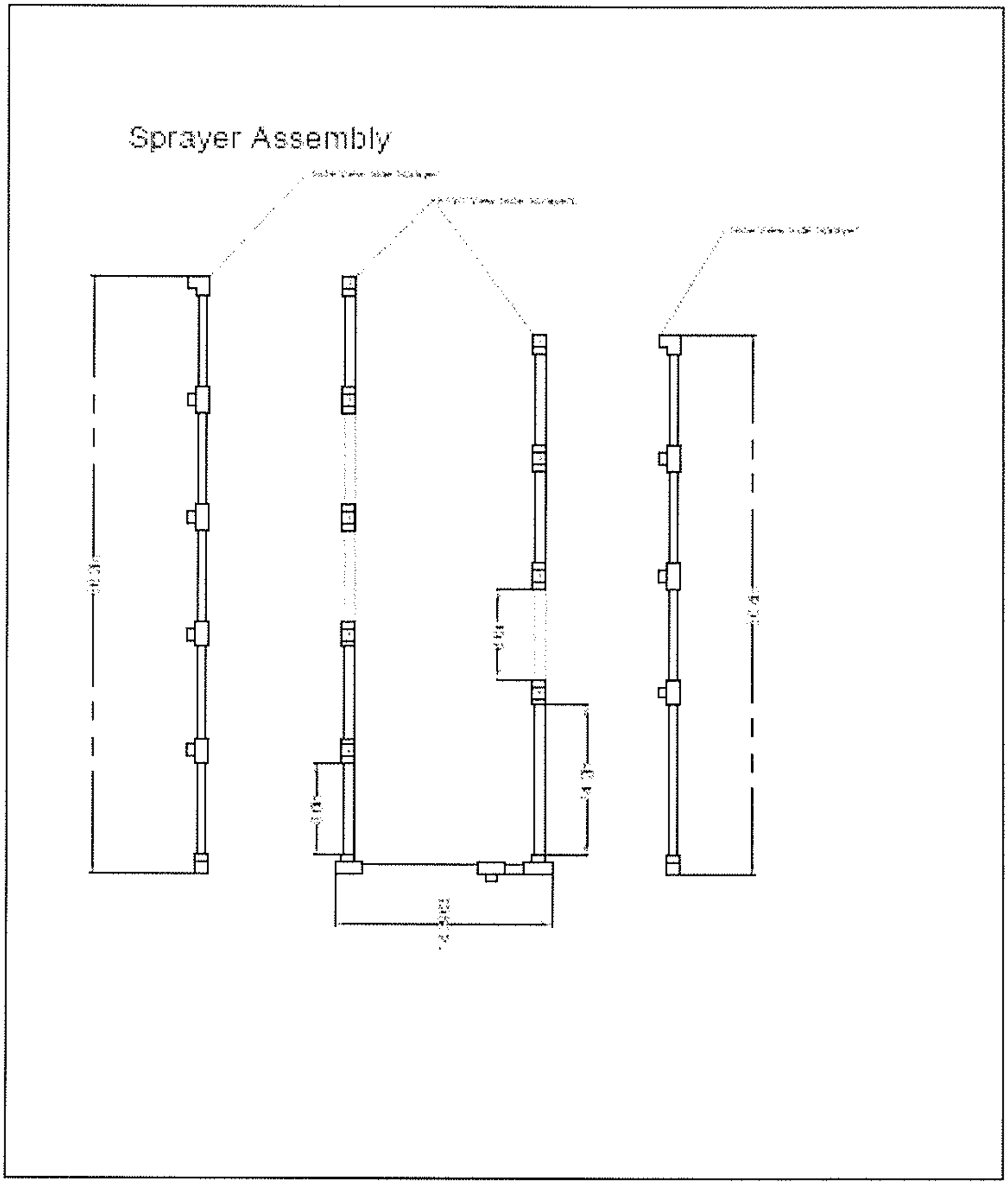


Figure 4: Sprayer Assembly

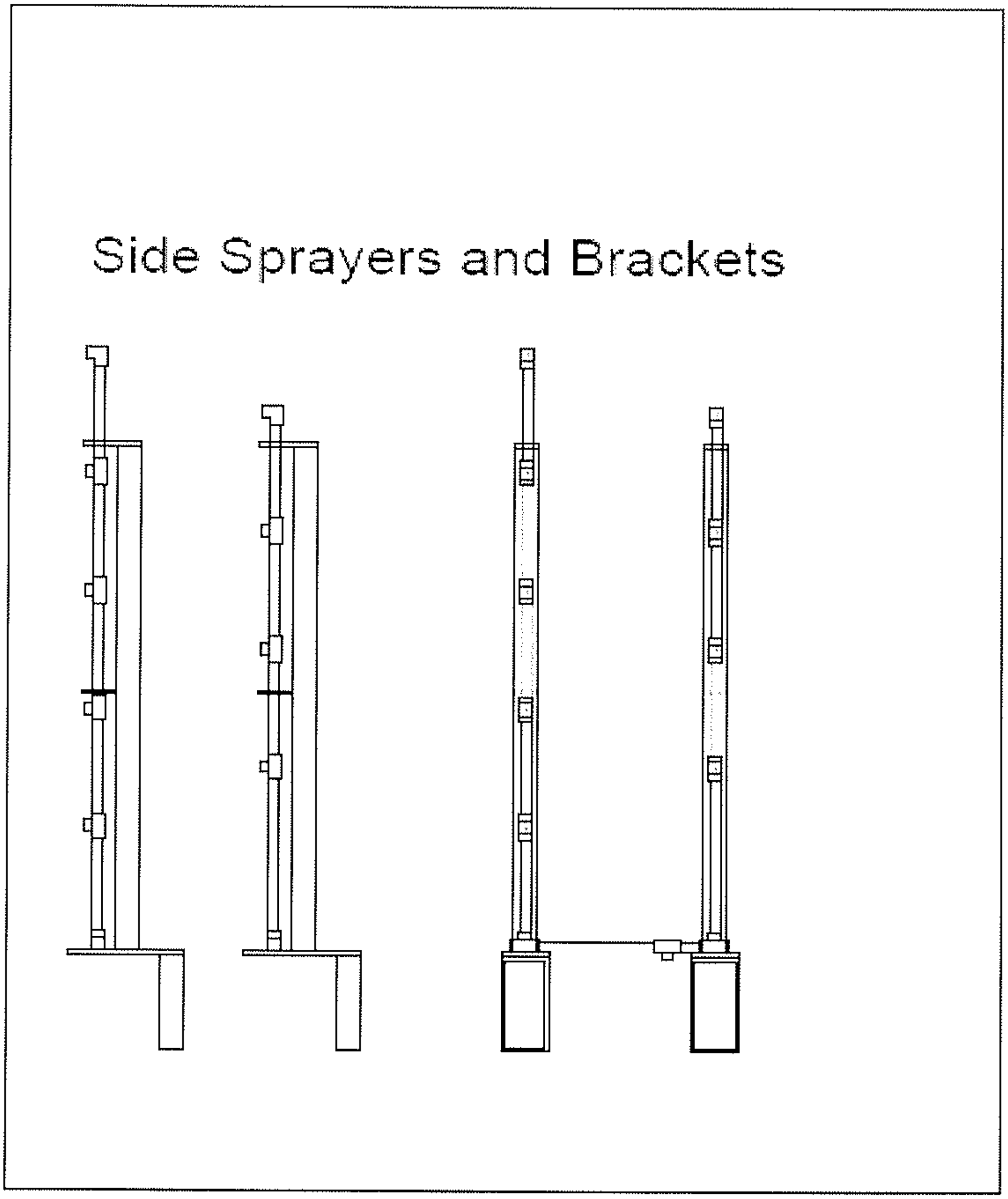


Figure 5: Side Sprayers and Brackets

Appendix C- Experimental Procedures

C.1- DO Test Procedure

Azide-Winkler Method (Michaud, 1991)

1. Fill a 300-mL glass stoppered BOD bottle with sample water. Make sure the bottle is completely submerged in the water to ensure no air bubbles are in the bottle.
2. Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. (If the reagent is added above the sample surface, you will introduce oxygen into the sample.) Squeeze the pipette slowly so no bubbles are introduced via the pipette.
3. Add 2 mL of alkali-iodide-azide reagent in the same manner.
4. Stopper the bottle with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settle to the bottom, mix the sample by turning it upside down several time and let it settle again.
5. Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place. As an added precaution, squirt distilled water along the stopper, and cap the bottle with aluminum foil and a rubber band during the storage period.
6. In a glass flask, titrate 201 mL of the sample with sodium thiosulfate to a pale straw color. Titrate by slowly dropping titrant solution from a calibrated pipette into the flask and continually stirring or swirling the sample water.
7. Add 2 mL of starch solution so a blue color forms.
8. Continue slowly titrating until the sample turns clear. As this experiment reaches the endpoint, it will take only one drop of the titrant to eliminate the blue color. Be especially careful that each drop is fully mixed into the sample before adding the next. It is sometimes helpful to hold the flask up to a white sheet of paper to check for absence of the blue color.
9. The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used. Each milliliter of sodium thiosulfate added in steps 6 and 8 equals 1 mg/L dissolved oxygen.

NOTE: Be very careful when doing DO analyses. The reagents are corrosive, so keep them away from your skin and clothes. Wear safety goggles and wash your hands when you are done.

C.2- BOD Test Procedure (Biological Oxygen Demand (BOD) - Overview)

The BOD test takes 5 days to complete and is performed using a dissolved oxygen test kit. The BOD level is determined by comparing the DO level of a water sample taken immediately with the DO level of a water sample that has been incubated in a dark location for 5 days. The difference between the two DO levels represents the amount of oxygen required for the decomposition of any organic material in the sample is a good approximation of the BOD level.

1. Take 2 samples of water
2. Record the DO level (ppm) of one immediately using the method described in the dissolved oxygen test.
3. Place the second water sample in an incubator in complete darkness at 20oC for 5 days. If you don't have an incubator, wrap the water sample bottle in aluminum foil or black electrical tape and store in a dark place at room temperature (20oC or 68 °F).
4. After 5 days, take another dissolved oxygen reading (ppm) using the dissolved oxygen test kit.
5. Subtract the Day 5 reading from the Day 1 reading to determine the BOD level. Record your final BOD result in ppm.

What to expect

BOD Level (in ppm)	Water Quality
1-2	Very Good:
3-5	Fair: Moderately clean
6-9	Poor: Somewhat polluted
100 or greater	Very Poor: Very polluted

Ultimate Soil Bearing Capacity Test Procedure

Terzaghi Equation for Ultimate Soil Bearing Capacity

$$q_u = 1.3c'N_c + qN_q + 0.4\gamma BN_\gamma$$

To find the Ultimate Soil Bearing Capacity we must first find the unknowns which are:

γ = Unit Weight of soil
c' = Cohesion
ϕ' = Friction Angle, Based on effective stress
N_c, N_q, N_γ= Terzaghi's Bearing Capacity Factors
B = Base of the footing

1. Unit Weight of soil is found by the Standard Proctor Test elaborated in ASTM D-698 (ASTM, 2007)

$$\gamma = \frac{W}{V_m}$$

W = Weight of compacted soil in the mold
V_m = Volume of the mold [$\frac{1}{30} ft^3$]

2. Friction Angle is found by the Direct Shear Test elaborated in ASTM D-3080 (ASTM, 2011)

   This test gives the Nominal Shear Stress (τ) and the nominal normal stress (σ_n) giving by the following equations respectively

   $$\tau = \frac{F_s}{A}$$

   And

   $$\sigma_n = \frac{F_n}{A}$$

   The Friction Angle is then found by plotting Nominal Shear Stress (τ) verses the nominal stress (σ_n).
3. Using the Terzaghi Equation and the Terzaghi's Bearing Capacity Factors based on the Friction Angle (ϕ') from table 16.1 in Das (2010).

Appendix C – West Texas A&M University Engineering Senior Design: Spring 2015

Appendix C – West Texas A&M University Civil Engineering Senior Design Spring 2015

West Texas A&M University

School of Engineering and Computer Science

Spring 2015 Senior Design

Final Report

For

United States

Department of Homeland Security

Undercarriage and Wheel Wash

Submitted to:

Dr. Robert E. DeOtte, Jr., PhD, PE, PG

Dr. Emily M. Hunt PhD

May 4, 2015

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Introduction

It is important to prevent Foot-and-Mouth disease (FMD) because it is a highly contagious viral disease with the potential to infect large numbers of domesticated mammals with cloven hooves. FMD is spread primarily when an infected animal comes into physical contact with susceptible animals. The disease is rarely fatal to the animals but the ones that survive have a large decrease in the amount of beef and milk produced (Animal and Plant Health Inspection Service 2013). This mass decrease in production causes significant economic losses.

FMD is difficult to identify in animals because the virus remains subclinical for 2 to 10 days. The animals then begin to experience a sudden fever. Blisters, also known as vesicles, begin to form in and around the mouth, on the mammary glands, and around the hooves. The vesicles continue to grow until they break open, which causes erosions and enables the spread of further infection to other animals. The blisters in the mouth make eating difficult, which in turn, leads to many other symptoms such as: depression, anorexia, lameness, excessive salivation, and reluctance to move or stand (Animal and Plant Health Inspection Service 2013). Figure 1 shows a lesion that has formed on the hoof of a cow infected with foot-and-mouth disease. A lesion occurs on an organ or tissue that has been damaged due to injury or disease.

Figure 1: Foot Lesion
(Foot-and-Mouth Disease Virus n.d.)

Preventative measures have already been established in the event of an FMD outbreak. The Department of Homeland Security (DHS) performs regular simulation exercises to ensure preparedness for an animal disease outbreak. The DHS is involved in the planning of the National Veterinary Stockpile (NVS) Logistics Exercise, a full-scale exercise (FSE) designed to provide a learning environment for everyone involved in an emergency situation.

Due to this type of preparation, the last outbreak on U.S. soil occurred in California in 1929 (Maas 2008). Unfortunately, this is not the case for many other countries. The largest FMD outbreak occurred in the UK in 2001, where over 4 million animals were slaughtered under disease control measures (Thompson, et al., 2002).

Through the use of preventative measures, the United States has been able to avoid both direct and indirect losses. The World Organization for Animal Health classifies countries into the following categories:

- FMD Present
    - With vaccination
    - Without vaccination
- FMD Free
    - With vaccination
    - Without vaccination

The countries with “FMD-free without vaccination” status receive higher prices for their stock. This makes the prevention of an outbreak important to continue the economic growth of feedlots (Rushton & Knight-Jones, Pg. 7). Design ideas are being explored which will prevent a possible economic crisis resulting from an intentional FMD epidemic.

Students in the 2015 Civil and Mechanical Engineering Design courses have been charged with developing a preventative measure in the form of an undercarriage and wheel wash system. The team will provide a base-model design template to allow installation at desired locations, as well as a site-specific model. The main focus for this project is to design a countermeasure against a disease outbreak. The DHS is funding the site-specific design, and Enviro-Ag Engineering, Inc. will be supervising the construction of the system.

The design of the undercarriage and wheel wash system is planned according to several different criteria. The most important criterion being the removal of large quantities of manure and dirt while maintaining a consistent flow of traffic. With the wheels in direct contact, the virus can be transferred easily throughout the feedlot. The vehicles are washed and disinfected simultaneously using a series of high pressure nozzles and an approved disinfectant.

The wash accommodates a consistent flow of traffic throughout a 10-hour day. Therefore, the overall time allowed for the wash process will be limited by the amount of vehicles during the operation times. The vehicles range from small cars to large semi-trucks. The system is required to be fully automated. This is achieved by the use of two pairs of sensors incorporated in the system. The final product will take both cost and safety into consideration.

Initial Design Solutions

At the beginning of the semester, the design team developed three different preliminary solutions: portable, stationary, and drive-thru washes. Each had unique advantages and disadvantages as an undercarriage and wheel wash system. To determine which solution would be fully designed, the pros and cons of each were evaluated while taking cost and feasibility into consideration.

Portable

Overview

The main reason for a portable wash was to provide a quick response to an outbreak. The design would be cost effective, but remain durable enough for sustained use, and rugged enough to accomplish the tasks in harsh conditions. The first idea was to use a modified Lowboy trailer, allowing the vehicles to drive directly on and off. The trailer's best advantage was the large amount of weight that could be loaded. Unfortunately, the trailer alone ($50,000 - $200,000) was outside of the allotted budget. Another design used a frac tank as the frame, which would collect all the wastewater, and house the treatment system. The design, however, would be difficult to transport and would require significant modifications of the trailer. The portable wash design chosen for the preliminary layout resembled a portable weigh station, with reinforced tracks and ramps. This design would be easier to manufacture and transport compared to the initial ideas.

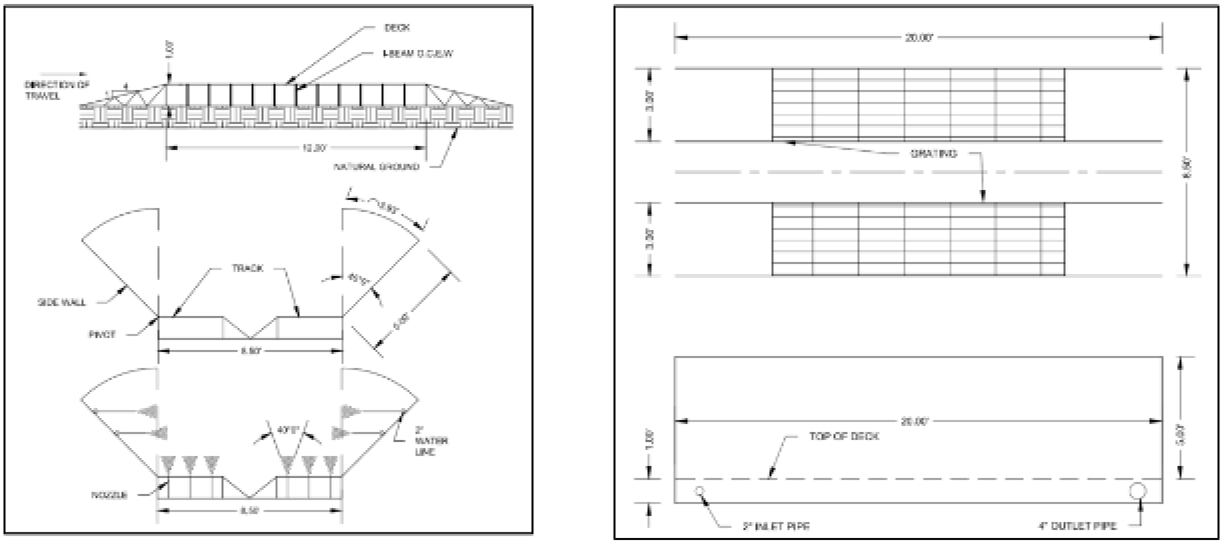


Figure 2: Preliminary Portable Schematic

Layout

The portable wheel and undercarriage wash used a fully supported deck that would transfer the weight to the steel ramps of the wash frame. The deck required aluminum or steel grates, because fiberglass or reinforced plastic are not strong enough to hold the anticipated weight (Kendrick 2015). These grates were to be mounted on steel beams that span the length of the wash. Sidewalls would provide support for the wheel sprayers and help contain overspray. A center trough was designed to collect wastewater, which would then be pumped to a trailer for potential treatment.

The key concept for this design was that it could be transported on a trailer and assembled on site. Each track would dismantle into four 3 feet sections. These sections were calculated to weigh about 125 lb without grating and would interconnect to span 12 ft between the ramps. The lengths chosen were meant to support heavier loads by allowing only one set of axles on the system at a time. Since the ramps are wide and sturdy, little groundwork would be needed for an effective design. The trailer would carry the necessary pumps, tanks, and other equipment to create a self-contained system. If water utilities are not available, water could be pumped into the reservoir or provided from a tanker.

Stationary

Overview

The term stationary, deviating from the drive-thru, implies that the vehicle will be immobile during the washing cycle. The purpose of exploring this option was to ensure adequate disinfection time. Permitting the vehicle to be parked on the wash eliminates the possibility of leaving the wash prematurely without being properly disinfected.

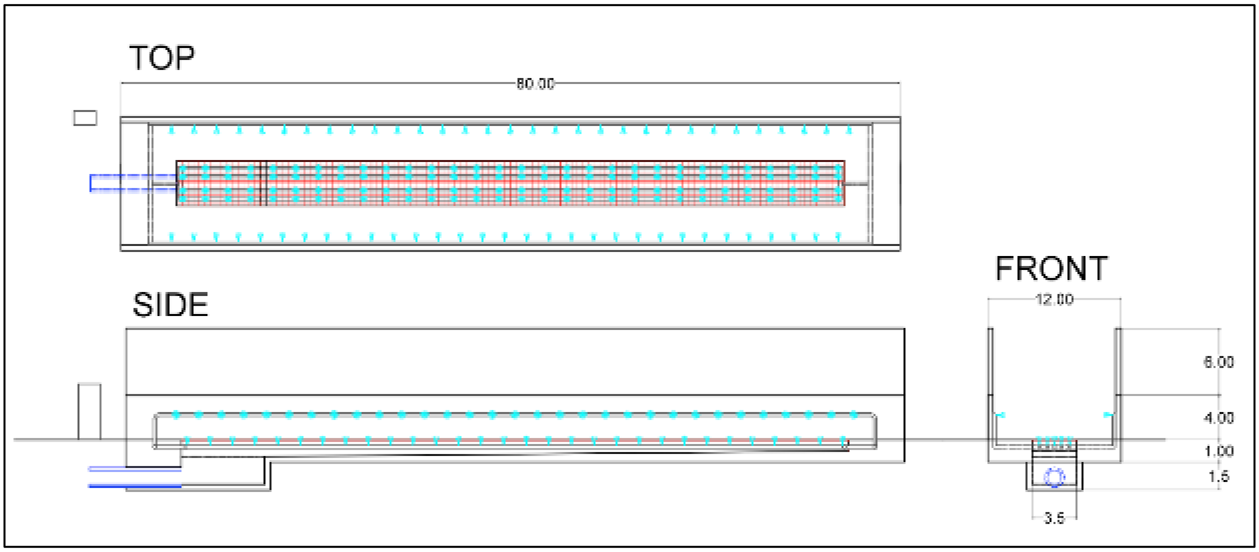


Figure 3: Preliminary Stationary Schematic

Layout

The length of the wash was 80 feet which allowed a truck to sit entirely within the washbasin. The width was 12 feet to account for the larger width of a semi-truck compared to a smaller car.

A covered drain would have been placed in the middle, measuring 3.5 feet by 60 feet, directly underneath the vehicles. There would be three water and chemical dispersion lines, which utilized various nozzles spraying vertically through the grate to clean the undercarriage. The drain had side rails to keep the vehicles on line and to ensure safety. A water and chemical dispersion line would be attached to a 3 feet concrete ledge on each side. On top of the ledge, would be a stainless steel sidewall to help minimize aerosols created by the nozzles. There would also be drainage along the outer long edges to help expedite drainage.

Drive-Thru

Overview

The drive-thru option was designed with constant traffic flow being one of the main priorities. The design incorporated a signal system to ensure vehicle speed would remain in sync with the disinfection process. Strategically positioned nozzles provided adequate cleaning and disinfection, while not having to remain stationary.

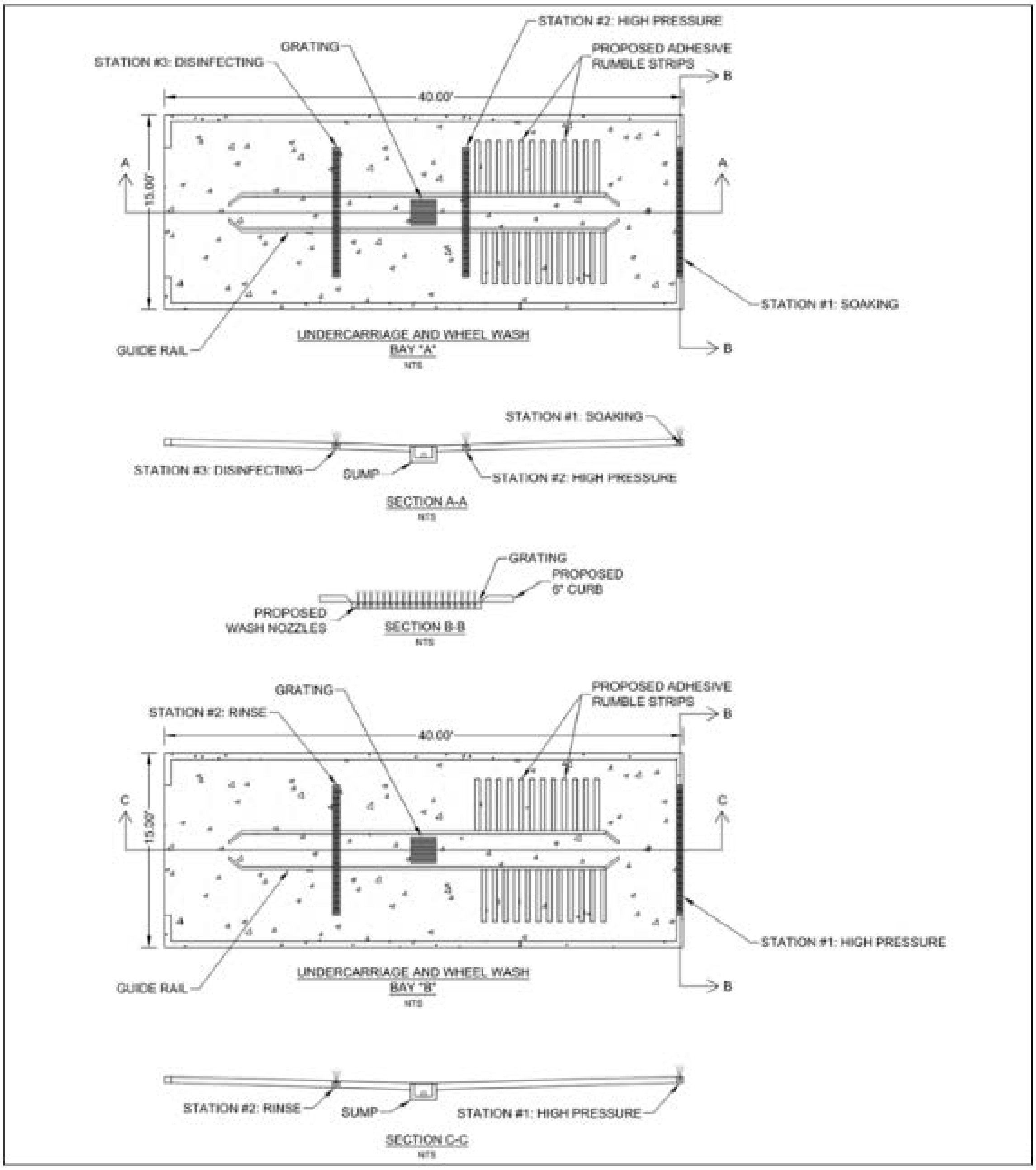


Figure 4: Preliminary Drive-Thru Schematic

Layout

The drive-thru option consisted of two concrete wash bays each measuring fifteen feet wide by forty feet long. Each bay would have a grate covered open channel in the center measuring approximately two feet wide by fifteen feet long.

The main wash bay consisted of three different stages: soaking cycle, pressure wash, and a disinfecting cycle. The second wash bay only consisted of a rinse cycle and pressure wash. Both wash bays involved a rinse cycle to soak the debris initially, which would allow the pressure wash to remove the material easily. The disinfecting cycle served as an optional, though highly recommended, stage for the wash process.

An all-weather surface approach was placed leading up to and away from each bay. Each approach measured approximately fifty to seventy feet in length. The materials for each approach was most likely going to consist of crushed concrete or reclaimed asphalt pavement due to their workability and cost.

Initial Design Selection

To recap, the project began by evaluating three initial wash layouts: drive-thru, stationary, and portable. Each of the washes had to be designed according to the provided criteria mentioned in the introduction. Various parameters were evaluated for the three preliminary designs, to determine which wash would be fully explored and finalized. Each of the three designs had the flexibility to implement all categories listed in the appendices. At the same time, each design had unique advantages or disadvantages when compared to each other.

Portable

The portable design's main strength was that it could easily be relocated to key infected areas, should an FMD outbreak occur. This system was meant to be versatile and able to be installed on rough terrain. The trailer containing the equipment could be utilized as a manual wash system using a handheld sprayer. The lightweight structure of this design could allow for more than one system to be hauled to a site. If necessary, the system could remain in one piece and be lifted onto a trailer for faster mobility. The downfalls of the portable wash are the durability and safety of the system. Due to excessive handling, the parts would wear out faster than the other designs. Also, there is no permanent foundation, so after extended use the ground may become unstable. Chemical application would require a parking zone where the sprayed vehicles would have to wait for the chemical to take effect. The following cost analysis was the preliminary estimate for the base model of the portable wash:

Table 1: Preliminary Portable Cost Analysis

Portable Cost Analysis = $26,000		
Trailer	20 foot flatbed trailer to support structure and wash systems	$ 10,500
Materials	A36 steel for track and ramp assemblies	$ 6,500
Generator	On-board power source	$ 2,000
Fabrication	Custom built sections for field assembly	$ 6,000
Nozzles	50 nozzles priced at $20 each	$ 1,000

Stationary

The stationary design focused on the contact time and space needed for proper disinfection. Keeping the vehicle immobile during the treatment process allowed for the applied chemical to fully disinfect, instead of leaving it at the driver's discretion. The length of the design allowed more than one smaller vehicle to pass. The size of the design was problematic, requiring a significant amount of area, and the foundation was estimated to cost over $25,000. The amount of water lines needed to ensure proper pressure ratings would have required a formidable amount of nozzles and a large pump, which would have increased the cost. Further, the contact time required for disinfection would have potentially resulted in traffic backup. The following cost analysis was the preliminary estimate for the base model of the stationary wash:

Table 2: Preliminary Stationary Cost Analysis

Stationary Cost Analysis = $46,700		
Excavation	Ditching for foundation and sludge collection (3'x15'x80')	$ 16,000
Materials	Reinforced concrete	$ 12,000
Approaches	2 truckloads of crushed concrete at $250 per load	$ 500
Labor	100 hours at $150 per hour	$ 6,000
Nozzles	160 nozzles priced at $20 each	$ 3,200

Drive-Thru

The drive-thru design's main goal was to decrease the amount of time required to disinfect the vehicles traversing through the feedlot, while still maintaining quality control. The drive-thru design, like the stationary, has a large footprint but would provide more flexibility for unforeseen needs of the design. The following cost analysis was for the preliminary estimate for the base model of the drive-thru wash:

Table 3: Preliminary Drive-Thru Cost Analysis

Drive-Thru Cost Analysis = $24,750		
Excavation	Ditching for foundation and sludge collection (1.5'x15'x40')x2	$ 8,000
Materials	Reinforced concrete	$ 8,000
Approaches	2 truckloads of crushed concrete at $250 per load	$ 500
Labor	45 hours at $150 per hour	$ 6,750
Nozzles	50 nozzles priced at $20 each	$ 1,000

Final Decision

Overall, the drive-thru design was deemed most proficient in the following categories: traffic flow, cost, and safety. The drive-thru and stationary designs were lacking one major benefit in comparison to the portable design, and that was the ability to be utilized at multiple locations. However, the benefits of the drive-thru wash outweighed the disadvantages of the alternatives. Table 4 compares the pros and cons of each preliminary design:

Table 4: Advantages and Disadvantages of the Preliminary Designs

Design	Pros	Cons
Portable	▪ Can be easily relocated ▪ Does not require a permanent foundation	▪ Requires built in power source ▪ Durability issues ▪ Safety concerns ▪ Parts require higher maintenance
Stationary	▪ Allows for monitored contact time ▪ Driver can exit the vehicle to avoid concentration of sanitizer and toxicity	▪ Large size ▪ Higher number of nozzles ▪ Higher cost ▪ Driver has to interact with the system
Drive-Thru	▪ Allows for higher traffic flow ▪ Easier sludge and waste water collection ▪ Smaller size ▪ Higher durability ▪ Lower cost	▪ Complex system of automation ▪ Contact time complications

Drive-Thru Final Design

Transportation and Surveying

Soil

Soil testing is best way to determine the minimum structure limitations without introducing a factor of safety. The soil not only has to be able to support loads, but it also exerts a force on the structure which must be taken into consideration. Soil properties influence the development of building sites. A soil survey is conducted to determine its properties. From a soil survey we can obtain the texture, color, structure, and the reaction of the soil, etc. (Natural Resources Conservation Service 2014).

To get an initial estimate of the type of soil that will be encountered at the site specific location, the United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS) website was used. Figure 5 shows the variation in types of soil for the designated location.

Figure 5: Soil Distribution for the Designated Feedlot
(Natural Resources Conservation Service 2014)

The subsurface material encountered at this feedlot is Pullman A- clay loam, 0 to 1 percent slopes (Natural Resources Conservation Service 2014). Table 5 shows some of the properties and characteristics for the encountered soil:

Table 5: Soil Properties

(Natural Resources Conservation Service 2014)

Type of Soil: Pullman-A-Loam Clay	
Classification of Soil:	
0 in. to 36 in. depth	Clay
AASHTO	**Unified System**
A-7-6	CH, CL
Characteristics of Soil:	
Slope	0 to 1 percent
Clay (%)	43.4
Silt (%)	26.4
Sand (%)	30.2
Liquid Limit (%)	50.3
Plasticity Index (%)	26.6
Water Content one-third bar (%)	37
Drainage Rating	Well Drained
Shrink-Swell	High Shrink-Swell (0.92)
Bulk Density one-third bar (g/cm^3)	1.4
Corrosion Rating to:	
Steel	High
Concrete	Low

Soil Bearing Capacity

Soil bearing capacity refers to how much weight the soil can hold before it collapses. The maximum load the soil will experience is the combined weight of the large semi-trucks with their respective load and the foundation. With poor quality to support any eccentric loads, the in-situ stress for the soil encountered has a sustainability of 700 psf (Natural Resources Conservation Service 2014).

An estimated total load value for the maximum load being applied to the soil is 7,372 psf. This value was calculated from the weight of the foundation (150 psf) and a fully loaded semi-truck (7222 psf). The calculations for the previous values are shown in Appendix 1: Sample Calculations

The internal shear angle of 20 degrees was obtained from Amarillo Testing & Engineering. The value falls within the initial assumption range of 15 to 30 degrees. The soil bearing pressures relating to the shear angle are shown in Table 6. The soil bearing capacity determined that the natural conditions will support the expected total load previously mentioned. Therefore, the use of backfill material to support the loadings will not be needed based on the estimated capacity value. Using a factor of safety of three, the allowable bearing pressure is 40,971.31 psf.

Table 6: Range of Soil Bearing Capacities

(Natural Resources Conservation Service 2014)

Terzaghi's Bearing Capacity Factors for Square Footing								
ρ (lbs/ft^3)	g (ft/s^2)	ϕ (degrees)	N_c	N_q	N_γ	D	B	Q_U (psf)
						ft	ft	
87.4	32.2	0	5.7	1	0	0.67	12	15,223.57
		5	7.3	1.6	0.5			26,853.18
		10	9.6	2.7	1.2			43,765.29
		15	12.9	4.4	2.5		Range of soil Bearing Pressure	72,253.86
		20	17.7	7.4	5			122,913.92
		25	25.1	12.7	9.7			213,713.59
		30	37.2	22.5	19.7			395,591.59
		34	52.6	36.5	35			664,706.26
		35	57.8	41.4	42.4			786,076.76
		40	95.7	81.3	100.4			1,733,492.46
		45	172.3	173.3	297.5			4,748,742.71

Settlement

Since the soil will be compacted, only an immediate elastic settlement was calculated. An elastic settlement occurs after the application of the load without changing the moisture content. The immediate elastic settlement calculated is 0.038 inches. The calculations to support the total elastic settlement are shown Appendix 1: Sample Calculations.

.

Site-Specific Soil Test Results

Several laboratory tests were conducted to determine the characteristics of the site-specific soil. Samples from three different locations were evaluated and are shown below:

1. Sample 1: Taken 10 feet from a small stream of wastewater
2. Sample 2: Taken at the entrance of the feedlot where the roadway transitions from asphalt to dirt
3. Sample 3: Taken about 100 feet away from the location of sample 2

The following soil tests were performed:

1. Moisture Content – The moisture content in a soil sample is the percentage of water present compared to the dry soil mass.
2. Sieve Analysis – Performing a sieve analysis is needed to classify any type of soil for engineering purposes. The test determines the distribution of the grain sizes in a given mass of soil.
3. Standard Proctor Compaction Test – is used to improve the strength of soil.
4. Modified Proctor Compaction Test – is used to improve the strength of soil.
5. Atterberg Limits:
    a. Liquid Limit – The moisture content required for a cohesive soil to change from a liquid state to a plastic state.
    b. Plastic Limit – The moisture content required for a soil to change from a plastic to a semisolid state.
    c. Shrinkage Limit – The moisture content required for a soil to change from a semisolid to a solid.

Moisture Content

Soil water content is useful for many different laboratory tests. To obtain the moisture content for each soil sample, an average of ten cans was used. Table 7 shows the results for each sample in the natural conditions. The moisture content results for each trial are shown in Appendix 2: Moisture Content.

Table 7: Average Moisture Content

	Sample 1	Sample 2	Sample 3
Average Moisture Content	13.7 %	16.8 %	15.8 %

Sieve Analysis

A sieve analysis shows the distribution of particle-sizes which is used to classify any type of soil. The coefficient of gradation C_u indicates the distribution range of grain sizes, while C_c is the coefficient of curvature. Table 8 shows the results from each soil sample. The values for C_u for each of the soil samples are much greater than 1 which means the soil is well-graded. For the soil to be considered poorly graded, the value must be close to 1. Sieve analysis results for each trial are shown in Appendix 3: Sieve Analysis.

Table 8: Sieve Analysis Results

	Sample Number		
	1	2	3
D_{10}	0.14	0.10	0.25
D_{30}	1.10	0.64	1.50
D_{60}	4.30	2.40	4.50
C_c	**2.01**	**1.78**	**2.00**
C_u	**30.71**	**25.00**	**18.00**
Classification	***SW-SC Well Graded Sand with Clay (or silty clay) and Gravel***	***SW-SC Well Graded Sand with Clay (or silty clay) and Gravel***	***SW Well Graded Sand with Gravel***

Figure 6: Particle distribution for a sieve analysis

Standard and Modified Proctor Compaction Tests

The compaction test is used to determine the optimum moisture content for the soil to achieve the best compaction (maximum dry density). The test is performed by removing the air voids using mechanical equipment, and the degree of compaction is measured in terms of dry unit weight.

During the compaction, water is added to fill the voids in the soil. When the proctor hammer is dropped on the soil, it is mechanically pushing the soil particles together using Newton's second Law, which is $\overrightarrow{\sum F} = ma$. This results in the slipping of soil particles over each other because the water acts as a softening agent on the particles. This means the soil is in a densely packed position. The dry unit weight will increase as the moisture content increases. The soil moisture content is gradually increased until the optimal dry unit weight is achieved. This occurs when the maximum dry unit weight begins to decrease; the results are best understood graphically, which is shown in Appendix 4: Standard and Modified Proctor Compaction Tests. Once the maximum dry unit weight is achieved, the soil particles begin to move in relative to each other each time the hammer is dropped. When the soil particles do not stay in place; this means the soil is saturated past the optimum moisture content.

The modified compaction test is used to better represent field conditions. The modified proctor test was conducted in accordance to ASTM D-1557. Due to the increase in compaction, the modified results have higher increase in maximum dry unit weight of soil which is accompanied by a decrease in the optimum moisture content.

Atterberg Limits

The Atterberg limits are made up of the shrinkage, plastic, and liquid limits. The liquid limit in soil engineering is the moisture content required to change the soil properties from a liquid state to a plastic state. When excess amounts of moisture are added to the soils, they will transition into a liquid state. The flow of the soil in a liquid state is comparable to a viscous liquid. Once the moisture begins to evaporate, the soil will enter into a semisolid state followed by a solid state. The moisture contents required to transition the soil from a plastic to a semisolid state; then from a semisolid to a solid state are the plastic and shrinkage limits, respectively. Figure 7 from Soil Mechanics Laboratory Manual by Braja M. Das shows the limits associated with the Atterberg limits, and Table 9 shows the results from the soil tests:

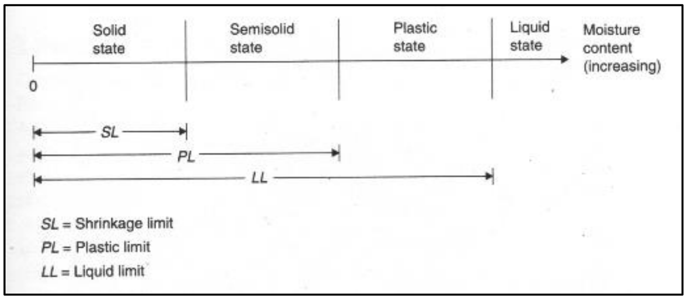


Figure 7: The Limits Associated with the Atterberg Limits

Table 9: Atterberg Limit Results for Each Sample

	Sample 1: Trench Location	Sample 2: Entrance North	Sample 3: Entrance South
LL	39.9	42.5	41.75
PL	20	20	37.5
PI	19.9	22.5	4.25

It is recommended that soil testing be performed for every potential site where the undercarriage and wheel wash could potentially be built.

Vehicle Dimensions

There are a number of vehicles that enter the feedlot. These vehicles range from passenger cars and pickup-trucks, to semi-trucks. Each of these vehicles has different dimensions that need to be considered for the design of the undercarriage and wheel wash. Although the dimensions for each vehicle can vary, the design team researched the most common types vehicles that would be using the wash system and let these specifications drive the initial stage of the design. Table 10 shows the dimensions for expected vehicle traffic.

Table 10: Vehicle Dimensions
(Eby) (Stein Transportation)
(Truck Sales) (www.chevrolet.com)

	Commuter Vehicles	Semi-Trucks
Width (ft)	Minimum 6	Minimum 8.5
Length (ft)	Minimum 8	Up to 73
Ground Clearance (in)	5 to 12	19 - 21
Weight (tons)	0.5 – 3.5	Up to 50

The dimensions for trailers also vary by type. Figure 8-10 give an overview of the most common types of trailers, and semi-truck lengths used to transport livestock with their respective dimensions.

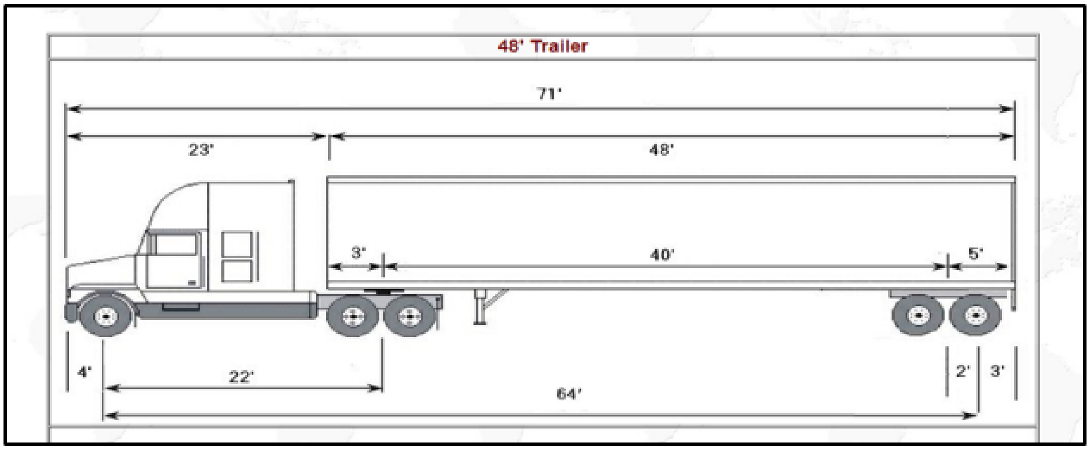


Figure 8: Semi-Truck Dimensions for a 48 foot Trailer

(Truck Sales 2015)

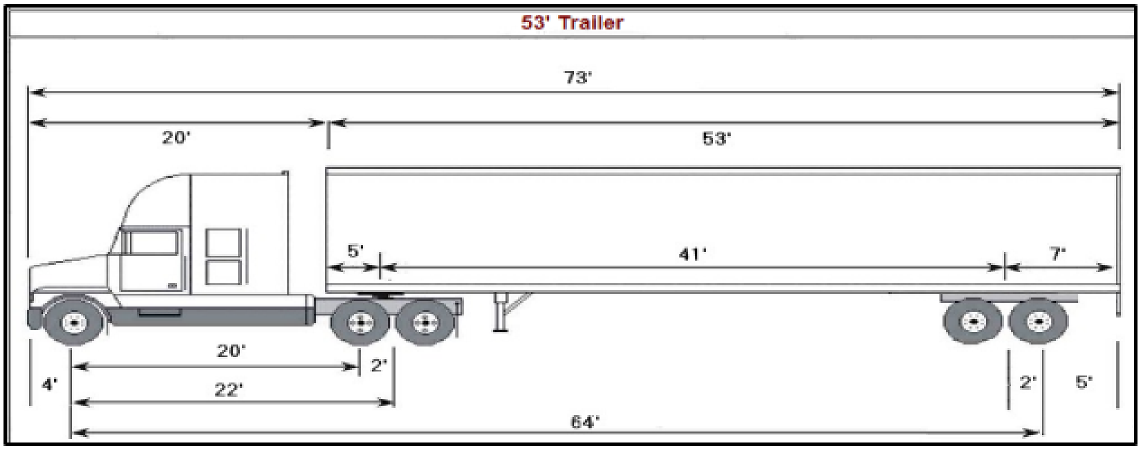


Figure 9: Semi-Truck Dimensions for a 53 foot Trailer
(Truck Sales 2015)

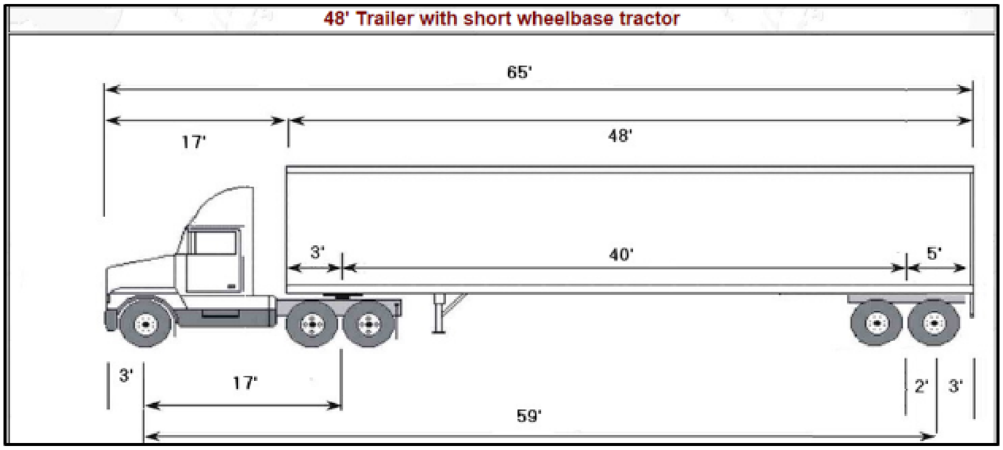


Figure 10: Semi-Truck Dimensions for a 48 foot Trailer and Short Wheelbase
(Truck Sales 2015)

Road Approaches

Road approaches are needed for the entrance as well as the exit of the wash bay. The purpose for having a road approach is to minimize the transfer of mud into the bay. The purpose of the waiting area is to allow for contact time, retain any dripping water, chemical from the truck, and minimize formation of puddles. This will help reduce the spread of any FMD if present because it will keep the infected material within the washing bay. Using the pavement damage calculations method from the United States Environmental Protection Agency (EPA), a thickness of 12 inches was determined (United States Environmental Protection Agency (EPA) 2003). To determine the pavement damage, the Equivalent Single Axle Load (ESAL) was used to represent the mix of traffic of different axle loads, and different axle configurations predicted over the design. A pavement damage of 1 (100%) or less means that the assumed material and thickness can hold the flow of traffic been looked at. The reference axle load used was an 18,000-lb single axle with dual tires (Texas Department of Transportation, Third Quarter, 2005). This method takes the flow of traffic for the whole year and then splits it into the seasons of the year with a corresponding correction factor for each season. This traffic volume was then converted to ESALs and split into the seasons. The site-specific traffic volume of 120 vehicles per day yields about 43,800 vehicles per year. Table 11 shows calculations conducted to estimate the 12 inch gravel thickness.

Table 11: Total Pavement Damage

Trial Base Thickness,				Serviceability Criteria		Rutting Criteria	
D_{BS} (in.) =	12			ΔPSI =	2.5	RD (in.) =	2
1. Season (Roadbed Moisture Content)	2. Roadbed Resilient Modulus M_R (psi)	3. Base Elastic Modulus M_R (psi)	4. Projected 18-kip ESAL Traffic, W_{18}	5. Allowable 18-kip ESAL Traffic (W_{18}) PSI	6. Seasonal Damage, W_{18} /(W_{18})	7. Allowable 18-kip ESAL Traffic, (W_{18})	8. Seasonal Damage, W_{18} / (W_{18})
Winter (Frozen)	20000	25000	3650	500000	0.0073	225000	0.016222222
Spring/Thaw (Saturated)	2000	25000	1825	30000	0.060833333	15000	0.121666667
Spring/Fall (Wet)	4500	25000	10950	190000	0.057631579	20000	0.5475
Summer(Dry)	6500	25000	27375	220000	0.124431818	60000	0.45625
		Total Traffic =	43800	Total Damage =	0.25019673	Total Damage =	1.141638889
Winter (Frozen) =	1						
Spring/Thaw (Saturated) =	0.5						
Spring/Fall (Wet) =	3						
Summer(Dry) =	7.5						
About 120 vehicles per day							
Estimated # of vehicles per year =	43800						

The location for the construction of the undercarriage and wheel wash was determined from a topography survey that was conducted on this ~~site specific~~specific site. The location will accommodate the semi-truck turning radius specified by the Texas Department of Transportation. Figures 11-14 show the specified dimensions. A turning radius of 30 feet is needed to correctly align with the wash bay. The road approach leading into the bay will be 30 feet long by 12 feet wide. A waiting area designed to allow for the disinfection contact time, will be placed at the exit of the bay. This area will be 50 feet wide by 70 feet long and it will accommodate five semi-trucks. The road approach and the waiting area will both be made up of crushed concrete. The estimated price for materials and delivery is $3,800 provided from Howell sand in Amarillo, Texas.

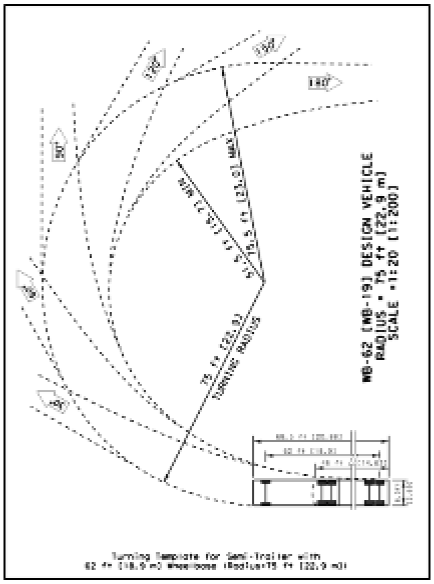


Figure 11: Semi-Truck Turn Radius 1

(Texas Department of Transportation 2014)

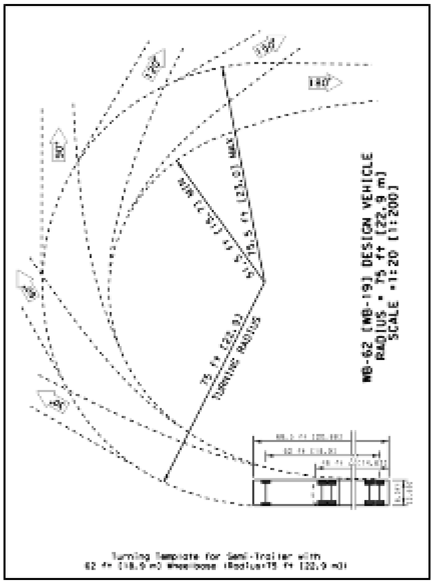


Figure 12: Semi-Truck Turn Radius 2

(Texas Department of Transportation 2014)

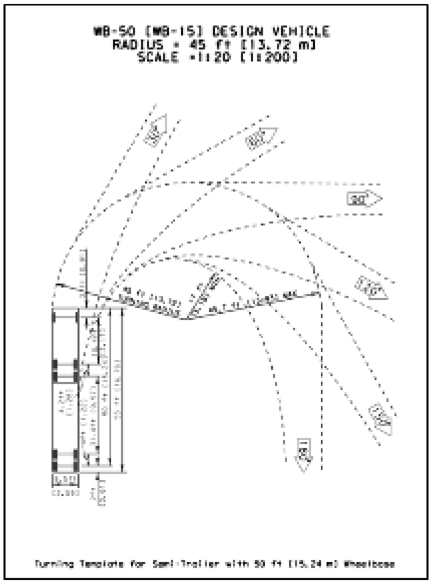


Figure 13: Semi-Truck Turn Radius 3

(Texas Department of Transportation 2014)

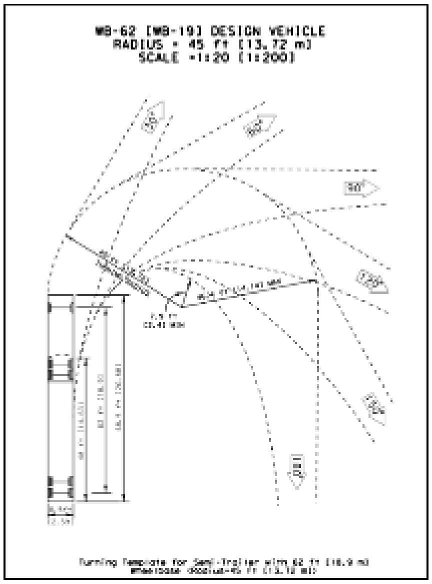


Figure 14: Semi-Truck Turn Radius 4

(Texas Department of Transportation 2014)

Structural Design

There are two slabs that have been designed: a slab for the wash bay and a concrete pad that will support the water treatment system. The foundation of the wash bay is analyzed as a slab-on-grade. The analysis is commonly used when designing concrete floors experiencing repetitive loads from vehicle traffic. The concrete pad is designed to transfer the load seen from the treatment system to the ground below. The sections following will describe the methods used to analyze both slabs. Figure 15 and Figure 16 respectively, represent the top view of the wash bay foundation and treatment pad.

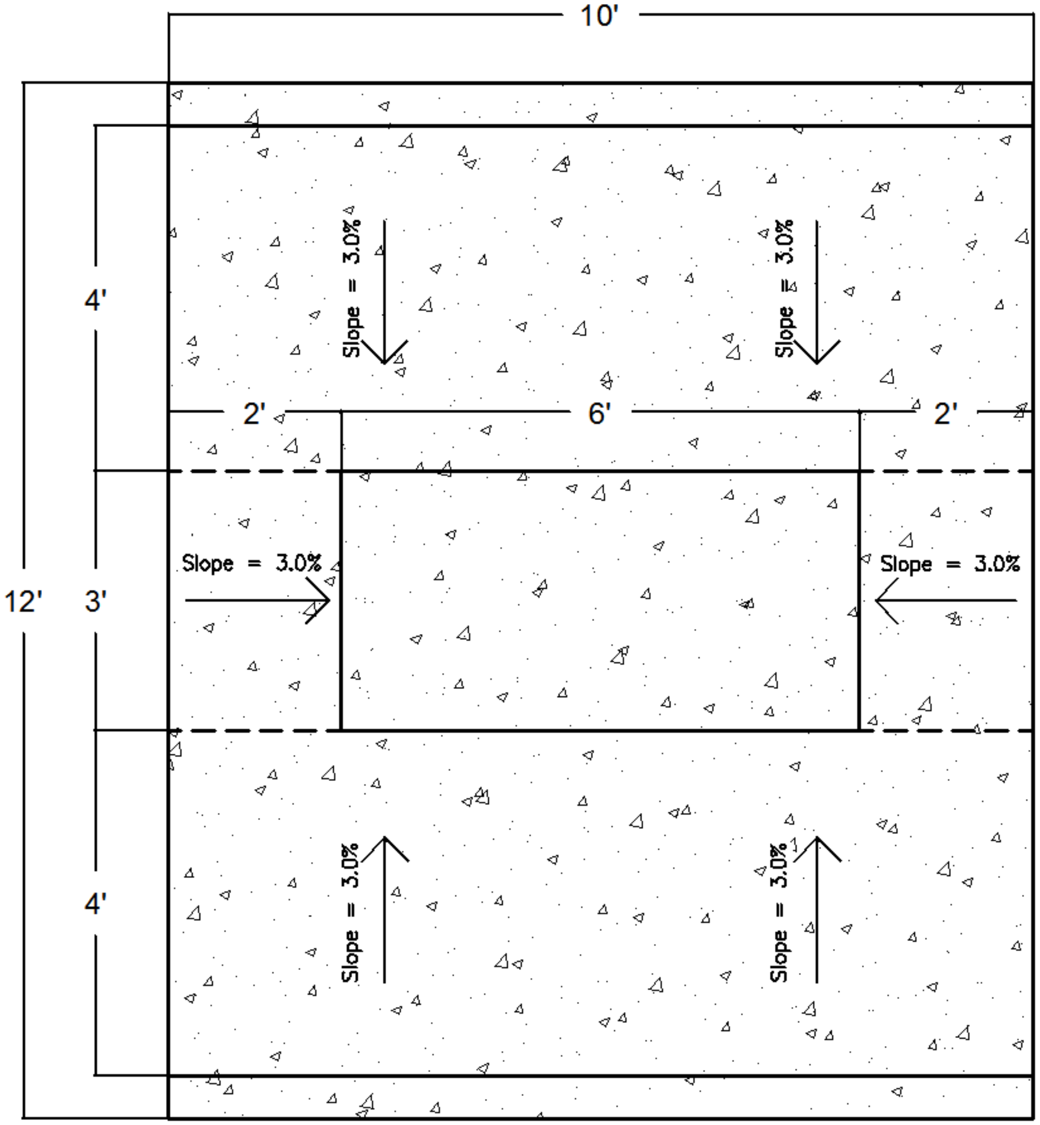


Figure 15: Top View of Main Wash Bay

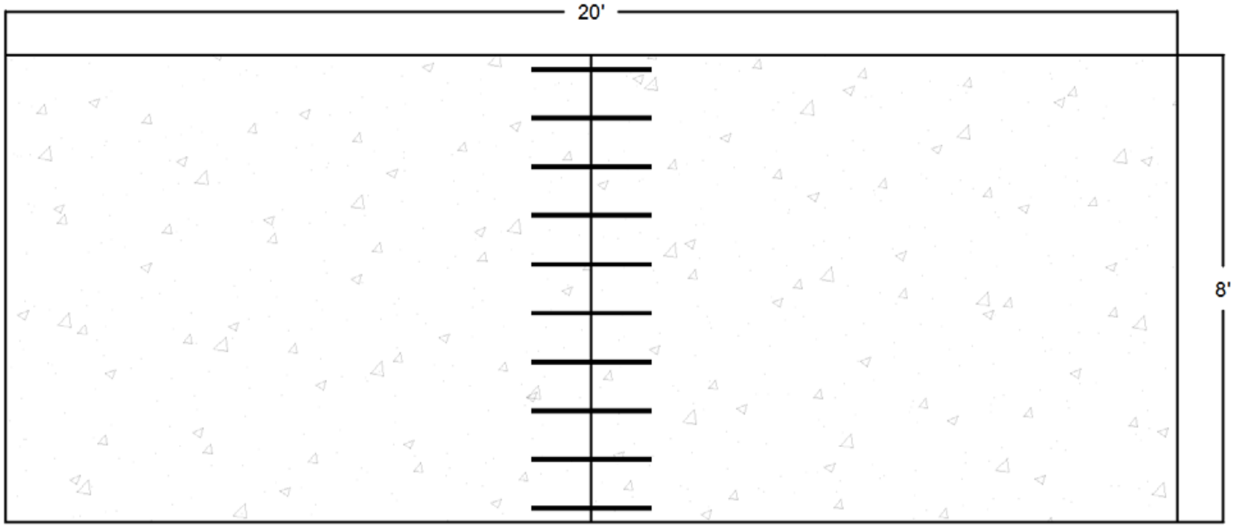


Figure 16: Top View of Treatment Supply Slab

Drive-Thru Wash Foundation

The wash foundation is reinforced with 6 gauge wire welded mesh, rather than the initially selected 1/2 in deformed bars. A 6 in thick concrete curb is integrated into the foundation that runs the exterior longitudinal span of the slab. The curb will control water runoff and is not a critical load bearing portion of the slab for vehicles, and will not require reinforcement. The curb is represented in Figure 17 showing the layout and dimensions.

The bottom perimeter of the concrete slabs will also include a thickened edge to account for curling of the concrete during installation, as well as stability against slippage across the base underlying the foundation (Abdul-Wahab and Jaffar 1983). The thickened edge is shown in Figure 17. Curling of the concrete slabs must be considered due to the differential shrinkage of the concrete during the curing period. This is caused when the top surface dries faster than the subsequent layers below (American Concrete Institution (ACI) 2009).

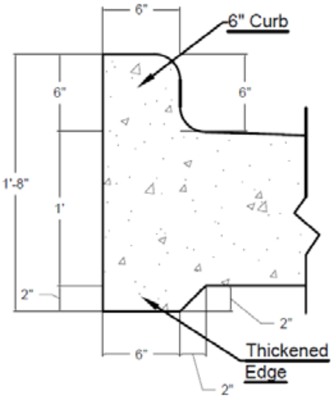


Figure 17: Cross-Section of Slab Thickness, Curb, and Thickened Edge

During the initial process of analysis, a recessed sludge basin was placed underneath the middle of the wash bay to capture mud, manure, and water coming off the vehicles. This has been replaced with a cut out section of concrete that is 6 ft long, 3 ft wide and 6 in deep. This channel is lined with the pipelines carrying water and disinfectant. The runoff will be transferred to a sludge basin, which is about 15 ft to the side of the bay, using a cylindrical pipe. The sludge basin will be a cylindrical pre-cast concrete vault provided by Vaughn Concrete Products, Inc. to account for the volume of sludge draining off of the wash foundation.

The ground below the slab must be at 95% compaction to sustain an optimal bearing pressure for support of the wash foundation which is satisfied by a sand base layer. The sand base lowers the frost line and helps in stabilizing the foundation as well as increase the coefficient of friction between the concrete and the earth's sub-grade to reduce slippage.

The initial wash design dimensions required joint control, which was spaced at 20 ft between the longitudinal faces of the slab. These joints aided in contraction of the concrete due to temperature changes of the exposed slab. For optimization, the slab was shortened from 40 ft to 10 ft to save on costs. However, for the treatment slab, the joint control will be used at the midpoint of the longitudinal span of the foundation due to a minimum joint spacing of 20 ft. This control joint will be doweled by 1/2 in smooth bars that will be epoxied into one end of the slab and lubricated on the other end to allow the foundation to expand and contract as necessary. A diagram of the dowel placement is shown in Figure 18. Both foundations will contain 1/4 in sawcuts to control the cracking of the foundation and will be spaced at a maximum of 5 ft.

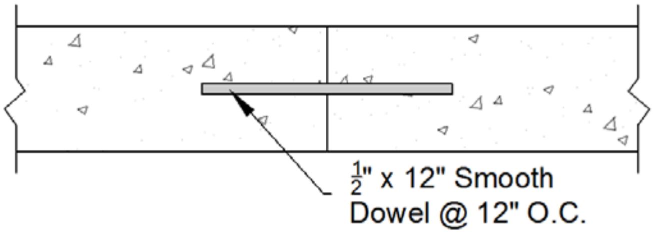


Figure 18: Dowel Placement

Design of the concrete mix for 4000 psi compressive strength includes air entrainment for moderate exposure to the water and deicing chemicals. The estimated weight of this particular mix will be on the order of 3960 lb/yd^3. This was calculated using various tables from Materials for Civil and Construction Engineers (Mamlouk and Zaniewski 2011).

Other specifications are implemented into the design that include the required sieve for the concrete mix design, proper mixing and placement of concrete according to ACI standards, and proper filed test submittals for ready mix companies. These are listed in the details on the drawings and in the specifications section. They will help ensure the quality of a superior concrete paving for the design. The performance of a life cycle cost analysis (LCCA) will show the adequacy of using this design as well. The LCCA shows the initial cost of the installation as well as the cost for maintaining a quality concrete pavement. The cost estimate was determined using a local concrete contractor provided in the Cost Analysis section.

Design Process

This section shows the procedures and calculations that were used to determine all structurally load bearing aspects of the wash basin's slab thickness.

Thickness selection

The Portland Cement Association (PCA) has developed a method for determining a floor thickness that foresees repetitive vehicular loadings over a given period of time. The design objectives for this method primarily focus on adequate support of the edges of the slab, to decrease the risk of spalling. Spalling is when the concrete cracks and chips away at the edges of a concrete structure, and is caused by excessive flexural stresses, deflections, settlement due to soil pressures, and excessive concrete bearing or shear stresses (Farny, J. 2001).

Flexure is another critical design consideration, as it pertains directly to the overall behavior of the floor under vehicular loadings. This can be measured by use of the Modulus of Rupture of concrete. Finding the flexural strength of the concrete used is the first step that was used in analysis of the thickness selection process. This was found by dividing the concrete flexural strength by design factors based on what the foundation will be used for. The design factor includes a safety factor that accounts for fatigue and load induced flexural (Farny, J. 2001).

The safety factor selected utilizes Table 28 which gives a stress ratio based on the allowable load repetition number over the given design life of the foundation. A maximum repetition of 1,820,000 cycles over the entire design life of 50 years was estimated as a ceiling value. This is conservative, as it means that the wash would receive 100 vehicles every day for 50 years. The appropriate stress ratio was selected to be 0.48, and taking the inverse provides the safety factor of 2.1.

Taking the Modulus of Rupture for concrete and dividing it by the product of the selected safety factor provides in return the working stress of the concrete. This value will be used in the last steps of the design process.

Other pertinent information needed for the design process includes:

- Axle load
- Dual wheel spacing
- Wheel assembly spacing
- No. of wheels on axle
- Tire inflation pressure
- Subgrade modulus, *k*
- Ultimate concrete shrinkage

- Concrete compressive strength
- Concrete flexural strength, MR

Initially, the design thickness was determined using the dimensions of the original wash bay, 40 ft long by 15 ft wide. This size of slab requires expansion joints half way through the longitudinal length of the slab. The joints allow for a joint factor in thickness selection, which led to an initial thickness of 11 in. For optimization to reduce costs overall on concrete, reinforcement, piping, and nozzles, the slab dimensions were adjusted to 10 ft long by 12 ft wide. The acceptable 8 in thickness selection was increased to 12 in to assist in a minimum 2 in coverage of concrete between the subgrade and the bottom of the drain.

The design of the treatment slab was analyzed using the highest loading that would be applied to the foundation. This load would be the weight of the settling tanks when they are full of water and sludge. The maximum weight that the settling tank could bear is 9000 lb of water and debris plus the 350 lb of the settling tank itself with a contact area of 2035 in^2. Dividing the total weight over the contact area gave us 4.59 psi. Using 4000 psi concrete is more than enough to suffice this maximum loading. Using calculations shown in Appendix 5: Structural Calculations, a minimum cross sectional area of 0.23 in^2 is required from the steel reinforcement. The minimum area of steel requires the use of 1/2 in rebar spaced at 10 in on center each way of the slab. Figure 19 shows the cross-section of the slab for the treatment system.

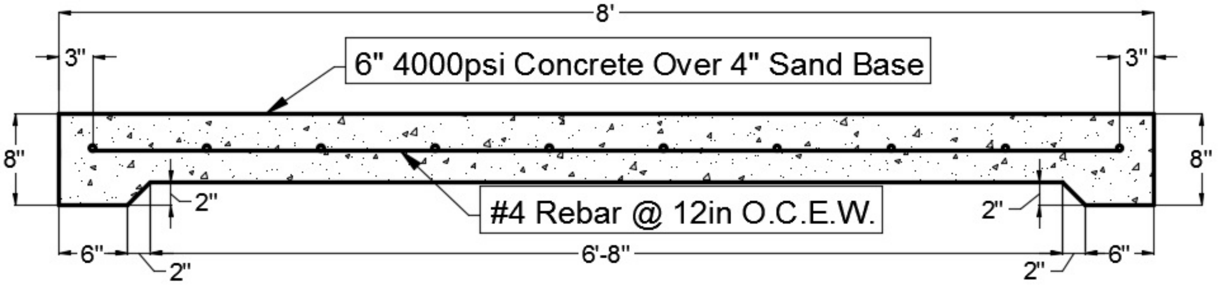


Figure 19: Cross-Section of Treatment Slab

Environmental

There are many contaminants to consider before a proper wastewater system can be chosen. Some expected pollutants that will be designed for are: petroleum products, such as motor oil, hydraulic oil, gasoline, diesel fuel, brake dust, grease, and asphalt products. Crude oils and petroleum are explained in Appendix 6: Crude Oils and Petroleum.

The wastewater system will also need to handle the large amounts of dirt that will be washed off the trucks. The environmental design team considered the worst case scenario of 35 cubic feet of mud. The majority of this mud was concentrated in and around the wheels, while a thin layer of dirt covered the rest of the truck and trailer.

Another important design consideration is treating the water for pathogens. Whether the wash water is recycled or discharged the water should be treated to prevent the spread of diseases. While the idea behind the wash is to regulate an outbreak of FMD, there are more common viruses that could potentially affect a feedlot or similar operation. Some of the viruses of concern are bovine viral diarrhea (BVD), adenovirus, coronavirus, and bovine papular stomatitis (Montgomery, 2015).

Before the wastewater system can remove organic and chemical substances, the heavy solids need to be separated from wastewater. Two options that can remove the suspended solids are: a vortex chamber, also known as cyclone clarifier (Accuweigh, 2015), and a simple grit chamber. Grit chambers protect mechanical equipment, such as pumps, from damages caused by heavy solids. This is done by slowing the suspended particles down so that gravity can settle the particles out. They are usually installed and placed before pumps and/or tanks. The following describing the vortex chamber:

- Utilizes no moving parts
- Provides continuous removal of solids from a liquid
- Directly powered by the pump of the wash system
- Removes sand, soil, grit, sludge, and other solid matter centrifugally with minimal head loss
- Constructed of durable, corrosion resistant material for a longer design life (Accuweigh, 2015)

The vortex chamber had many advantages over the grit chamber but shared the same disadvantages. The vortex chamber and grit chamber would have to be very large to accommodate the worst case scenario of mud. Both systems would have to be cleaned regularly and the collected sludge is not disinfected. The lack of disinfection required the team to search for a different system that could handle the large amount of dirt and disinfectant.

Early in the design process, the team looked into the sand filters to act as the primary treatment stage. The benefits of a sand filter (Stormwater Technology Sand Filter, 2015) are listed below:

- Trap the solids as the wastewater passes through
- More effective when dealing with solid particles that are smaller than 40 micrometers
- Can be backwashed using either water from the filter or from an outside water source (Everfilt, 2015)

Small sand filters work best as a secondary treatment stage. Therefore, the use of a heavy solids and primary sedimentation would be needed. However, after three to five years, the sand filter will begin to experience congestive problems and will need to be replaced. It can be disposed in the landfill approved by Texas Commission by Environmental Quality (TCEQ). As before, disinfection and cleaning was a large problem.

The environmental design team also looked into completely enclosed wastewater treatment systems. One of these systems is the Magellan Wastewater Treatment System manufactured by Contech Engineered Solutions. The Magellan is constructed of a Steel Reinforced Polyethylene (SRPE) outer shell and interior plastic components. This combination results in an estimated product life cycle of 75 years, long outlasting similar products made of concrete, fiberglass, or epoxy. This unit contains no moving parts and is capable of treating between 2,000-250,000 gallons per day. The system begins with a primary treatment of wastewater consisting of grit removal, solids separation, and flow equalization. The second stage of the process is the bioreactor containing a Moving-Bed Biofilm Reactor (MBBR) which aids in nutrient removal, enhanced scum removal, and effluent filtration. The Magellan also has options for a third phase of treatment such as UV or chlorine disinfection. The system has the ability to produce effluent ranging from 5-30 mg/L BOD and TSS by both biological and chemical nutrient removal. This system was priced in the range of $50,000 to $150,000 and did not include the water disinfection option.

The best system that the team found was a CATEC CWR-15 closed loop system. This is a factory built system that performs all the necessary functions to recycle ~~the~~ wastewater. CATEC will provide the sump pump which will transfer the water to the two 750 gallon tanks; this will act as storage and settling tanks. Also the Ozone generator on the CWR-15 will continually pump into these tanks and disinfect the water and sludge. When more water is needed, the included pump will pull the wastewater through a series of filters, removing particles down to 10 micrometers. The treated water will be added to a staging tank where the wash will reuse this water many times over. It is recommended that the system be flushed with fresh water quarterly.

Figure 20: CATEC CWR-15 Industrial Water Reclaim System

The largest challenge of this design project was handling the large amount of mud coming off the trucks. A large sump pit can contain the mud but would require routine cleaning. To help keep this automated, the team considered a conveyor and an auger. The conveyor system was large, complicated, and would make maintenance a challenge. The auger system from Martin Sprocket and Gear was a better system and researched further. Since the auger was shaftless, it would move heavy solids and retain the water. It could be automated to run when needed which also allows the sump pit to be sized smaller. Unfortunately, the auger cost $13,000 and could not be implemented..

Some key environmental issues facing wheel washes are wash water, fuel tanks, grit trap waste, and air emissions (Environmental Rules for Car Washes, 2014). Chemicals and sediments from wheel-washes can contaminate water supplies, block sewer lines, damage pumps, and upset the proper treatment of wastewater. Grit trap waste is the solid, liquid, or semisolid material that accumulates in wheel and undercarriage wash water. The grit trap must be cleaned regularly to prevent overflows. Waste can be managed by drying the wet waste on site or disposing of the wet sludge. On site, the effluent can be disposed in an evaporation bed to let it dry. Dried waste must be removed from the drying site and disposed to the lagoon. If chosen to keep grit trap waste wet, it must be removed from the site for proper treatment and disposal (Environmental Rules for Car Washes, 2014).

To manage the wash water, a catch basin or grit trap must be used to filter sediment and trash from the used wash water before proceeding through the treatment process. To protect the incoming water supply from potential contamination hazards, a reduced pressure principle backflow prevention assembly is installed as required by the Texas Commission on Environmental Quality (TCEQ). Discharging wash water to septic systems is prohibited by TCEQ. On the other hand, discharged wash water would pollute septic systems with toxic and poisonous substances. Used wash water can be recycled and treated with disinfectant agents and reused (Environmental Rules for Car Washes, 2014).

Wastewater containing solids may be transported to the treatment system or storage pond(s). The pond(s) may be designed to treat wastewater using evaporation to let wastes dry and be disposed, with or without the recycling of wastewaters. Disposal of waste and wastewater must be managed in such a manner as to prevent nuisance conditions such as odors. Wastewater must not be irrigated when the ground is frozen, saturated, or during precipitation events. Wastewater disposed of during such conditions would create run off.

Environmental problems can be reduced by (Environmental Rules for Car Washes, 2014):

- Handling, storing, and disposing of waste in a manner that will avoid spills or releases and prevent it from using a nuisance such as odor.
- Covering wash bays to prevent drain from overflowing when precipitation occurs.
- Inspecting equipment, tanks, containers, and nozzles regularly for leaks or clogs. Make repairs immediately. Inspect drains for clogs as well as repair any clogged drains.
- Recycling and reusing wash water.
- Installing low-flow nozzles or adjust flow in nozzles, sprays, and other lines to meet quality requirements. Calibrate equipment routinely.
- Stainless-steel nozzles
- Installing positive shut-off valves in case of any emergencies such as leaking.
- Using biodegradable products instead of solvent-based or highly concentrated solutions.
- Reducing the amount of detergent used in the system. Less detergent produces fewer suds and reduces the amount of rinse water needed.
- Water softeners and special filtrations units can lower the amount of solids in the water and reduce spotting.
- Storing fuel in an aboveground tank, instead of an underground tank.

An above ground storage tank with a volume of 3,000 gallons is utilized between the well and the nozzle pump. The tank allows enough water to be stored and used independently from the incoming flow. The foundation will consist of soil and a ballast.

Mechanical Components

Overview

This design enables the cattle industry to proactively prevent and control disease outbreaks among bovine, primarily Foot and Mouth Disease (FMD), by cleaning and disinfecting the undercarriages and wheels of work and cattle-transportation vehicles. To clean vehicle surfaces, the vehicle wash system is designed to pressure wash soil that is potentially infected with the FMD virus. This wash system focuses on cleaning undercarriage and wheel surfaces where pathogen infected soil primarily gathers on vehicles. For quick wash times, the system is designed to be a single-stage pressure-disinfection wash; which vehicles drive through. The wash uses Accelerated Hydrogen Peroxide (AHP) as its FMD disinfectant and cleaner, and unlike its competitors, AHPs chemical properties allow a single-stage pressure-disinfection wash to be possible.

To decrease the overall cost, this wash system is designed to use cold water which negates the need for a water heater. Referring to Figure 21, four rows of pipes fitted with spoon nozzles will run along the length of the wash foundation. Spoon pressure nozzles deliver hard-hitting impact and are clog resistant for hard and high-sediment water use. These nozzles are made from 316 stainless steel to resist abrasion, and the nozzle industry proclaims this will prolong nozzle life at optimum cost.

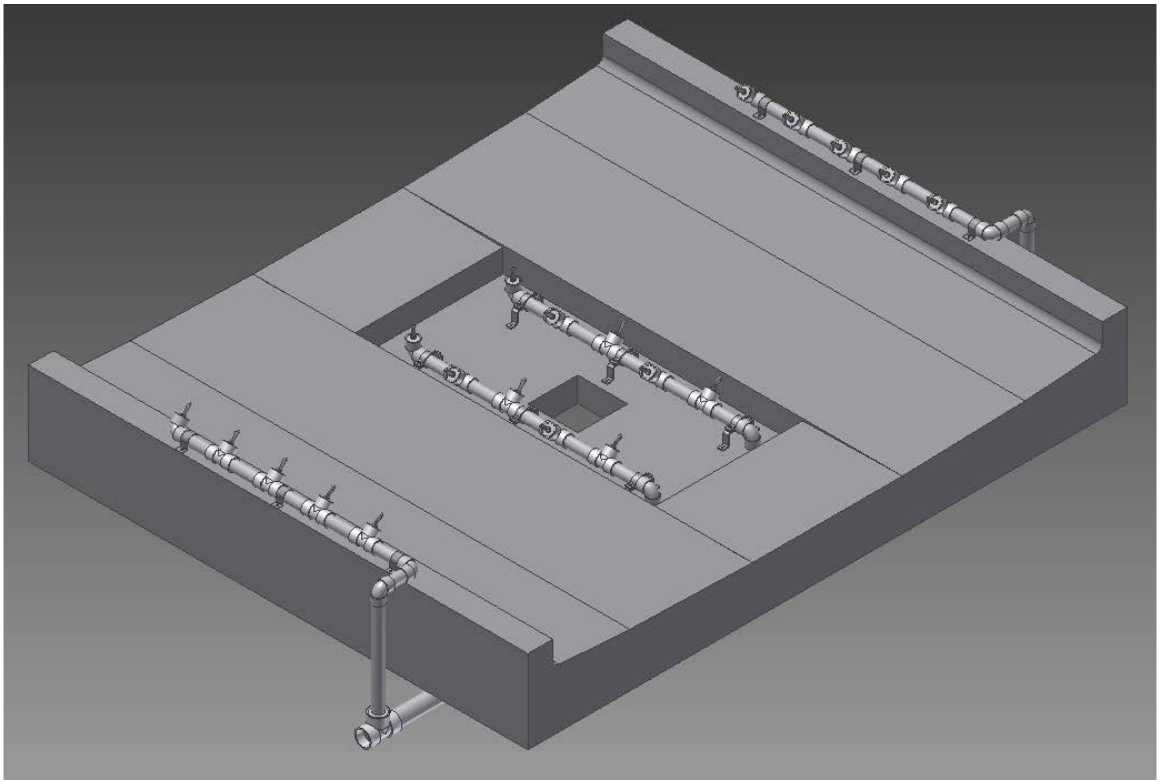


Figure 21: Vehicle Wash System Overview

The system's pipe network consists primarily of ASTM (American Society for Testing and Materials) standard~~,~~ Chlorinated Polyvinyl Chloride (CPVC) which is the most cost-effective, durable, and corrosion-resistant piping material compared to ~~its~~ competitors. All CPVC pipe, fittings, and solvent cement should be manufactured per standard ASTM F441, F439, and F493, respectively. A model 4K131 pump manufactured by CAT Pumps® circulates delivers a water-AHP solution to the wash's 20 nozzles at 100 GPM, and operates at a pressure of approximately 50 psi. Each nozzle discharges approximately 5 GPM resulting in an estimated 1.2 psi of spray impact. The FS1CR005A Flow Injection System manufactured by Pulse Instruments® automatically injects AHP at a 1:64 concentration into the pipe network.

FMD Disinfectant

The vehicle wash system uses Accel®, a hydrogen peroxide based disinfectant, to rid vehicle surfaces and soil of FMD and other pathogens. Accel® is commonly referred to as Accelerated Hydrogen Peroxide (AHP) which "is a patented synergistic blend of commonly used, safe ingredients that when combined with low levels of hydrogen peroxide dramatically increase its germicidal potency and cleaning performance (Virox Technologies Inc.)." Virox Technologies is the creator and manufacturer of Accel®, and Ogena Solutions, LLC is the provider. AHP passed all criteria determined for the wash's needs unlike its competitors. To be used for the design, the chosen disinfectant must:

- Have government approval for use against FMD
- Be safe to use in the presence of drivers and livestock within vehicles
- Cause little to no harm ~~on~~ to the environment
- Create minimal corrosive effects on design and vehicle components
- Work effectively in the presence of high amounts of feces

AHP has yet to gain approval by the United States government. However, Dr. Lucas Pantaleon, Director of Ogena Solutions, stated via personal interview that AHP passed the initial test for disinfecting FMD at a 1:64 concentration within a 10 minute contact time (Pantaleon, Director of Ogena Solutions, 2015) and is capable of killing bacteria, viruses, and fungi within 5 minutes (Ogena Solutions, LLC). Label approval by the Environmental Protection Agency (EPA) is expected by Fall of 2015 (Pantaleon, Director of Ogena Solutions, 2015). Fortunately, if the design is fabricated and implemented before then, an Exemption 2EE can be made to the EPA in case of an outbreak emergency (Pantaleon, Director of Ogena Solutions, 2015).

Concerning safety, Dr. Pantaleon assured that AHP is perfectly safe to use when livestock are present in cattle trailers during the wash process, but this will be considered an off-label use (Pantaleon, Director of Ogena Solutions, 2015). During the wash process, drivers will be enclosed in their vehicle's cabin and protected from wash sprays. Furthermore, the Material Data Safety Sheet (MSDS) for Accel®, mixing solution requires no Personal Protection Equipment (PPE) for drivers, and the MSDS states that this disinfectant "contains no substances which at their given concentration are considered to be hazardous to health" (Ogena Solutions, LLC, 2013).

Because hydrogen peroxide converts to water vapor and oxygen, Accel® is safe for the environment (Ogena Solutions, LLC). This chemical property also excludes the need to rinse cleaned surfaces (Pantaleon, Director of Ogena Solutions, 2015) which enables the wash design to exclude a rinse stage and save water. AHP also possesses good compatibility with hard water (Pantaleon, Director of Ogena Solutions, 2015) which enables the design's wash process to be further simplified to a single, pressure-disinfection stage. Furthermore, Virox Technologies won environmental awards that prove the environmental stability of Accel® including (Virox Technologies Inc.):

1. Champion Status of the EPA's Design for the Environment's Safer Detergents Stewardship Initiative (SDSI) Award.
2. Leadership in Energy & Environmental Design (LEED) Silver Certification from the U.S. Green Building Council (USGBC).
3. Environment Canada's first EcoLogo registered disinfectant-cleaner.

Referring to Table 12, AHP is compatible with the materials expected to be present in vehicle and design components. Even at a 10% concentration, the active ingredient in Accel®, hydrogen peroxide, is compatible with aluminum unlike its USDA recommended competitors. This chemical property is important to note for design requirements because aluminum is used extensively for cattle trailer components.

Table 12: Material-Disinfectant Compatibility
(Cole-Parmer Instrument Company, LLC)

		USDA Recommended Disinfectants for FMDV					
		Sodium Hypochlorite (< 20%)	Vinegar (4% Acetic Acid)	Sodium Carbonate	Sodium Hydroxide (20%)	Citric Acid	Hydrogen Peroxide (10%)
Materials	304 Stainless Steel	C	A	A	B	B	B
	316 Stainless Steel	C	A	A	B	A	B
	PTFE	A	A	A	A	A	A
	PVC	A	B	A	A	B	A
	Natural Rubber	C	B	A	A	A	B
	Aluminum	D	D	D	D	C	A
	Epoxy	C	A	C	A	A	C
	Polyurethane	D	D	B	B	A	B

Rating	**Description**
A	**Excellent.**
B	**Good** - Minor Effect, slight corrosion or discoloration.
C	**Fair** - Moderate Effect, not recommended for continuous use. Softening, loss of strength, swelling may occur.
D	**Severe Effect** - Not recommended for ANY use.
N/A	Information not available.

For the design, Accel® needs a minimum 1.56% (1:64) concentration to be effective against FMD (Pantaleon, Director of Ogena Solutions, 2015). At AHP's lowered concentration, epoxy and polyurethane receive A-ratings in the table shown previously (Pantaleon, Director of Ogena Solutions, 2015). In the design, epoxy and polyurethane based coatings prevent degradation of CPVC pipe exposed to the sun and UV rays making disinfectant compatibility more important. If no protection can be provided, the design would use stainless steel piping, which greatly increases design cost and decreases pipe network efficiency. AHP also has no adverse effects on the wash's concrete foundation (Pantaleon, Director of Ogena Solutions, 2015).

Feedlot dirt is expected to contain high amounts of feces. "A recent controlled study performed by a research team at Iowa State University demonstrated that under simulated field conditions normally seen in swine trailers AHP disinfectant distributed by Ogena Solutions, LLC patented and manufactured by Virox Technologies Inc. was able to kill 100% of PEDV (Porcine Epidemic Diarrhea Virus) in the presence of both light and high amounts of fecal matter (Pantaleon, AHP Inactivates PEDV in the Presence of High Feces Load, 2014)." Going further beyond its need to be an effective disinfectant in the dirtiest conditions, Accel® also doubles as an effective cleaner, and standardized testing gave Accel an 86% cleaning efficacy (Pantaleon, Director of Ogena Solutions, 2015).

With this information and previous concepts in mind, AHP allows the vehicle wash system to be effective under the most pressing environmental and design conditions. The projected cost for Accel® is $1,400 per 55 gallons (Pantaleon, Director of Ogena Solutions, 2015). At a 1:64 concentration ratio, the wash system uses approximately 1.65 GPM of AHP to keep pace with the system's 100 GPM demand. For more information concerning AHP's competitors, refer to Appendix 7: Considered Disinfectants.

Pressure Nozzles

The vehicle wash system utilizes spoon nozzles to simultaneously pressure wash and apply AHP disinfectant. The pressure wash nozzles used for the system must be able to:

- Create sprays capable of dirt clearing impact at distance
- Use water with high mineral and sediment content
- Resist corrosion resulting from exposure to the system's disinfectant
- Be made of material durable enough to resist abrasion at optimum cost
- Provide adequate vehicle coverage

To fulfill these requirements, the design team chose the SPN40 spoon nozzle manufactured by BETE Fog Nozzle Inc. As shown in Figure 22: BETE SPN-Model, Fan Nozzle below, spoon nozzles efficiently form a flat and narrow, hard-driving spray by deflecting a solid stream off a spoon-like surface which results in minimal spray atomization (BETE Fog Nozzle Inc.). The SPN40 nozzles chosen create a 50 degree spray angle fan that is deflected 50 degrees from the vertical. For reference, Figure 22 shows a narrow angle, spoon nozzle deflected 35 degrees from the vertical.

Figure 22: BETE SPN-Model, Fan Nozzle
(BETE Fog Nozzle Inc.)

Eric Amato, Applications Engineer of BETE Fog Nozzle Inc., stated that spoon nozzles produce the largest droplet sizes of any spray nozzle types his company offers (Amato, 2015). To maintain impact at a distance, it is important to choose a nozzle that minimizes atomization of sprays. The better a nozzle can maintain large droplet sizes, the less effected by drag the sprays will be. This results in higher impact at distance.

To determine the impact pressure for a fan nozzle, the cohesive and adhesive strength of the soil that will knock particles apart needed to be determined. Clay soil is common in the Texas Panhandle. According to Rodolfo Mireles, Engineer of Amarillo Testing and Engineering Inc., the general adhesive and cohesive strength of clay soil is 375 psf (2.60 psi) and 500 psf (3.47 psi) respectively, and these values can decrease by 50% to 75% as the soil becomes saturated with water (Mireles, 2015). These are compacted soil values and voids are expected to develop in dirt accumulated on vehicles. Since cohesive strength is greater, the required impact range for nozzle sprays need to be within or exceed the saturated, cohesive strength of clay between 125 psf (0.87 psi), and 250 psf (1.74 psi). The design has been optimized to allow each of its spoon nozzles to operate at 50 psi and discharge water at approximately 5 GPM each. At this operating condition, each of the design's nozzles produce at least 1.2 psi of impact which is within the desired range for clearing soil from vehicle surfaces.

It is possible to further increase pressure at each nozzle. However, Amato explained that increasing a nozzle's outlet pressure correlates to decreasing droplet size, and he recommended using a maximum pressure of 100 psi to avoid creating ineffective droplets (Amato, 2015). Small droplets travel quickly near the nozzle outlet, but their reduced mass lowers their inertia (an object's tendency to maintain their speed in their direction of travel). With decreased inertia, drag slows droplets down more quickly as they travel through the air. Slower and smaller droplets result in a less impact force at distance which decreases cleaning effectiveness. For further information on approximating spray impact, refer to Appendix 8: Spray Impact Optimization.

Recall that the SPN40 nozzles chosen have a 50 degree spray angle and 50 degree deflection angle. This enables the system to provide most cleaning coverage. A vehicles ground clearance limits the distance sprays that travel. The less distance a fan spray travels the less coverage width it can provide. As shown in Figure 23, the design orients sprays of 20 SPN40 nozzles, 5 per assembly row to clear debris from the undercarriage, inner-wheel, outer-wheel, and wheel-arch surfaces of vehicles.

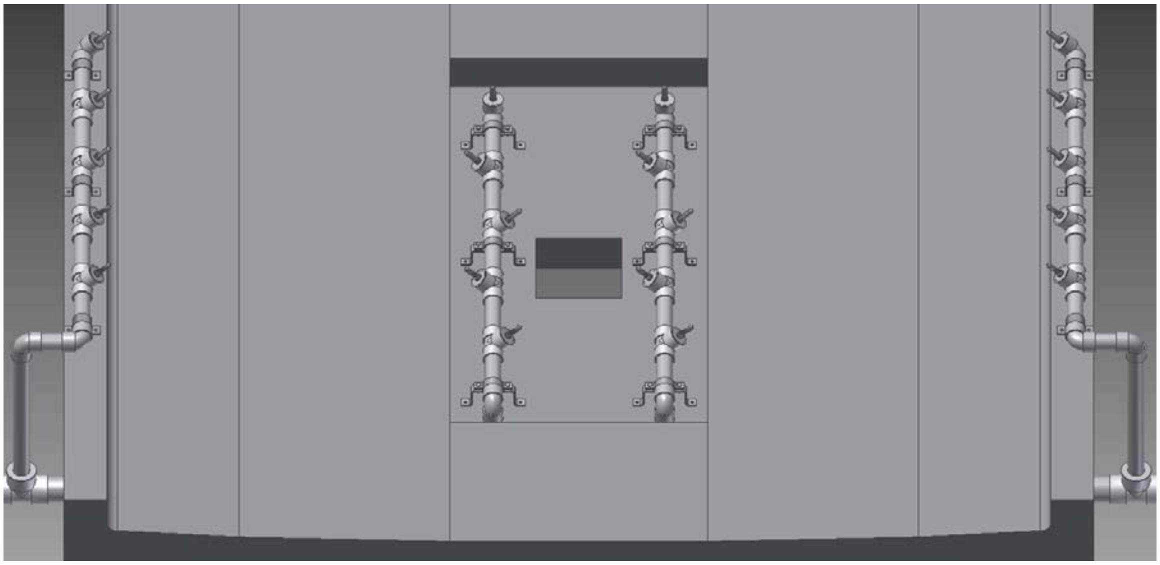


Figure 23: Spray Nozzle Configuration

The two, outer rows focus sprays on wheel arches and outer wheel surfaces. The first three nozzles towards the front (top of the photo) spray towards the front, and the two in the back (bottom of photo) spray towards the rear. The rows are canted 45 degrees towards the center to ensure maximum wheel coverage.

Figure 24 shows the pair of rows in the foundation's drainage pit focuses sprays on the inner wheels and undercarriage:

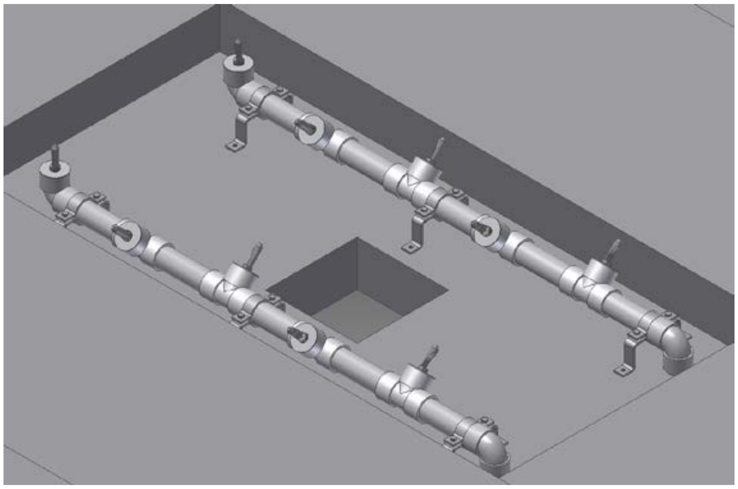


Figure 24: Center Nozzle Rows

The nozzles fitted into the elbows on the left spray forward into oncoming vehicles. At a 45 degree cant, the two nozzles after it spray forward, and two after rearwards. Table 13 shows the undercarriage coverage width percentages this configuration is capable:

Table 13: Undercarriage Coverage Width Percentages Center Nozzle Rows are Capable

Vehicle	Average Ground Clearance	Average Width	Percent of Undercarriage Width Covered
Car	6 Inches	56.8 Inches	51.14 %
Pickup	8.8 Inches	78.8 Inches	87.44 %
Cattle Trailer	20 Inches	102 Inches	100 %

For more in depth information about the design's spray coverage, refer to Appendix 8: Spray Impact Optimization

To be resistant against hard water and sediment, BETE SPN nozzles have straight cut orifices that minimize clogging (BETE Fog Nozzle Inc.). The SPN40 nozzle orifices have a 0.152 inch diameter, over 1/8 (0.125) inches, which enables sediment to pass (BETE Fog Nozzle Inc.). By being clog resistant, spoon nozzles need less maintenance than standard pressure washing nozzles, and this allows maintenance costs to be minimized for the wash system.

The wash's nozzles are made of 316 Stainless Steel. Concerning disinfectant compatibility, a 10% concentration of hydrogen peroxide will only cause slight corrosion and discoloration for this material (Cole-Parmer Instrument Company, LLC). Dave Hachey, President of Ogena Solutions, looked over the BETE pressure nozzles considered for the wash system, and he recommends using pressure nozzles made of 316 Stainless Steel or Polytetrafluoroethylene (PTFE) for Accel® use. Concerning abrasion, "hardened [316] stainless steel nozzles provide excellent service, are cost effective, and resist wear 30% better than regular [303 or 304] stainless steel nozzles and up to 15 times better than brass" (Spraying Systems Company).

Pipe Network

Pipe and fittings selection for the vehicle wash system focused on balancing material cost, ease of fabrication and maintenance, and pipe network energy requirements. Computational analysis using Pipe2014 software by KYPipe® LLC allowed rapid pipe network analysis accounting:

1. Nozzle Discharge
2. Pipe Friction
3. Fitting Pressure Losses
4. Reservoir Depth
5. Pump Operating Pressure

Referring to the Figure 25, a 3 inch, nominal diameter pipe line connects all four nozzle rows, allowing approximately 100 GPM of flow into the system. About 25 GPM of flow enters each nozzle row. The design's pipe network operates at approximately 50 psi and allows all 20 of its spoon nozzles to discharge 5 GPM each. As a result, each nozzle spray produces approximately 1.2 psi of soil clearing impact. The network's fluid speeds range 2.7 ft/s in the subterranean, vertical 2-inch diameter lines and 4.7 ft/s for the main 3 inch pipe from the pump. The underground inlets will have the greatest flow rates rendering them the most susceptible to surge pressure or water hammer from valves closing or pump start up. Maintaining pipe flows below 5 ft/s minimizes water hammer by allowing the system to operate within working pressure.

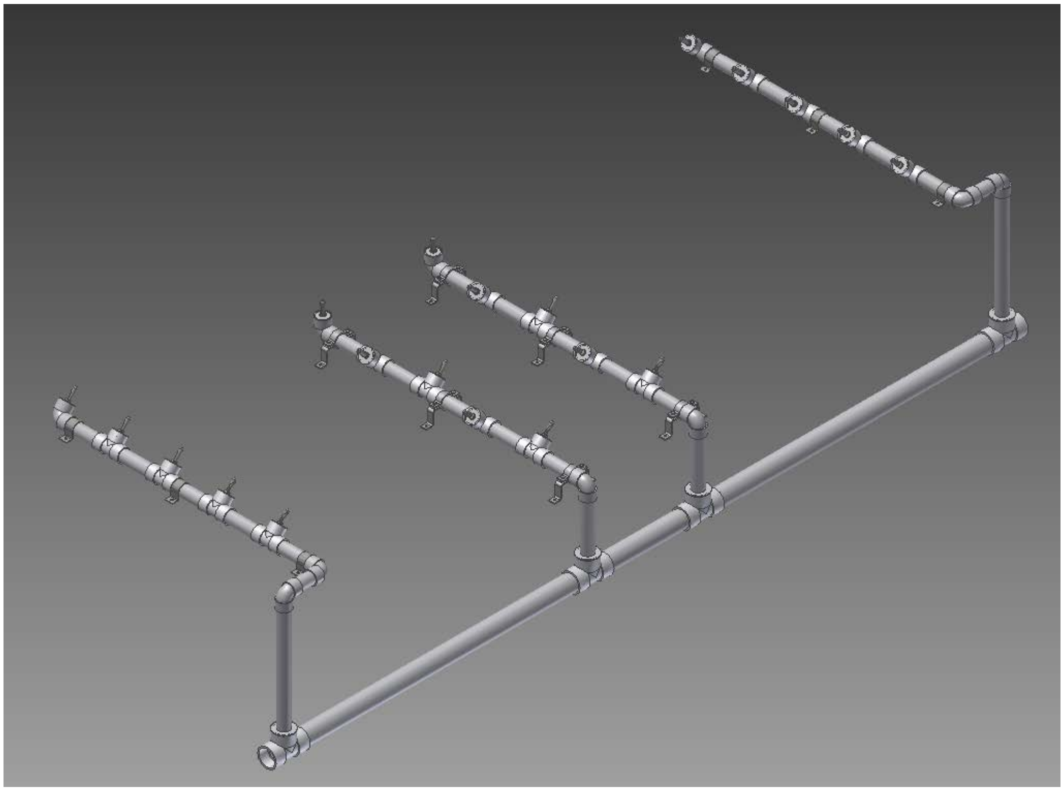


Figure 25: Foundation Pipe Network

Pipe Material

The material for the wash systems piping and fittings must:

- Be cost effective
- Endure system loads
- Resist corrosion caused by chemicals
- Withstand exposure to direct sunlight

The wash system's pipe network is made of Schedule 80, Chlorinated Polyvinyl Chloride (CPVC) pipes and fittings manufactured in accordance with ASTM standards F441 and F439, respectively. Plastic piping like CPVC is much less expensive than ~~their~~ metal counterparts. Also, plastic piping is easily assembled and repaired which minimizes fabrication and maintenance costs.

The system's pipes have nominal diameters of 2 and 3 inches, and the manufacturer's suggested maximum working pressure for Schedule 80, CPVC pipe is 400 and 370 psi respectively. The system specific working pressures are 178 and 216 psi from Appendix 11: Surge and Working Pressure Calculations.

Fitting Assemblies

There are a total of 16 Tee joint nozzle assemblies, 4 elbow joint nozzle assemblies. All CPVC fittings must follow ASTM F439 (formerly ASTM D1784) for CPVC schedule 80 socket style fittings and ASTM F493 standard for CPVC Solvent Cements.

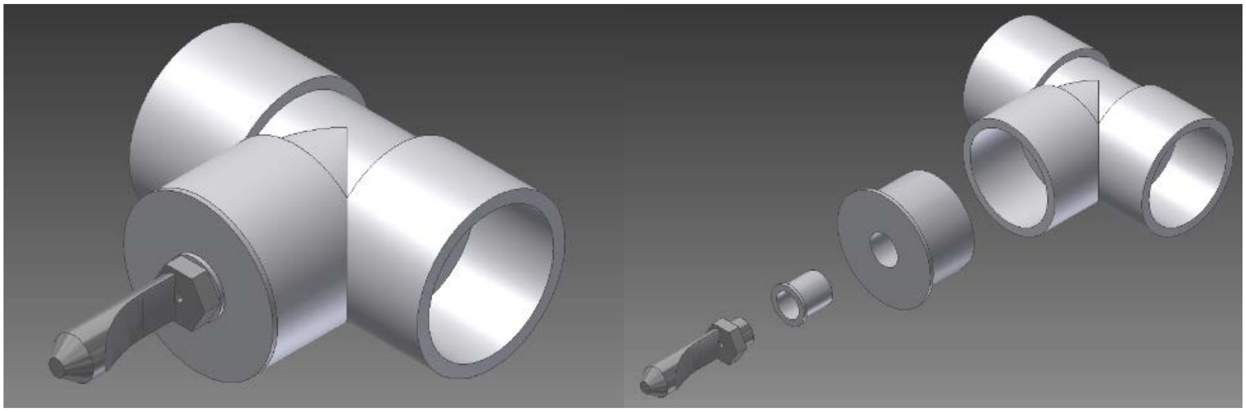


Figure 26: Tee Assembly Fitting

In Figure 26, the tee assembly fitting contains a:

1. 2 in Schedule 80 CPVC, Tee, socket end fitting
2. 2" x ½" reducing bushing, Schedule 80 CPVC, (S x S)
3. ½" x 3/8" socket to Female Pipe Thread (FPT), Schedule 80 CPVC to 316 stainless steel threaded transition adapter
4. SPN40 Nozzle 316 Stainless Steel 3/8" Male Pipe Thread (MPT)

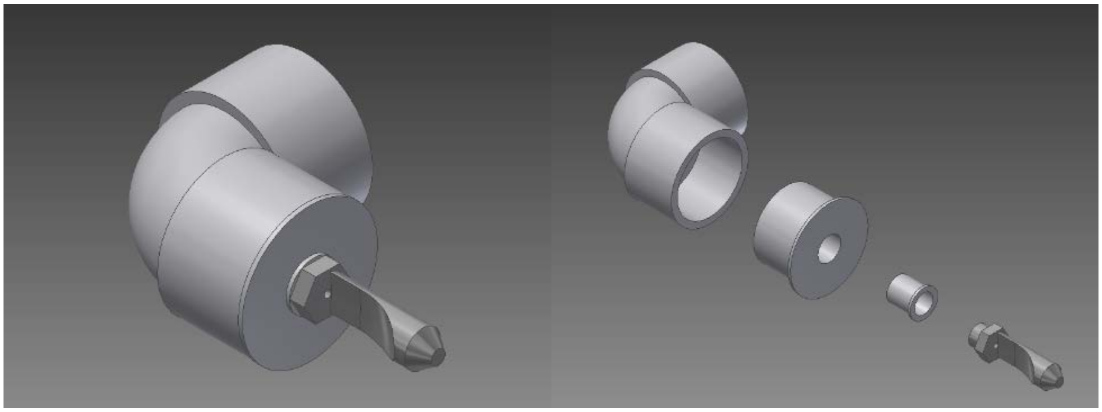


Figure 27: Elbow Assembly Fitting

From Figure 27, each elbow fitting assembly contains a:

1. 2" Schedule 80 CPVC, elbow, socket end
2. 2" x ½" Schedule 80 CPVC, reducing bushing, socket end
3. ½" x 3/8", Schedule 80 CPVC to 316 stainless steel threaded transition adapter, socket to FPT
4. SPN 40 Nozzle, 316 Stainless Steel 3/8" MPT

Nozzles thread into a CPVC to stainless steel threaded transition adapter. Threading metal into weaker CPVC threads generates excessive forces as the weaker plastic material deforms (Stryker, 2011).

Above Ground Supports

The supports for the above ground section in the wash bay are:

1. 316 Stainless Steel Offset Pipe Clamps
2. 316 Stainless Steel Short Clips

The offset pipe clamps give the center rows each support that will be fastened to the concrete using stainless steel wedge-all anchors and epoxy. In Figure 25, the center supports are offset pipe clamps and the short clips are along the curb. Offset clamps provide a safety factor of 6.94, and short clips give a 3.62 safety factor against thrust loads. For more information about support analysis, refer to Appendix 13: Pipe Network, Support Structures

Maintenance

Suspended solids in well water will settle over time. For domestic irrigation lines, removing sprinkler heads and running the system clears sediment in the pipes. For this wash system, removing the nozzles from the elbows and discharging the system ensures minimal sediment collects in each row.

Nozzles eventually scale when pumping hardened, well water. Hard water contains compounds such as calcium carbonate and gradually deposits scale on metallic surfaces similar to a kitchen faucet. A simple remedy involves removing and soaking the nozzles in a weak acid solution (Kinsela, Jones, Collins, & Waite, 2012), such as citric acid or vinegar available at any grocery store. Appendix 12: Pipe Scaling, explains scaling in greater detail. The wash's nozzles are threaded and easily removable for cleaning.

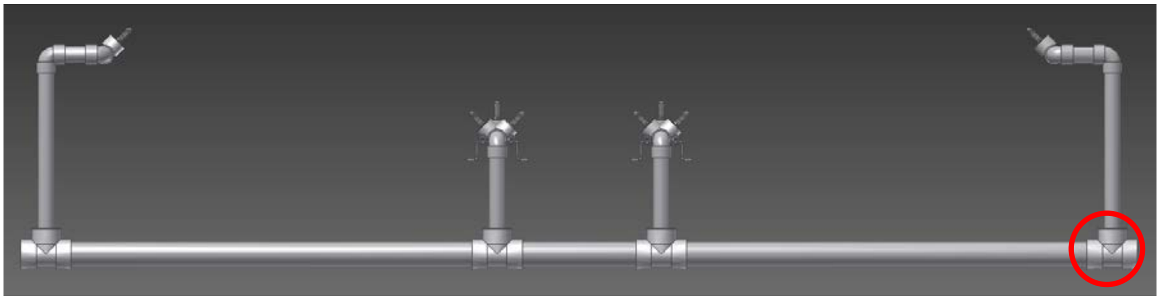


Figure 28: Pipe Network

A drainage valve runs into the sump pit from the final tee joint located opposite of the pump inlet, as indicated by the red circle in Figure 28. This valve is placed as the lowest point in the system allowing the network drain. A simple water meter key can be used to turn the valve. This valve allows the system to drain for maintenance, and prevent overnight freezing during winter months.

Pump Systems

Water Pump

The water pump selected for the wash system needs to (CAT Pumps ®, 2014):

- Be properly sealed to prevent air and water leaks
- Require low maintenance and permit easy repair of its impeller and seal
- Include mounting flanges for secure, easy installation
- Protect its electrical components from water exposure

The pump should also match the system characteristics of the vehicle wash system's pipe network. Pipe2014 software by KYPipe® was used to simulate the pipe network configuration with 10 foot tall reservoir that will feed the system and the pump operating from ground level. CAT Pumps® matched the design's system curve to their model 4K131 pump shown below. This pump uses a 5 hp motor operating up to 3450 RPM, and uses three-phase power which is shown in Figure 29.

Figure 29: CAT Pump 4K131

(CAT Pumps ®, 2014)

The 4K131 produces the following pump curve:

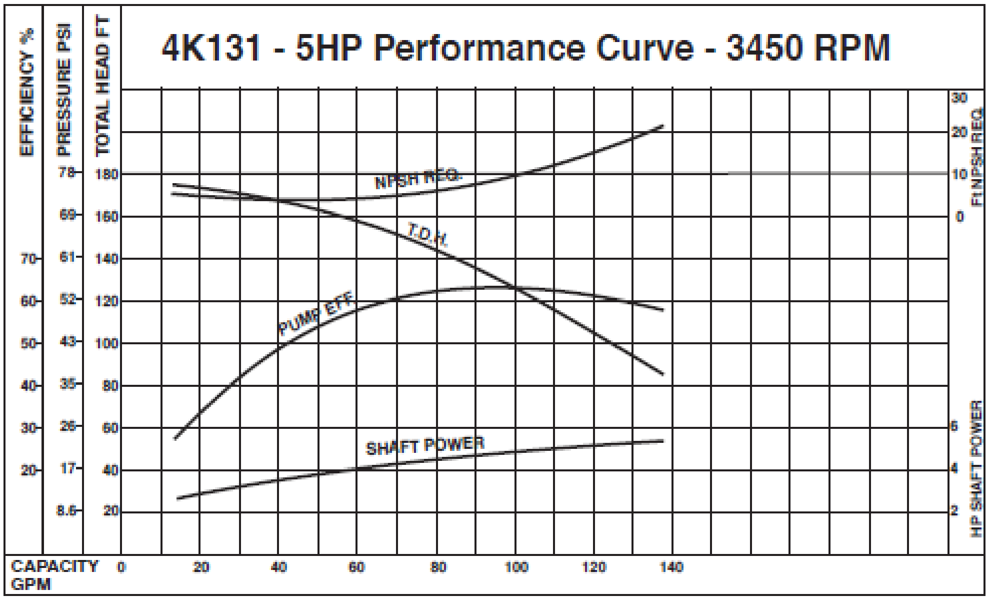


Figure 30: CAT Pump 4K131 Curve

(CAT Pumps ®, 2014)

The desired, operating point for the system needs to be approximately 100 GPM because that is the total required flow rate for the pressure wash. The total head required for 100 GPM is 107 ft.

Pipe2014 indicated that a pump needs to produce at least 52 psi to deliver more than 50 psi to each nozzle Figure 31. Below shows a comparison of the 4K131's pump curve compared to the system curve found with Pipe2014:

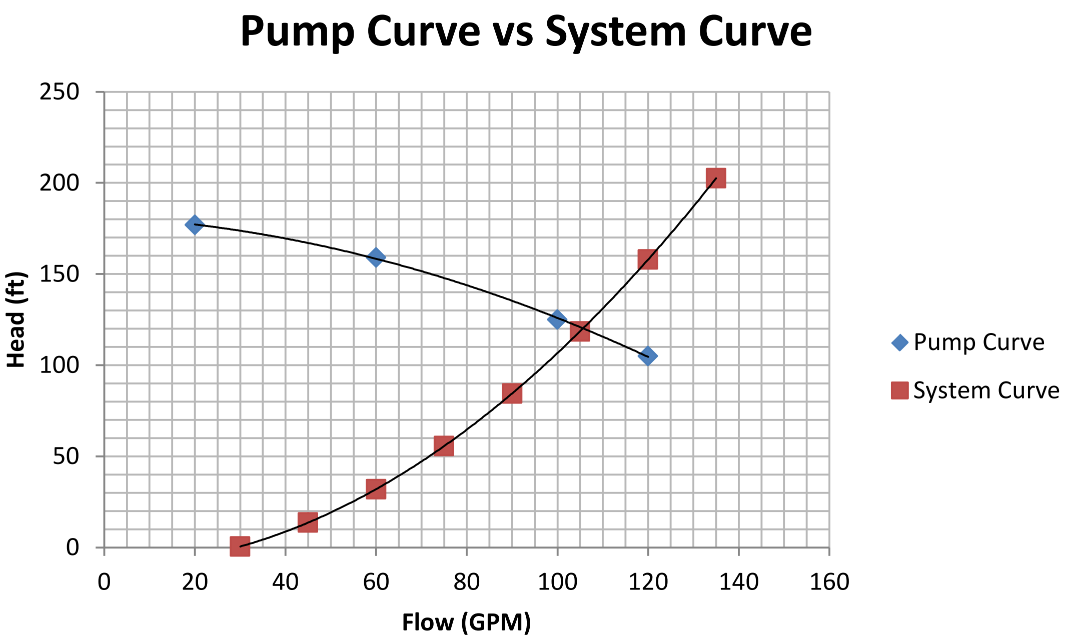


Figure 31: Pump Curve vs System Curve

In the curve comparison, the operating point is where the pump curve and the system curve intersect, is located at around 105 GPM, 120 ft and 52 psi. The 4K131 pump performs well for the system because it reaches its best efficiency point at 100 GPM, which is close to the operating point of 105 GPM. It is important to have a pump that operates close to its best efficiency point to avoid cavitation that shortens the pumps life (Ferman, 2012). Therefore, the 4K131 pump is ideal to use for the vehicle wash system.

Water Pump Fittings and Components

A pump like the CAT Pump 4K131® will need a 2.00" ANSI flange on the inlet and a 1.25" ANSI flange on the discharge (Majewski, 2015). Then, these ports will be connected to the pipe using fittings that will match with the system.

A filter or strainer should be installed upstream from the pump to prevent debris from getting inside the pump. Also, a shut-off valve should be connected upstream from the pump to close the flow from the storage tank if the pump is going to be replaced. A check valve should be placed downstream from the pump to ensure that the pump always has enough pressure to start up (Majewski, 2015).

When the photoelectric sensors detect a vehicle, a signal is sent to a relay connected to a solenoid valve. Then, the valve completes the circuit of the pump to turn it on (Terry, 2015). This means the pump will be constantly turning on and off during the day, but Derek Majewski, Technical Sales

Representative of CAT Pumps, stated that this will not be an issue for the life expectancy of the 4K131 pump (Majewski, 2015).

Chemical Injection Pump

Figure 32 shows the FS1CR005A Flow Injection System manufactured by Pulse Instruments® will pump Accel® disinfectant into the wash's pipe network at a minimum 1:64 concentration ratio.

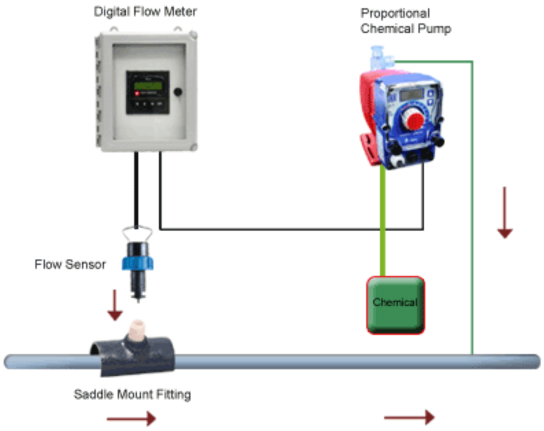


Figure 32: FSQCR005A Flow Injection System
(Pulse Instruments)

The system is prewired, preprogrammed, and includes a (Pulse Instruments):

1. Digital Flow Meter
2. Flow Sensor
3. Installation Fitting
4. Chemical Injection Pump
5. ORP & pH Meter Kit

This injection system is automatic and can be configured to inject chemicals proportional to flow rates.

Automation

Considering the characteristics of the undercarriage and wheel wash, photoelectric sensors such as the QS30 from Banner Engineering Corp. or the IP67 from Pantron Automation, Inc. shall be used in this wash. These sensors have the ability to work effectively while being cheaper than other types of sensors such as the radar and inductive loop. Moreover, they have a lifespan of 8-10 years (Finley, 2015), which is longer than the 2-4 years of ultrasonic sensors (Lewis, 2015) and 3 years of radar sensors (Cearley, 2015). A comparison of the cost of different types of sensors is presented below.

Table 14: Sensor Cost Comparison

Sensor type	Cost	Reference
Photoelectric	$205	(Finley, 2015)
Ultrasonic	$205	(Lewis, 2015)
Radar	$662	(Cearley, 2015)
Inductive Loop	$220	(Lewis, 2015)

This table represents the costs for the sensors and does not include any installation costs. The installation cost will be particularly high for the inductive loop because the loop needs to be inside the concrete so that the trucks will pass over it.

How It Works

There will be a total of two pairs of sensors that consist of a transmitter and a receiver. When a vehicle passes between the pair of sensors, the beam will be broken; therefore, initiating the wash. When the vehicle has completely passed the sensors, the beam will be re-established and the wash will turn off.

The sensors control the pump using relays and solenoids (Rich, 2015). Relays are devices that can transform an electric signal into an on/off switch. Solenoids are devices that convert an electric current into linear motion (Trossen Robotics, 2012). Basically, the output of the sensors' receiver when the beam is broken (dark operate) goes to a relay, which is programmed using a control center. The relay will then send an electric current to a 24vdc coil solenoid, and this device completes the circuit of the pump to turn it on. The sensors and relay are 24 Vdc operated and need a power supply, which could be a 500mA 24 Vdc for each or a 2.4 Amp for all of them. The relay handles 10amps and will last for several years. These components will be placed in an electrical box and mounted in the building with the wastewater treatment system. (Rich, 2015).

Sensor Placement

One pair of sensors will be placed at each end of the wash. This will allow the wash to stay on until the entire vehicle has passed through. The sensors are mounted at an angle to ensure that they continuously detect the trucks when they pass (Finley, 2015). The receiver will be mounted 5 feet from ground level, while the transmitter is mounted 18 inches from ground level. A simple layout is shown in Figure 33. This ensures that the beam will be broken no matter the height of the vehicle passing through the wash. The sensors are supported using a 2.375 in, 15 gauge, and galvanized fence post. The posts are embedded 3 feet into the ground and cast in concrete. The sensors are held onto the post using u-bolts. Post placement is at the four corners, 1 foot away from the concrete edge. The wiring for the sensors and the pump is routed through CPVC conduit which runs alongside the feed line for the nozzles. This avoids the use of extra equipment, labor, and an additional ditch to install the wiring.

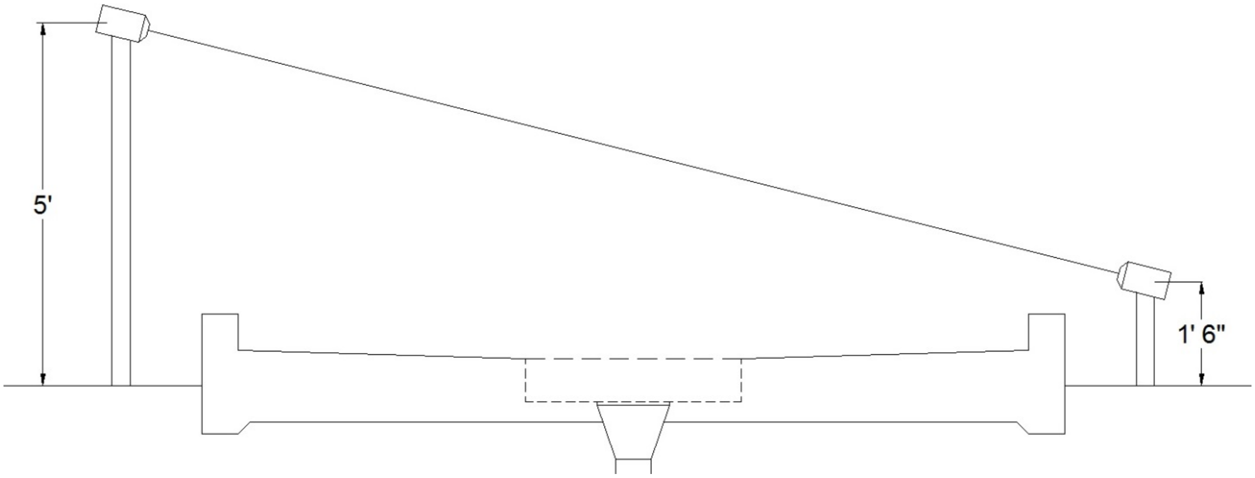


Figure 33: Sensors Angles

Safety

These sensors activate the wash when the beam is broken. This means that any object that passes through the beam will activate it. Warning signs will placed around the wash to keep people from walking through the beams. A 2 second delay is implemented to allow an object to move before the wash begins.

Maintenance

These sensors are made to resist dust, dirt, mud, chemicals and other particles accumulating on their lenses (Finley, 2015). They are also functional during a heavy rain. (Finley, 2015). Cleaning the lenses is recommended every six months. (Finley, 2015)

Cost

Table 15: Sensors Cost

Part	Price per unit	Units	Cost	References
Transmitter	$34	2	$68	(Finley, 2015)
Receiver	$53	2	$106	(Finley, 2015)
Amplifier	$111	2	$222	(Finley, 2015)
Amplifier socket	$6	2	$12	(Finley, 2015)
Solenoid Switch	$25	2	$50	(Del City ®)
Power supply	$180	1	$180	(Rich, 2015)
Relay and bases	$25	2	$50	(Rich, 2015)
Enclosure	$200	1	$200	(Rich, 2015)
Fence Post Cap	$4	4	$16	(Lowe's, 2015)
Fence Post	$22	3	$66	(Lowe's, 2015)
Quikrete (For Posts)	$4	4	$16	(Lowe's, 2015)
Labor	$95	32	$3040	(Perez, 2015)
		Total Cost	$4026	

Appendix 1: Sample Calculations

Sample Calculation for Truck Loading

The values for the design are based on the maximum weight of a fully loaded semi-truck which was assumed to be 125,000 lb.

- Total weight = 130,000 lb
- Total number of wheels = 18
- Contact area per wheel = 1 ft^2

$$\frac{Total\ Weight}{Number\ of\ Wheels} = \frac{130{,}000\ lb}{18\ wheels} x \frac{1\ wheel}{1\ ft^2} = 7222.2\ lb \approx 7222\ psf$$

Sample Calculation for Weight of Foundation

- Weight of concrete = ɣ = 150 $\frac{lb}{ft^3}$
- Dimension of washing Bay
- Length = 10 feet
- Width = 12 feet
- Thickness = 1 feet

Weight of foundation = (10ft) x (12ft) x (1ft) x (150$\frac{lb}{ft^3}$) = 18,000 lbs.

Sample Calculation for Settlement

- Length = L = 10 ft
- Base = B = 12 ft
- Footing depth = D_F = 0.67 ft
- Distance to water table = H = 6 ft

$$m' = \frac{L}{B} = \frac{10\ ft}{12\ ft} = 0.833$$

$$n' = \frac{H}{\left(\frac{B}{2}\right)} = \frac{6\ ft\ (2)}{12\ ft} = 1.0$$

$$\frac{D_F}{B} = \frac{0.67\ ft}{12\ ft} = 0.05$$

- Medium Clay, μ_s = 0.5
- I_f = 0.85
- F_1 = 0.142
- F_2 = 0.083
- Modulus of Elasticity for hard clay = E_S = 1750 $\frac{Psi}{in^2}$

$$I_S = F_1 + \frac{1-2\ \mu_S}{1-\mu_S} F_2 = 0.142 + \frac{(1-2(0.5))}{(1-0.5)} = 0.42$$

$$S_e = \Delta\sigma(\alpha\beta') \frac{(1-\mu_S)^2}{E_S} I_S\, I_F = \frac{(18{,}000\ Lbs)}{120} (4)(5) \frac{(1-0.25)}{(1750)(144)} (0.42)(0.85) = 0.038\ in$$

(Das, Braja)

Appendix 2: Moisture Content

Table 16: Moisture Content of Sample 1

Moisture Content						
Sample 1: Trench Soil						
Sample Number	Can Mass (g)	Initial Mass + can (g)	Oven-Dry Mass + can (g)	Mass of Moisture (g)	Mass of Dry Soil (g)	Moisture Percent
A	11.3	62.6	55.2	7.4	43.9	16.9
B	11.3	59.8	53.8	6.0	42.5	14.1
C	11.5	65.1	56.7	8.4	45.2	18.6
D	11.0	63.8	56.7	7.1	45.7	15.5
E	11.3	59.3	52.9	6.4	41.6	15.4
F	11.2	56.8	50.0	6.8	38.8	17.5
G	11.1	60.5	53.4	7.1	42.3	16.8
H	11.1	66.0	57.3	8.7	46.2	18.8
I	11.3	62.8	56.1	6.7	44.8	15.0
J	10.8	65.1	56.4	8.7	45.6	19.1
					Average	**16.8**

Table 17: Moisture Content of Sample 2

Moisture Content						
Sample 2: North Fence Line						
Sample Number	Can Mass (g)	Initial Mass + can (g)	Oven-Dry Mass + can (g)	Mass of Moisture (g)	Mass of Dry Soil (g)	Moisture Percent
A	11.1	60.3	54.5	5.8	43.4	13.4
B	11.2	55.6	49.7	5.9	38.5	15.3
C	11.1	61.2	56.2	5.0	45.1	11.1
D	11.2	58.9	52.6	6.3	41.4	15.2
E	11.0	57.0	51.5	5.5	40.5	13.6
F	11.2	62.7	57.3	5.4	46.1	11.7
G	11.4	58.1	53.1	5.0	41.7	12.0
H	11.5	61.2	54.4	6.8	42.9	15.9
I	11.3	59.9	53.3	6.6	42.0	15.7
J	11.3	56.3	51.2	5.1	39.9	12.8
					Average	**13.7**

Table 18: Sample Content of Sample 3

Moisture Content						
Sample 3: South Fence Line						
Sample Number	Can Mass (g)	Initial Mass + can (g)	Oven-Dry Mass + can (g)	Mass of Moisture (g)	Mass of Dry Soil (g)	Moisture Percent
A	11.1	50.9	45.5	5.4	34.4	15.7
B	11.0	46.2	41.3	4.9	30.3	16.2
C	11.1	54.1	47.9	6.2	36.8	16.8
D	11.2	47.9	42.9	5.0	31.7	15.8
E	11.1	56.2	49.8	6.4	38.7	16.5
F	11.4	51.5	46.3	5.2	34.9	14.9
G	11.3	49.8	44.6	5.2	33.3	15.6
H	11.0	47.0	42.2	4.8	31.2	15.4
I	11.2	51.0	45.6	5.4	34.4	15.7
J	11.0	48.0	43.0	5.0	32.0	15.6
					Average	**15.8**

Figure 34: Moisture Cans Used to Find the Average Moisture Content for Each Location

Sample calculations for the first moisture can obtained from soil sample 1:

- M_1 = 11.3g
- M_2 = 62.6g
- M_3 = 55.2g

$$M_2 - M_3 = 62.6\text{g} - 55.2\text{g} = 7.4\text{g}$$

$$M_3 - M_1 = 55.2\text{g} - 11.3\text{g} = 43.9\text{g}$$

$$w = \frac{M_2 - M_3}{M_3 - M_1}\ x\ 100 = \frac{7.4g}{43.9g} x100 = 16.9\%$$

Appendix 3: Sieve Analysis

Table 19: Sieve Analysis Results for Sample 1

<table>
<tr><th colspan="6">Sample 1: Trench Soil</th></tr>
<tr><th colspan="6">Sieve Analysis</th></tr>
<tr><th>Sieve No.</th><th>Sieve Opening (mm)</th><th>Mass of Soil Retained on Each Sieve M_n (g)</th><th>Percent of Mass Retained on Each Sieve R_n</th><th>Cumulative Percent Retained $\sum R_n$</th><th>Percent Finer $100-\sum R_n$</th></tr>
<tr><td>4</td><td>4.750</td><td>372</td><td>37.2%</td><td>37.2%</td><td>62.8%</td></tr>
<tr><td>10</td><td>2.000</td><td>232</td><td>23.2%</td><td>60.4%</td><td>39.6%</td></tr>
<tr><td>20</td><td>0.850</td><td>118</td><td>11.8%</td><td>72.2%</td><td>27.8%</td></tr>
<tr><td>30</td><td>0.600</td><td>42</td><td>4.2%</td><td>76.4%</td><td>23.6%</td></tr>
<tr><td>40</td><td>0.425</td><td>32</td><td>3.2%</td><td>79.6%</td><td>20.4%</td></tr>
<tr><td>60</td><td>0.250</td><td>48</td><td>4.8%</td><td>84.4%</td><td>15.6%</td></tr>
<tr><td>140</td><td>0.106</td><td>72</td><td>7.2%</td><td>91.6%</td><td>8.4%</td></tr>
<tr><td>200</td><td>0.075</td><td>34</td><td>3.4%</td><td>95.0%</td><td>5.0%</td></tr>
<tr><td>Pan</td><td>-</td><td>50</td><td></td><td></td><td></td></tr>
</table>

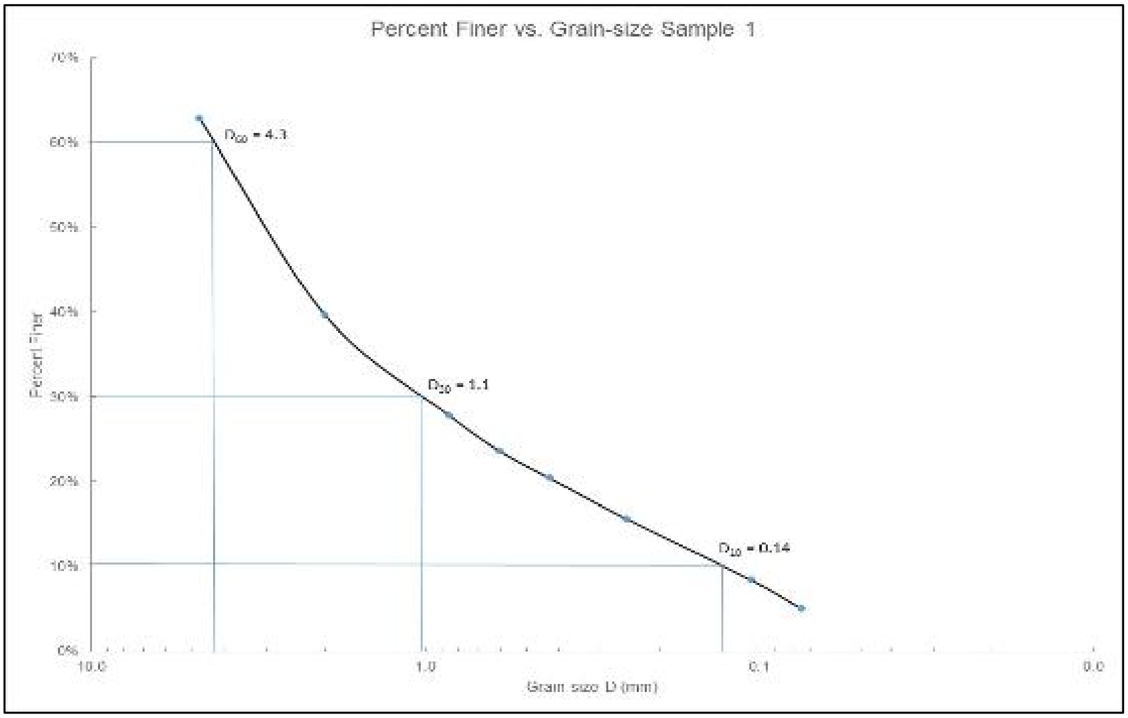


Figure 35: Percent Finer Versus Grain-Size for Sample 1

Table 20: Sieve Analysis Results for Sample 2

Sample 2: North Fence Line					
Sieve Analysis					
Sieve No.	Sieve Opening	Mass of Soil Retained on Each Sieve M_n (g)	Percent of Mass Retained on Each Sieve R_n	Cumulative Percent Retained $\sum R_n$	Percent Finer $100-\sum R_n$
4	4.750	180	18.0%	18.0%	82.0%
10	2.000	266	26.6%	44.6%	55.4%
20	0.850	190	19.0%	63.6%	36.4%
30	0.600	70	7.0%	70.6%	29.4%
40	0.425	48	4.8%	75.4%	24.6%
60	0.250	62	6.2%	81.6%	18.4%
140	0.106	78	7.8%	89.4%	10.6%
200	0.075	30	3.0%	92.4%	7.6%
Pan	-	76			

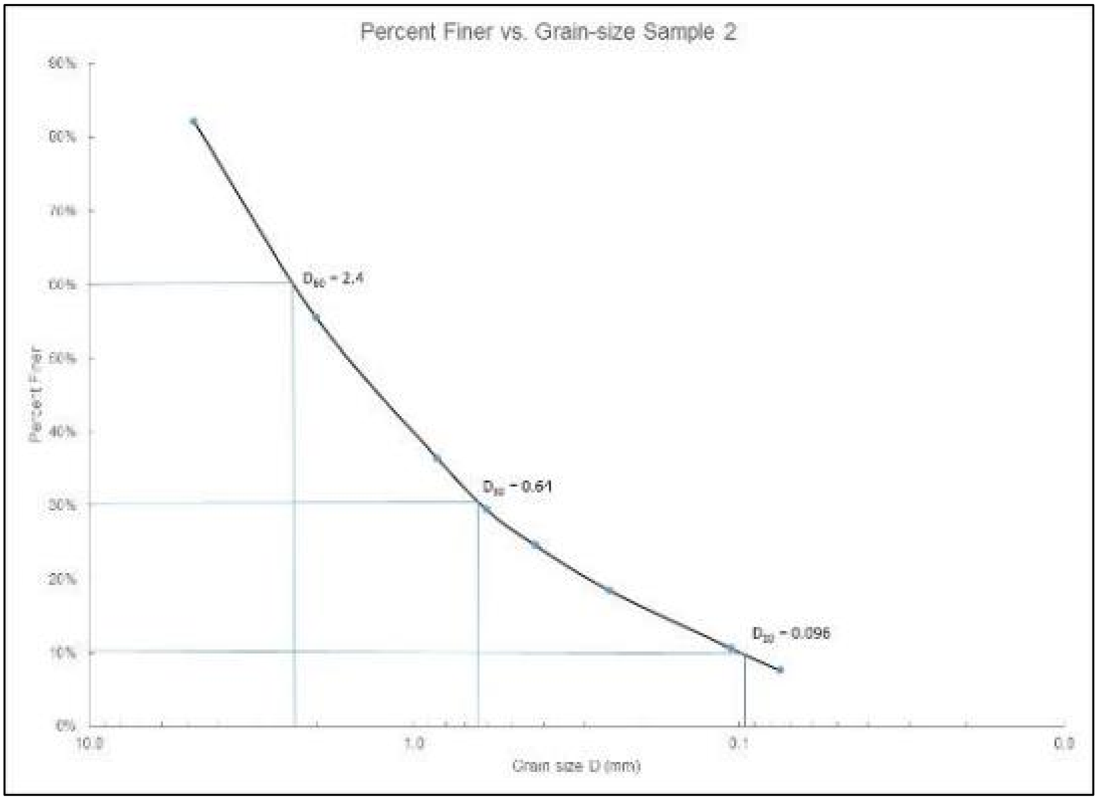


Figure 36: Percent Finer Versus Grain-Size for Sample 2

Table 21: Sieve Analysis Results for Sample 3

Sample 3: South Fence Line					
Sieve Analysis					
Sieve No.	Sieve Opening	Mass of Soil Retained on Each Sieve M_n (g)	Percent of Mass Retained on Each Sieve R_n	Cumulative Percent Retained $\sum R_n$	Percent Finer $100-\sum R_n$
4	4.750	374	37.4%	37.4%	62.6%
10	2.000	258	25.8%	63.2%	36.8%
20	0.850	145	14.5%	77.7%	22.3%
30	0.600	52	5.2%	82.9%	17.1%
40	0.425	32	3.2%	86.1%	13.9%
60	0.250	41	4.1%	90.2%	9.8%
140	0.106	54	5.4%	95.6%	4.4%
200	0.075	24	2.4%	98.0%	2.0%
Pan	-	20			

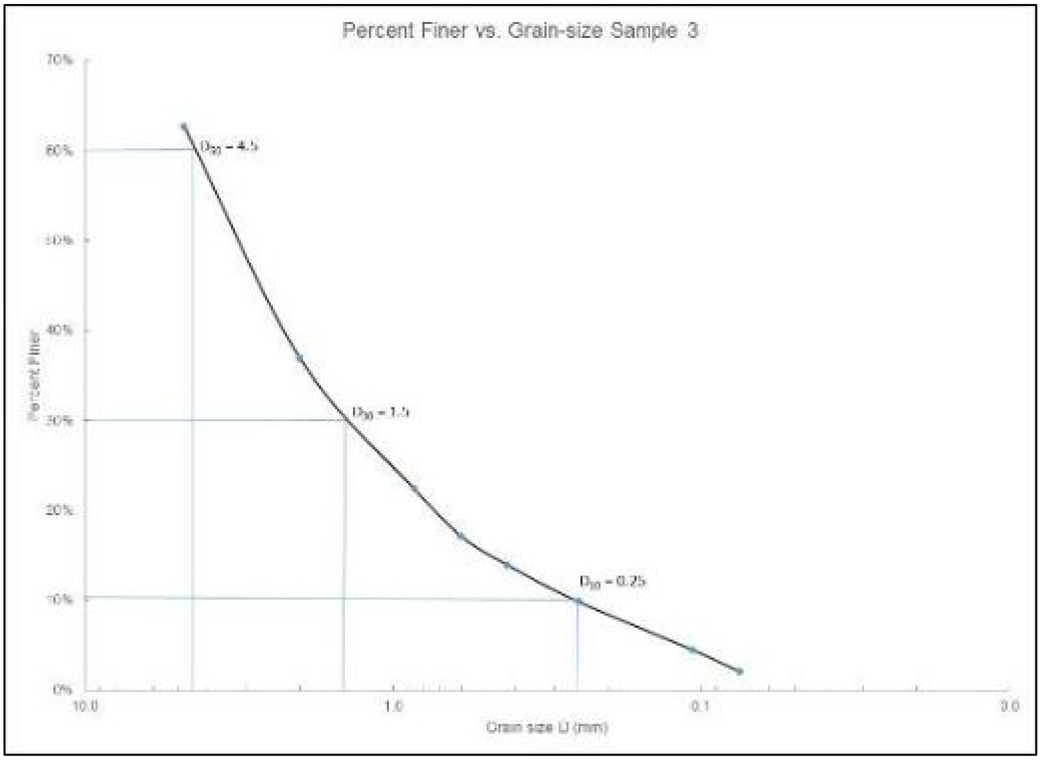


Figure 37: Percent Finer Versus Grain-Size for Sample 3

Sample calculations for Sample 1:

- Determine the D_{10}, D_{30}, and D_{60} values from the graph. These values are the diameters corresponding to percent fines of 10%, 30%, and 60%, respectively.
    - $D_{10} = 0.14$
    - $D_{30} = 1.10$
    - $D_{60} = 4.30$

$$C_u = \frac{D_{60}}{D_{10}} = \frac{4.30}{0.14} = 30.7$$

$$C_c = \frac{D_{30}^2}{D_{60} x D_{10}} = \frac{1.10^2}{4.30\ x\ 0.14} = 2.0$$

Appendix 4: Standard and Modified Proctor Compaction Tests

Table 22: Standard Compaction Test for Sample 1

Sample 1: Trench Location				
Standard Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.18	9.18	9.18	9.18
Weight of mold and base plate + moist soil, W_2 (lb)	12.56	12.82	12.88	12.92
Weight of moist soil, W_2-W_1 (lb)	3.37	3.64	3.70	3.74
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	101.21	109.13	110.87	112.07
Moisture can number	Sta #1	Sta #2	Sta #3	Sta #4
Mass of moisure can, M3 (g)	11.2	11	11.1	10.8
Mass of can + moist soil, M4 (g)	46.7	44.7	37.7	36
Mass of can + dry soil, M5 (g)	44.6	42.3	35.4	33.3
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	7.00	7.67	9.47	12.00
Dry unit weight of compaction, $\gamma_d(lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	94.58	101.35	101.28	100.06

Table 23: Modified Compaction Test for Sample 1

Sample 1: Trench Location				
Modified Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.21	9.21	9.21	9.21
Weight of mold and base plate + moist soil, W_2 (lb)	12.81	13.17	13.52	13.56
Weight of moist soil, W_2-W_1 (lb)	3.61	3.96	4.32	4.36
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	108.20	118.79	129.48	130.68
Moisture can number	Mod #1	Mod #2	Mod #3	Mod #4
Mass of moisure can, M3 (g)	11.2	11.4	11.4	11.3
Mass of can + moist soil, M4 (g)	26.6	44.4	36.7	34.3
Mass of can + dry soil, M5 (g)	25.5	41.9	34.3	31.8
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	7.00	8.20	10.48	12.20
Dry unit weight of compaction, $\gamma_d(lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	101.12	109.79	117.20	116.48

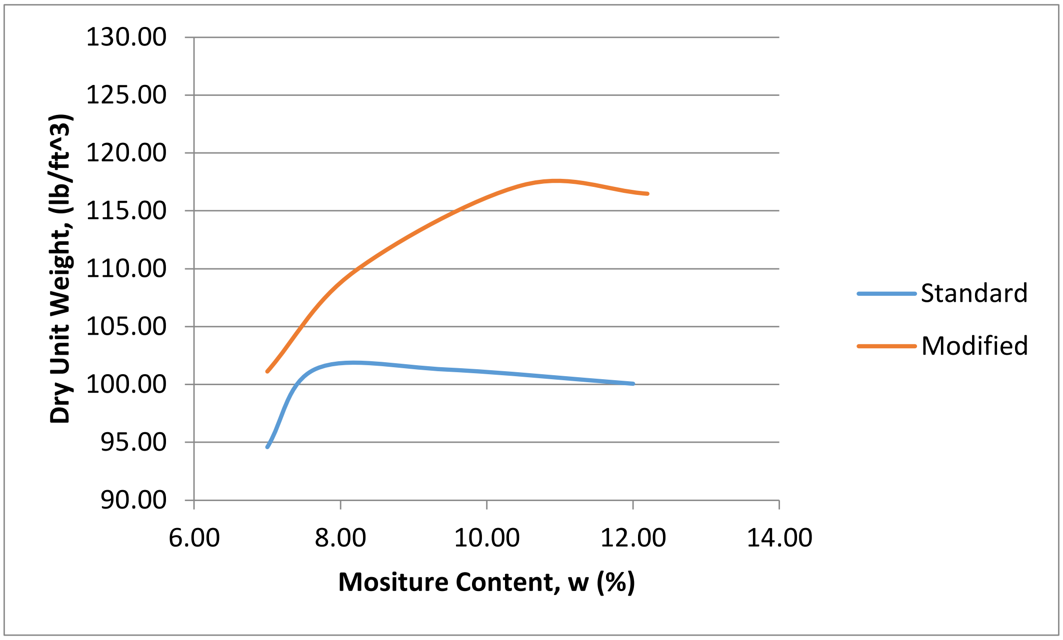


Figure 38: Dry Unit Weight versus Moisture Content for Sample 1

Table 24: Standard Compaction Test for Sample 2

Sample 2: Entrance North				
Standard Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.18	9.18	9.18	9.18
Weight of mold and base plate + moist soil, W_2 (lb)	12.37	12.65	12.76	12.77
Weight of moist soil, W_2-W_1 (lb)	3.19	3.47	3.58	3.59
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	95.70	103.95	107.49	107.70
Moisture can number	Sta #1	Sta #2	Sta #3	Sta #4
Mass of moisure can, M3 (g)	11.3	11.1	11.1	11.2
Mass of can + moist soil, M4 (g)	51.7	62.2	58	44.1
Mass of can + dry soil, M5 (g)	50.4	60.2	55.5	42
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	3.32	4.07	5.63	6.82
Dry unit weight of compaction, $\gamma_d(lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	92.62	99.88	101.76	100.83

Table 25: Modified Compaction Test for Sample 2

Sample 2: Entrance North				
Modified Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.18	9.18	9.18	9.18
Weight of mold and base plate + moist soil, W_2 (lb)	12.74	12.88	13.06	13.10
Weight of moist soil, W_2-W_1 (lb)	3.56	3.70	3.88	3.92
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	106.80	111.00	116.40	117.60
Moisture can number	Mod #1	Mod #2	Mod #3	Mod #4
Mass of moisure can, M3 (g)	11	11.3	11.2	11.4
Mass of can + moist soil, M4 (g)	53.9	58.4	54.4	48.4
Mass of can + dry soil, M5 (g)	52.7	56.7	52.2	46
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	2.88	3.74	5.37	6.94
Dry unit weight of compaction, $\gamma_d(lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	103.81	106.99	110.47	109.97

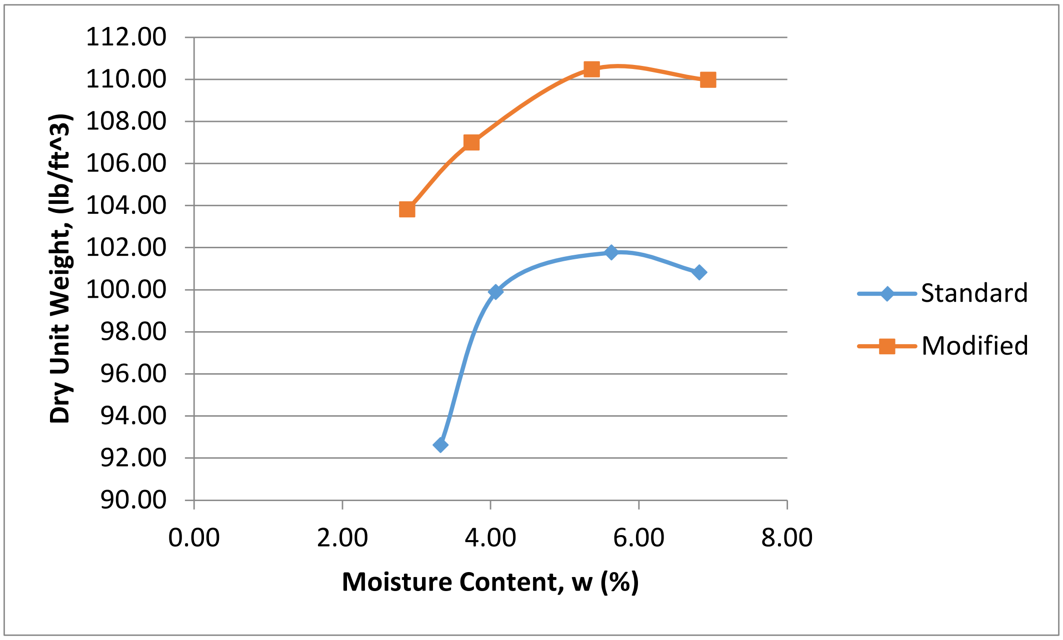


Figure 39: Dry Unit Weight versus Moisture Content for Sample 2

Table 26: Standard Compaction Test for Sample 3

Sample 3: Entrance South				
Standard Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.18	9.18	9.18	9.18
Weight of mold and base plate + moist soil, W_2 (lb)	12.58	12.68	12.80	12.63
Weight of moist soil, W_2-W_1 (lb)	3.40	3.50	3.62	3.45
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	102.06	105.00	108.60	103.35
Moisture can number	Sta #1	Sta #2	Sta #3	Sta #4
Mass of moisure can, M3 (g)	11.3	11	11.1	11
Mass of can + moist soil, M4 (g)	30.7	20.2	30.7	49.6
Mass of can + dry soil, M5 (g)	29.9	19.7	29.5	46.6
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	4.30	5.75	6.52	8.43
Dry unit weight of compaction, $\gamma_d (lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	97.85	99.29	101.95	95.32

Table 27: Modified Compaction Test for Sample 3

Sample 3: Entrance South				
Modified Compaction Test				
Test	1	2	3	4
Weight of mold and base plate, W_1 (lb)	9.21	9.21	9.21	9.21
Weight of mold and base plate + moist soil, W_2 (lb)	12.54	12.71	12.96	13.11
Weight of moist soil, W_2-W_1 (lb)	3.33	3.50	3.75	3.90
Moist unit weight, $\gamma = \frac{W_2 - W_1}{1/30}\left(\frac{lb}{ft^3}\right)$	99.90	105.06	112.50	117.00
Moisture can number	Mod #1	Mod #2	Mod #3	Mod #4
Mass of moisure can, M3 (g)	11	11.1	11.1	11.4
Mass of can + moist soil, M4 (g)	33.2	21.8	29.6	47.7
Mass of can + dry soil, M5 (g)	32.4	21.2	28.4	44.6
Moisture content, $w\ (\%) = \frac{M_4 - M_5}{M_5 - M_3} x100$	3.74	5.94	6.94	9.34
Dry unit weight of compaction, $\gamma_d (lb/ft^3) = \frac{\gamma}{1 + (w(\%)/100)}$	96.30	99.17	105.20	107.01

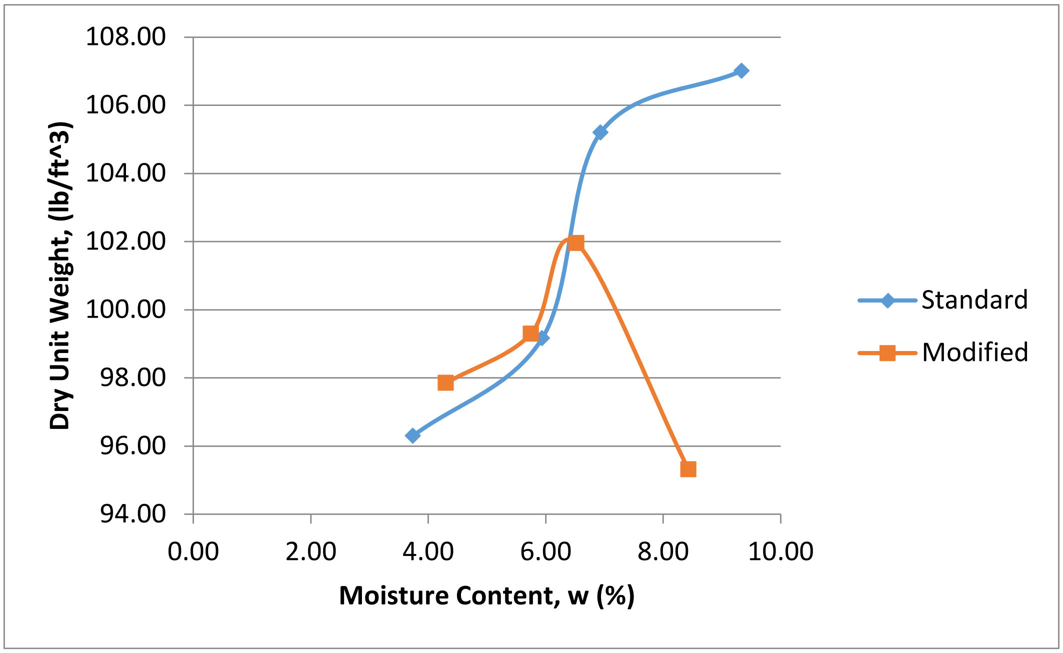


Figure 40: Dry Unit Weight versus Moisture Content for Sample 3

Sample calculations for sample 1-Standard Compaction Test for trial 1,

- W_1 =9.18 lb
- W_2 = 12.56 lb
- M_3 = 11.2 g
- M_4 = 46.7 g
- M_5 = 44.6 g

$$\gamma(\frac{lb}{ft^3}) = \frac{12.56 - 9.18}{1/30} = 101.21$$

$$w\ (\%) = \ \frac{46.7 - 44.6}{44.6 - 11.2} x100 = 6.29$$

$$\gamma_d\left(\frac{lb}{ft^3}\right) = \ \frac{101.21}{1 + (6.29/100)} = 58.71$$

Appendix 5: Structural Calculations

Main Wash Thickness Selection

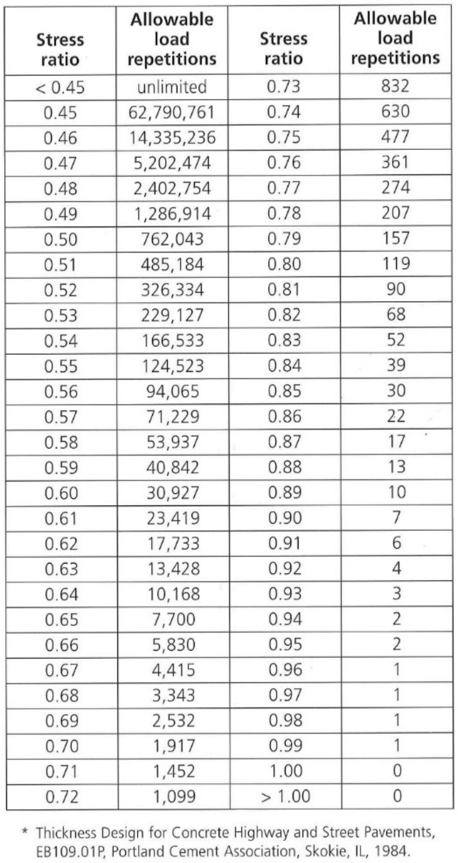
Using the axle load and dividing it by the inflation pressure results in a tire contact area value. Adjusting the contact area using Figure 41 yields an effective contact area of 81 sq. in.

The procedure utilizes the chart from Figure 42 by entering the figure from the left side with a dual wheel spacing of 37 in and moving to the effective tire contact area of 81 sq in. Traversing over to a trial slab thickness of 10 in will equate to an equivalent load factor of 0.63. This factor multiplied by the axle load of 34 kips yield 21.42 kips. The working stress is then divided by 21.42 kips providing a slab stress per 1000 lb of axle load of 12.67 kips.

The next step is to enter Figure 43 with 12.67 kips and move towards the effective contact area of 81 square inches. From this point moving up to 37 in wheel spacing and then moving to the right to obtain a subgrade modulus *k* of 100 yields a slab thickness of 8 in. This thickness is then used repeating the steps incorporating Figure 43 as an iterative process checking with an 8 in slab as opposed to a trial slab thickness of 10 in. Proceeding through the figures show that a thickness of 8 in is acceptable.

Table 28: Stress Ratio Versus Allowable Load Repititons

(Portland Cement Association (PCA), 2001)



Stress ratio	Allowable load repetitions	Stress ratio	Allowable load repetitions
< 0.45	unlimited	0.73	832
0.45	62,790,761	0.74	630
0.46	14,335,236	0.75	477
0.47	5,202,474	0.76	361
0.48	2,402,754	0.77	274
0.49	1,286,914	0.78	207
0.50	762,043	0.79	157
0.51	485,184	0.80	119
0.52	326,334	0.81	90
0.53	229,127	0.82	68
0.54	166,533	0.83	52
0.55	124,523	0.84	39
0.56	94,065	0.85	30
0.57	71,229	0.86	22
0.58	53,937	0.87	17
0.59	40,842	0.88	13
0.60	30,927	0.89	10
0.61	23,419	0.90	7
0.62	17,733	0.91	6
0.63	13,428	0.92	4
0.64	10,168	0.93	3
0.65	7,700	0.94	2
0.66	5,830	0.95	2
0.67	4,415	0.96	1
0.68	3,343	0.97	1
0.69	2,532	0.98	1
0.70	1,917	0.99	1
0.71	1,452	1.00	0
0.72	1,099	> 1.00	0

* Thickness Design for Concrete Highway and Street Pavements, EB109.01P, Portland Cement Association, Skokie, IL, 1984.

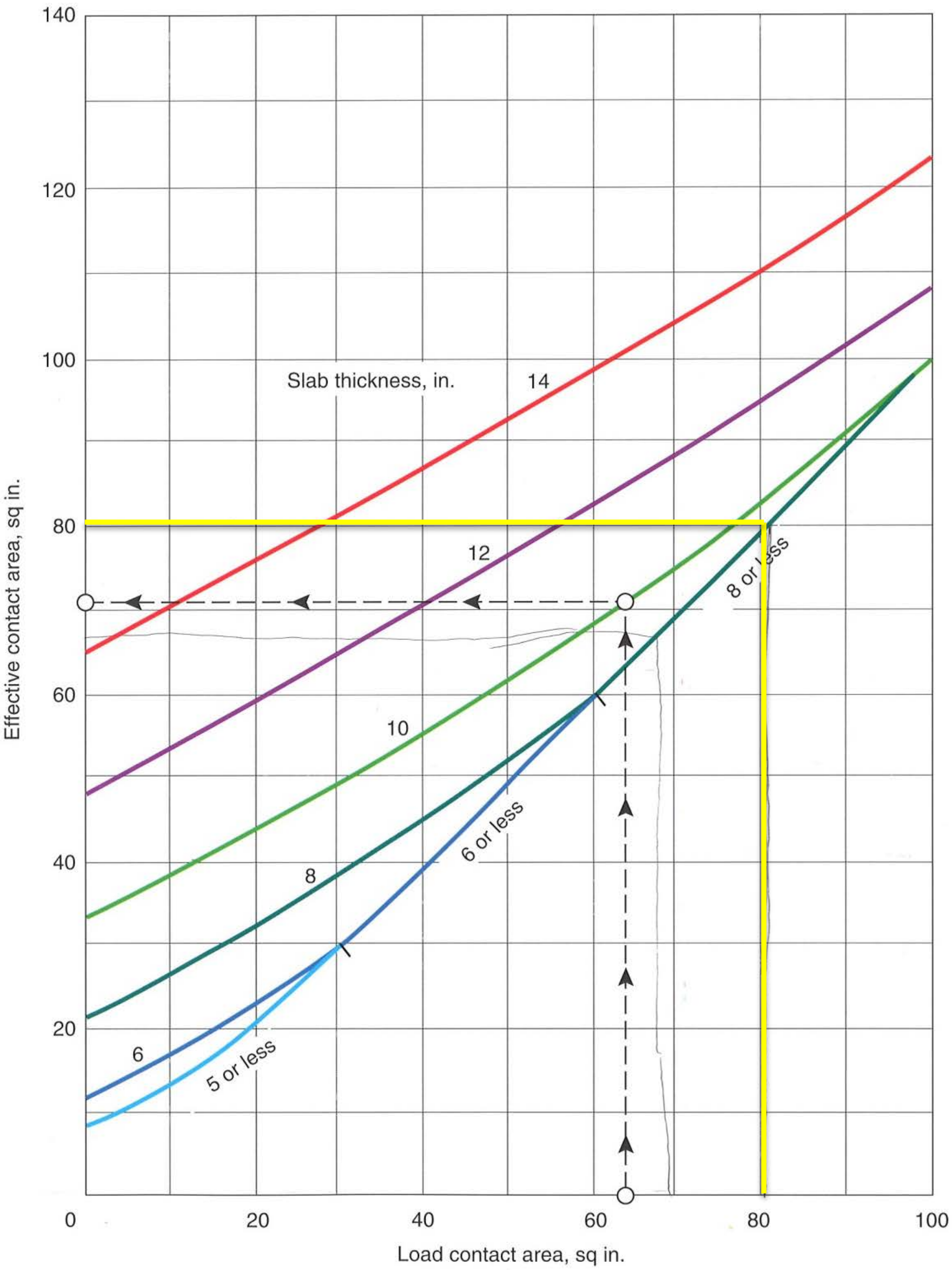


Figure 41: Effective Contact Area versus Load Contact Area

(Portland Cement Association (PCA), 2001)

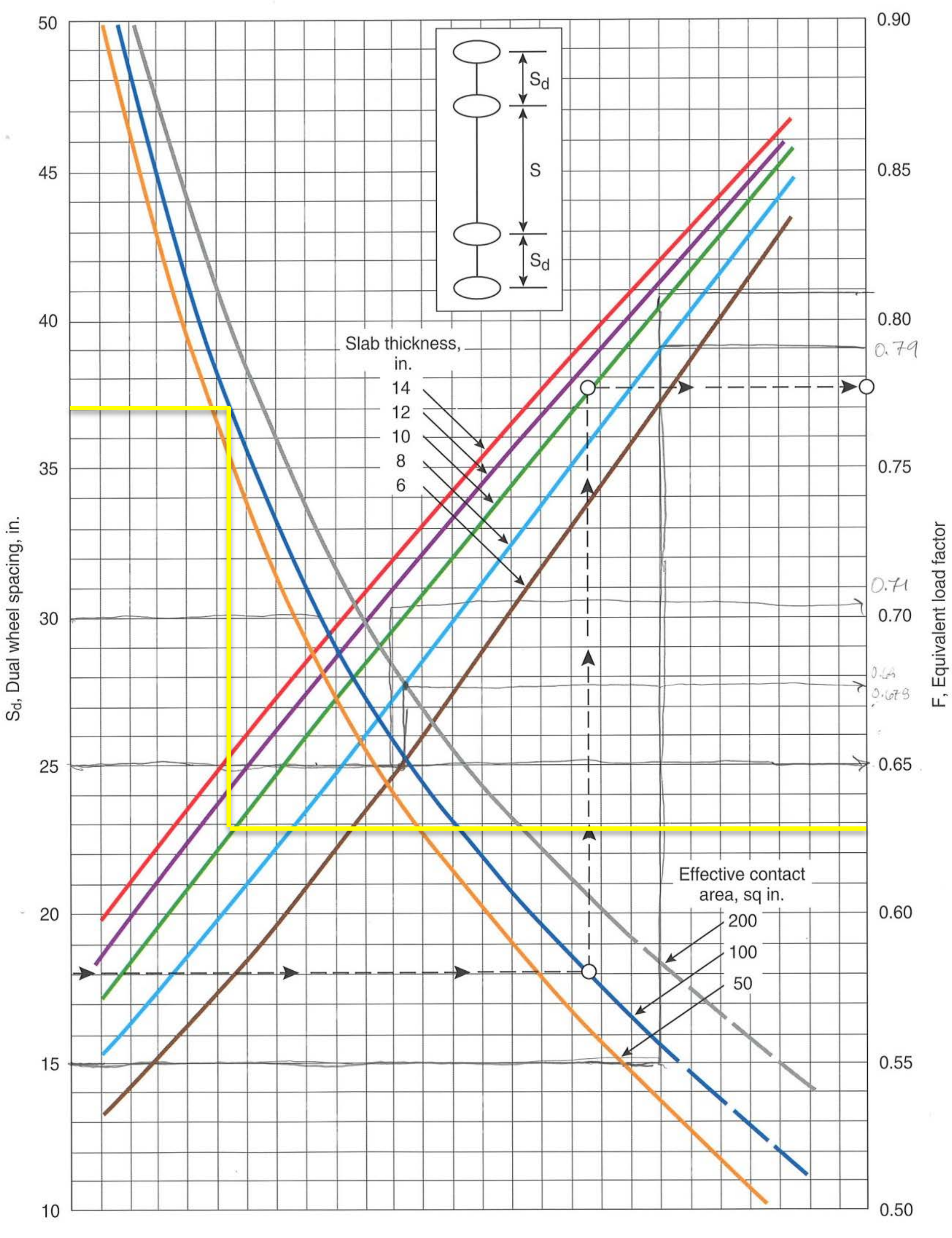


Figure 42: Design Chart for Axles with Dual Wheels

(Portland Cement Association (PCA), 2001)

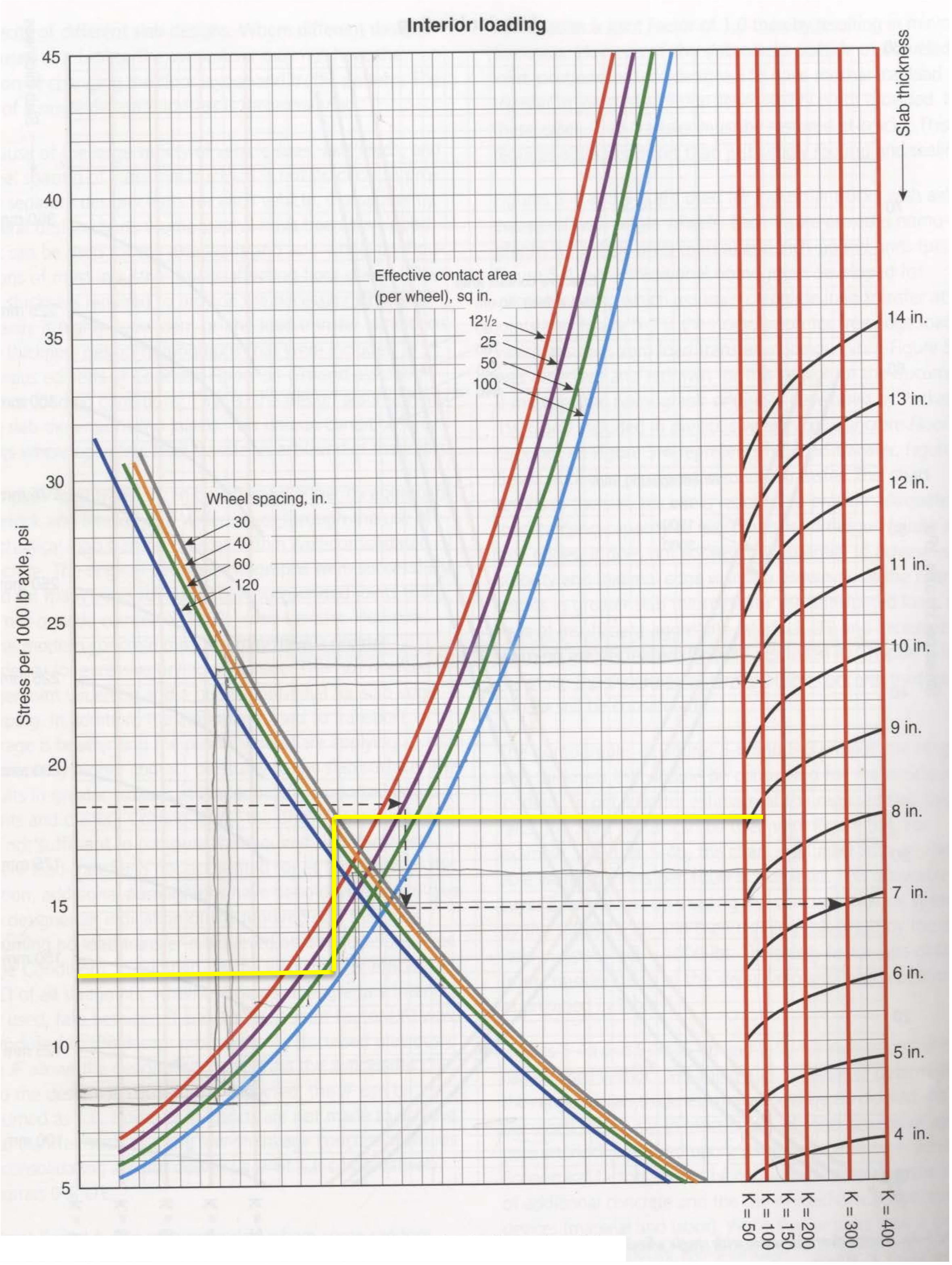


Figure 43: Design Chart for Axles with Single Wheels

(Portland Cement Association (PCA), 2001)

Treatment Foundation Analysis

$$A_s = \frac{36\sqrt{f'_c}t}{f_s} = \frac{36\sqrt{4000}(6)}{60000} = 0.23\ in^2$$

A_s = cross sectional area of steel required

f'_c = compression strength of concrete = 4,000 psi

t = thickness of slab = 6 in

f_s = yield strength of steel reinforcement = 60,000 psi

Appendix 6: Crude Oils and Petroleum

Crude oils and refined petroleum include large amounts of hydrocarbons. Crude oils comprise different hydrocarbons, organic, and inorganic substances including sulfur, nitrogen, and oxygen, as well as metals such as iron, vanadium, nickel, and chromium (EPA Oils, 2015). The hydrocarbons are a combination of fewer carbon atoms, therefore, hydrogen atoms vanish leaving a heavier and a less volatile portion. Crude oils and semi-refined supplies, such as diesel and bunkering oils may include cancer-causing polycyclic aromatic hydrocarbons and other contaminated properties. Crude oils include volatile oils that are often clear, and spread fast on solid or water surfaces. They have a strong odor, high evaporation rate, and are flammable. Other forms of crude oil are non-sticky oils, which are less toxic and can be removed by vigorous flushing. They have a viscous, sticky or tarry consistency, and are brown or black in color. Crude oils can also be non-fluids which are usually non-toxic, black or dark brown in color, and may melt making cleanup and removal very challenging (EPA Crude Oils, 2015).

A type of refined petroleum is gasoline. Gasoline is a hazardous, lightweight material that spreads quickly, and may evaporate in a few hours under temperate conditions. It poses a risk of fire and explosion because of its high volatility and elevated flammability. It is more toxic than crude oil. Gasoline contains a high ratio of toxic and volatile hydrocarbon such as benzene, which is known to cause cancer, and hexane, which can affect the nervous system. Like gasoline, kerosene is a hazardous, lightweight material that flows, spreads, and evaporates quickly. It has a risk of fire due to its elevated flammability. Lubricating oil is medium weight material that is easily dispersed if treated properly. It has a low volatility, and is persistent in the environment (Petroleum Oils, 2015). For oils, since surface tension will be higher, a spill will most likely linger in place. Oil is expected to move around in warmer waters than in very cold waters. The higher the viscosity of a liquid, the more likely it will remain in its place (Petroleum Oils, 2015).

Pollutant Concentration

To find pollutant concentration, calculate the following: (The amount of fluid in a semi- truck) / (the amount of water) x 100%

- 12-14 gallons of oil or 44 to 55 quarts of oil
- 3.5 gallons to 4 gallons of transmission fluid
- 2 to 3 quarts of brake fluid or 0.5 to 0.75 gallons of brake fluid

Each wash is 1 minute, and the Hydrogen Peroxide is a 3 to 4% solution. As long as the fluids are lower than the chemical, it will be easy to wash it and clean it off.

Table 29: Concentrations of Different Types of Oils Found when Washing Semi-Trucks

Oils	Gallons	Gallons	Wash (min)	Flow Rate (GPM)	Concentration Low (%)	Concentration High (%)
Oil Fluid	12	14	4	200	1.5	1.75
Transmission fluid	3.5	4	4	200	0.438	0.5
Brake Fluid	0.5	0.75	4	200	0.063	0.094

Appendix 7: Considered Disinfectants

USDA Recommended Disinfectants

AHP's competitors included the following United States Department of Agriculture (USDA) recommended disinfectants for FMD:

Table 30: USDA Recommended Disinfectants for FMD
(USDA)

Disinfectant	Dilution	Mixing Instructions	Notes	Contact Time
5.25% Sodium Hypochlorite (NaOCl) "Household Bleach"	3%	Add 3 gallons of chlorine bleach to 2 gallons of water; mix thoroughly.	This concentration can damage clothes, shoes, rubber goods, and is mildly corrosive to steel surfaces.	10 min
Acetic acid (CH_3CO_2H)	4-5%	Add 6.5 ounces of glacial acetic acid to 1 gallon of water; mix thoroughly.	Vinegar is a 4% solution of acetic acid. Not good for general premises disinfection	10 min
Potassium Peroxymonosulfate and Sodium Chloride "Virkon S®"	1%	Follow label instructions	Virkon-S	10 min
Sodium Carbonate (Na_2CO_3) "Soda Ash"	4%	Add 5.33 ounces of sodium carbonate to 1 gallon of hot water (or 1 pound to 3 gallons of hot water); mix thoroughly	The solution is mildly caustic but can dull paint and varnished surfaces.	10 min
Sodium Hydroxide (NaOH) "Lye"	2%	Add 1/3 cup of NaOH pellets (2.7 ounces of the lye) to 1 gallon of cold water; mix thoroughly	This solution is highly caustic. Use protective rubber clothing, gloves and safety glasses. Too caustic for general use. WARNING: Always add the lye to the water. Never pour the water over the lye.	10 min
Citric Acid ($C_6H_8O_7$)	3%	Add 4 ounces of citric acid solid to 1 gallon of water (or 30 grams to 1 liter of water); mix thoroughly.	Safe for clothes and body decontamination. Particularly useful when added to detergent.	15 min.

Recall that drivers and livestock will remain in the vehicles being washed and sanitized where they can potentially be exposed to disinfectant. Concerning the safety of drivers and livestock, Sodium Hydroxide (bleach) and Sodium Carbonate (soda ash) got disqualified for use due to being caustic (USDA). Forbidding its use the labeling for Virkon S® requires livestock to be removed from the premises of application (DuPont). Also, the Material Safety Data Sheet for Virkon S® requires the use of Personal Protection Equipment (PPE) including respiratory, eye, skin, and hand protection (DuPont, 2009). Needing to wear an extensive amount of PPE will be an inconvenience for drivers going through wash. The MSDS for Accel® requires no PPE (Ogena Solutions, LLC, 2013).

Referring to the table below, Vinegar and Citric Acid are corrosive to aluminum along with all the other USDA Recommended Disinfectants excluding Virkon S®:

Table 31: Material Compatibility of Disinfectants
(Cole-Parmer Instrument Company, LLC)

		USDA Recommended Disinfectants for FMDV					
		Sodium Hypochlorite (< 20%)	Vinegar (4% Acetic Acid)	Sodium Carbonate	Sodium Hydroxide (20%)	Citric Acid	Hydrogen Peroxide (10%)
Materials	304 Stainless Steel	C	A	A	B	B	B
	316 Stainless Steel	C	A	A	B	A	B
	Brass	D	D	B	B	D	N/A
	PTFE	A	A	A	A	A	A
	PVC	A	B	A	A	B	A
	Natural Rubber	C	B	A	A	A	B
	Aluminum	D	D	D	D	C	A
	Epoxy	C	A	C	A	A	C
	Polyurethane	D	D	B	B	A	B
	Nylon	D	A	B	A	A	C

Rating	**Description**
A	**Excellent.**
B	**Good** - Minor Effect, slight corrosion or discoloration.
C	**Fair** - Moderate Effect, not recommended for continuous use. Softening, loss of strength, swelling may occur.
D	**Severe Effect** - Not recommended for ANY use.
N/A	Information not available.

An aluminum safe disinfectant is necessary for the wash system since cattle trailers extensively use aluminum components. AHP utilizes low concentrations of hydrogen peroxide to disinfect and clean. Since hydrogen peroxide has minimal effects on aluminum, AHP is the most compatible disinfectant for the wash design.

Quaternary Ammonium Compounds

In 1916, Quaternary Ammonium Compounds (QACs) were introduced as disinfectants and "are still highly efficient as ready-to-use, no-rinse sanitizers" (Campagna et al. 2014, pg. 46). Eliminating the need for rinsing, QACs can enable our undercarriage and wheel wash design to save water.

Our design will have to deal with hard water and manure. Note that "besides their high antimicrobial and antiphage effects, QACs are non-staining, non-corrosive on surfaces and offer good residual activity, even in the presences of hard water and organic matter" (Campagna, Villion, Labrie, Duchaine, & Moineau, 2014, p. 46). Therefore, QAC sanitizers can enable our design to eliminate the need for hard water filtration, and insure the driver's vehicle's metal surfaces will be safe from rust.

Researchers Céline Campagna and associates (2014) tested the effectivity of commercial sanitizers against dairy bacteriophages. Using commercial QAC sanitizers with concentrations of 200 ppm and 500 ppm, they found QAC sanitizers to be effective against 9 different viruses in the presence of hard water, 1% whey, and 1% milk (Campagna, Villion, Labrie, Duchaine, & Moineau, 2014, pp. 44-45). Sanitizers have to meet the following criteria to be approved by health authorities (Campagna, Villion, Labrie, Duchaine, & Moineau, 2014, pp. 41-42):

- Must minimize residue levels
- Keep human toxicity low

Possess antimicrobial efficacy of 3 log reduction units or greater of specific bacteria or viruses within 5 minutes

The researchers testing showed that the commercial, QAC sanitizers they used had greater than 3 log~~3~~ 99.9%) reduction for all 9 viruses tested for within 2 minutes, and in many cases, the QAC sanitizers exceeded 4 log~~4~~ (99.99%) and 5 log~~5~~ (99.999%) reduction in the number of viruses present (Campagna, Villion, Labrie, Duchaine, & Moineau, 2014, pp. 44-45). Although it is effective against many varieties of bacteria and some viruses, its important note that QACs are ineffective against the foot and mouth disease virus and the bacteria that cause Johne's disease (University of Vermont, 2010).

Concerning safety, ~~Concerning safety,~~ QACs impose low toxicity risks when used with proper precaution, but extra caution needs to be exercised when using solutions of higher concentration (Schmidt, 2012, p. 8). Therefore, with proper implementation, Quaternary Ammonium Compounds prove to be a strong candidate for use as a general sanitizer in our final design of the undercarriage and wheel wash system.

Steam Cleaning and Sanitation

In recent years, steam proved to be an effective means for cleaning and sanitizing surfaces. Research shows that high temperatures are effective at neutralizing the foot and mouth disease virus (FMDV). Researchers Chou & Yang of National Taiwan University stated that temperatures greater than or equal to 80°C (176°F) is virucidal for FMDV (Chou & Yang, 2004, p. 738). Steam sanitizes surfaces by exposing them to such high temperatures.

~~In an experiment, Chou & Yang~~Researchers exposed samples of FMDV contaminated meat to wet steam of 75°C for 30 minutes (Chou & Yang, 2004, p. 738). After steaming the~~ir~~ samples, they found that an average of 97% of FMDV inactivated and approximately 63% of viruses present had degraded RNA (Chou & Yang, 2004, p. 740).

According to Rajiv Kohli, author of *Developments in Surface Contamination and Cleaning*, the advantages and disadvantages of precision steam cleaning include (Kohli, 2011, p. 209):

Advantages:

- Eliminates the use of solvents
- Reduces the amount of hazardous waste and hazardous air emissions generated compared to solvent degreasing
- Results in wastewater that is generally compatible with conventional industrial wastewater plants
- Lowers implementation cost utilizing simple equipment
- Provides solvent cost savings
- Removes grease, oil, flux, adhesive, fingerprints, and other contaminants
- Lowers water usage
- Capable of reaching otherwise inaccessible areas and spaces
- Eliminates and controls of the biofilms that resist typical disinfectants
- Cleans quickly

Disadvantages:

- Capable of corroding temperature- or moisture-sensitive parts
- Damages joints, seals, and bonds via residual moisture

Despite the great number of advantages, the design team decided to reject steam for use in our design solution, because it can be corrosive to many materials.

Appendix 8: Spray Impact Optimization

Industry Equations for Estimating Spray Impact at a Distance

Pressure, volumetric flow rate, and spray angle significantly influence the impact force of water jets. As the spray angle of a nozzle increases, the droplet sizes tend to decrease. The resulting, smaller droplets possess less momentum ~~which~~ decreas~~es~~ing the impact force a nozzle can potentially create. This section will go over the basics of finding the needed impact pressure from a nozzle and the minimum flow rate needed to produce that impact pressure when a desired operating pressure is known.

Spraying Systems Company states that the total theoretical impact of a fan nozzle's spray on a surface located 1 foot away can be approximated using the empirically derived equation below (Spraying Systems Company), and this equation can be used to:

$$I = 0.0526Q\sqrt{P} \quad [lbs]$$

Where,

$I = Water\ jet's\ total\ theoretical\ impact\ force\ (lb)$

$Q = Nozzle's\ volumtric\ flow\ rate(GPM)$

$P = Nozzle's\ pressure(psi)$

In general, doubling the flow rate of a nozzle can increase the impact by 100% while doubling the pressure can only give up to a 40% increase (Spraying Systems Company). Plotting this equation, it can be observed that increasing the amount of flow through a nozzle increases jet impact much faster compared to increasing the pressure:

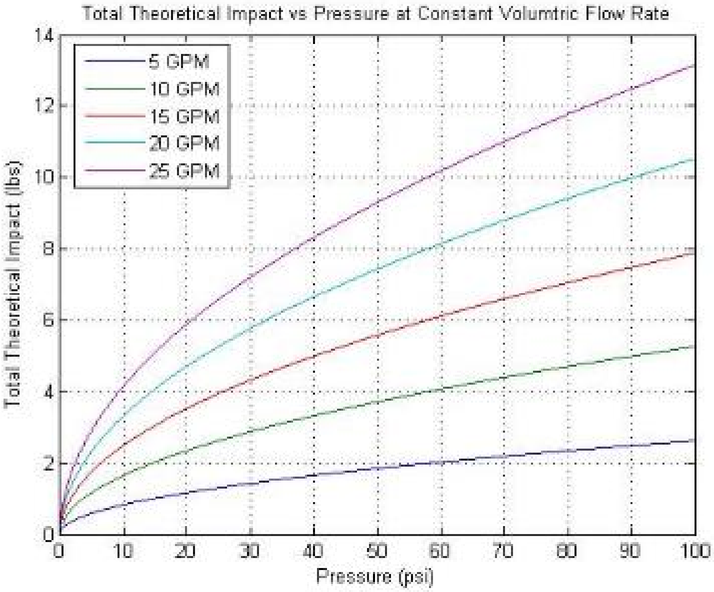


Figure 44: Impact increase at Varying Pressure and Constant Flow Rate

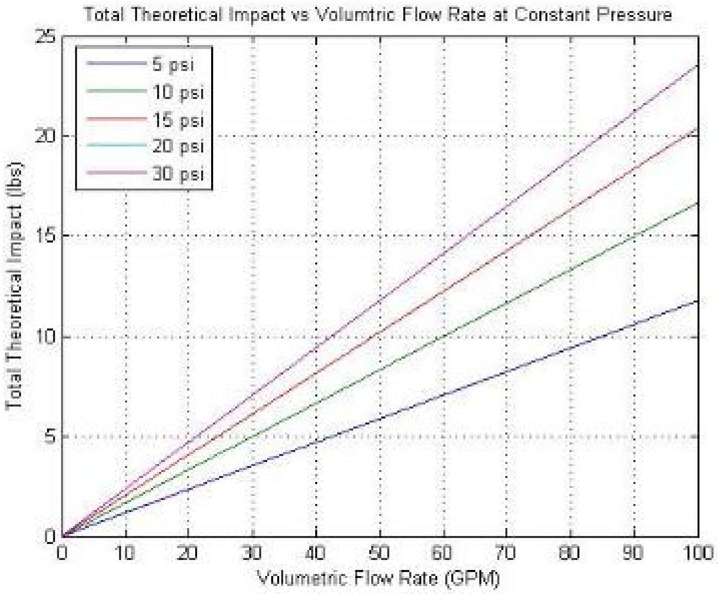


Figure 45: Impact Increase at Varying Flow Rate and Constant Pressure

After calculating the total theoretical impact, only a certain percentage of the impact can be obtained at various spray angles. The table below shows that increasing a nozzle's spray angle will decrease its overall impact. To find the theoretical impact force of a nozzle, multiply the total theoretical impact force by the empirically derived percent coefficient for the nozzle's spray angle.

Table 32: Total Impact Percentage at Various Spray Angles
(Spraying Systems Company)

Spray Angle	Percent of Theoretical Total Impact
15°	30%
25°	18%
35°	13%
40°	12%
50°	10%
65°	7%
80°	5%

For our optimization, it is more desirable to know the impact force per area rather than overall force since the soil properties we know are in terms of force per unit area. In their spray engineering handbook, the European nozzle company, PNR, gives an empirically derived equation similar to that of Spraying Systems Company's equation, where total theoretical impact is in units of pressure (PNR Italia S.R.L., p. 30):

$$I = 0.024Q\sqrt{P} \quad [kg/cm^2]$$

Where,

$I = Water\ jet's\ total\ theoretical\ impact\ pressure\ (kg/cm^2)$

$Q = Nozzle's\ volumtric\ flow\ rate (lpm)$

$P = Nozzle's\ pressure (kg/cm^2)$

Like before with Spraying Systems Company's equation, the total theoretical impact pressure will be adjusted by multiplying it with the corresponding percent coefficient found in Table 8 for the nozzle's spray angle.

Knowing the target impact pressure, the total theoretical impact pressure needed from a nozzle can be determined. To do so, divide the target impact pressure, 1.74 psi, by the percent coefficient for the nozzle's spray angle:

$$I = \frac{T}{E} \quad [psi]$$

Where,

$I = Total\ Theoretical\ Impact\ Pressure\ (psi)$

$T = Target\ Impact\ Pressure\ (psi)$

$E = Percent\ Coefficient\ for\ Corresponding\ Spray\ Angle$

Rearranging Equation 3, the minimum flow rate needed to produce the target impact pressure can be solved for:

$$Q = \frac{I}{0.024\sqrt{P}} \quad [lpm]$$

For Equation 5, substitute the total theoretical impact found in Equation 4 and desired operating pressure (after converting them from psi to kg/cm^2). Once this minimum flow rate is known, droplet sizes can be estimated by manufacturer data bases for standard fan nozzles. Optimum pressure and flow rate pairs will maintain above the desired droplet size.

Having to convert between metric and English units is the main inconvenience for using this Equation 3. Since our system will be used in the United States, it is best to present values in English units after calculations. To convert between metric and English units, the conversion factors are:

Table 33: Conversion Factor Table for Pressure and Flow
(Unit Converter with most Common Units)

From	To	Multiply By
psi	kg/cm^2	0.07
kg/cm^2	psi	14.21
GPM	lpm	3.785
lpm	GPM	0.2642

Washing nozzles give the best performance when their spray travels 6 to 8 inches to the surface being washed. However, ~~, and due to~~the drag forces~~, this effectiveness~~ can decrease performance by 50% if the spray travels 6 inches more (Spraying Systems Company). Spraying large droplets decreases drag effects, Amato explained that increasing a nozzle's outlet pressure correlates to decreasing droplet size. ~~Also~~Therefore, he recommended using a maximum pressure of 100 psi to avoid creating ineffective droplets for pressure washing (Amato, 2015). Small droplets still travel quickly near the outlet, but their reduced mass lowers their inertia (an object's tendency to maintain their speed in their direction of travel). With decreased inertia, drag slows droplets down more quickly as they travel through the air. Slower and smaller droplets result in less, impact force against dirt particles stuck on surfaces at a distance which results in a decreased cleaning effectiveness.

Appendix 9: Finding Flow Rate for Desired Impact

The goal is to achieve a 0.86 psi impact pressure for a 50 degree spray at 50 psi. The minimum flow rate needs to be determined to achieve this impact. For this case, 0.86 psi is the Target Impact Pressure (T), 50 psi is the Pressure (P), and the Percent Coefficient for a 50 Degree Spray Angle (E) equals 0.10. First, the Total Theoretical Impact (I) must be found:

$$I = \frac{T}{E} = 8.6\, psi$$

Converting units for P and I from psi to kg/cm^2:

$$I = \frac{0.07\, {}^{kg}/_{cm^2}}{psi} \cdot 8.6\, psi = 0.602\, {}^{kg}/_{cm^2}$$

$$P = \frac{0.07\, {}^{kg}/_{cm^2}}{psi} \cdot 50\, psi = 3.5\, {}^{kg}/_{cm^2}$$

Substituting converted values to find Flow Rate (Q) in units of lpm:

$$Q = \frac{I}{0.024\sqrt{P}} = 13.41\, lpm$$

Completing the calculation after converting units for Q back to GPM:

$$Q = \frac{0.2642\, GPM}{lpm} \cdot 13.41\, lpm \; = 3.54\, GPM$$

The vehicle wash system uses spoon nozzles with a 50 degree spray angle that are optimized to produce an impact of at least 0.86 psi. To determine the nozzles needed for this design, this method was used to tabulate the values needed to obtain this impact and crossed referenced with BETE's Fog Nozzle Inc.'s, nozzle selection sheets.

Appendix 10: Spray Coverage Optimization

Spray Coverage Theory

A vehicle's floor height greatly influences where fan nozzles should be placed to determine undercarriage coverage. The best process to follow to ensure full vehicle coverage in a worst case scenario is (Spraying Systems Company):

- Estimate the shortest distance between the fan nozzle and vehicle
- Adjust nozzles for full coverage at the shortest distance
- Overlap based on the number of nozzles required and excess coverage width produced.

Optimizing for the shortest floor height ensures vehicles of all heights to receive full spray coverage. An overlap improves cleaning effectiveness increasing the number of droplets present at greater distances.

Fan nozzles retain the most impact with spray angles of 15 degrees and are most ideal for pressure washing. To clean low undercarriages, more nozzles will be required to ensure the entire width of the undercarriage is washed, which increases cost. For the vehicle sanitation and rinse systems, surface coverage is more important than impact. Therefore, these systems are free to use wide angle sprayers to reduce the number required.

Pressure influences the spray angle of a fan nozzle. Increasing pressure correlates to widening spray angle of a fan nozzle and, as a result, coverage width (Spraying Systems Company). However, the effects of drag and gravity lessen the coverage width (PNR Italia S.R.L., p. 21). Referring to Figure 46, the Theoretical Spray Coverage (TSC) of a fan nozzle is much wider than the Actual Spray Coverage (ASC). Also, the Actual Spray Angle (ASA) decreases from the Theoretical Spray Angle as the spray travels over distance (L).

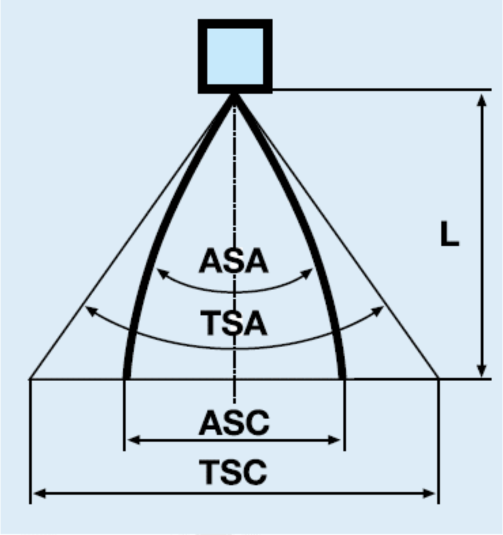


Figure 46: Effects of Drag and Gravity on Fan Nozzle Coverage Angle and Width
(PNR Italia S.R.L., p. 21)

Table 35 below gives guidelines for the actual spray coverage to expect from a theoretical spray angle over a spray distance.

Table 34: Actual Spray Coverage (ASC) Based on Theoretical Spray Angle (TSA) and Spray Distance (L)
(Spraying Systems Company)

Theoretical Spray Angle (TSA)	**Spray Distance (L)**					
	6”	**8”**	**10”**	**12”**	**15”**	**18”**
15°	1.6”	2.1”	2.6”	3.2”	3.9”	4.7”
25°	2.7”	3.5”	4.4”	5.3”	6.6”	8.0”
40°	4.4”	5.8”	7.3”	8.7”	10.9”	13.1”
65°	7.6”	10.2”	12.7”	15.3”	19.2”	22.9”
80°	10.1”	13.4”	16.8”	20.2”	25.2”	30.3”
110°	17.1”	22.8”	28.5”	34.3”	42.8”	51.4”

Note that spoon nozzles deflect at an angle making their streams travel diagonally. This means spoon nozzle sprays will travel more distance to make contact with an undercarriage directly above than a standard fan nozzle spraying straight up.

Sample Calculation: Determining Spray Coverage Widths

Converting from millimeters to inches, the Actual Spray Coverage table from PNR Italia’s Spray Engineering Handbook is given in Table 36.

Table 35: PNR Table for Actual Spray Coverage (ASC) in Inches
(PNR Italia S.R.L.)

	Spray Distance in Inches (L)											
Theoretical Spray Angle (TSA)	**2.0**	**3.9**	**5.9**	**7.8**	**9.8**	**11.7**	**15.6**	**19.5**	**23.4**	**27.3**	**31.2**	**39.0**
15°	0.51	1.01	1.56	2.07	2.57	3.08	4.10	5.15	6.16	7.18	8.23	10.26
25°	0.86	1.72	2.61	3.47	4.33	5.19	6.90	8.66	10.37	12.09	13.85	17.28
30°	1.05	2.11	3.12	4.17	5.23	6.28	8.35	10.45	12.56	14.63	20.63	20.90
35°	1.25	2.46	3.71	4.91	6.16	7.37	9.83	12.29	14.74	17.20	19.70	24.61
40°	1.40	2.85	4.25	5.69	7.10	8.50	11.35	14.20	17.04	19.89	22.70	28.39
45°	1.60	3.24	4.84	6.47	8.07	9.71	12.91	16.15	19.38	22.62	25.86	32.29
50°	1.83	3.63	5.46	7.29	9.09	10.92	14.55	18.17	21.84	25.47	29.09	36.39

This table can be used to develop spray profiles. These profiles can be drawn and visualized in Autodesk AutoCAD. For this sample calculation, the spray profile for a spoon nozzle with a 50 degree spray angle and 50 degree deflection will be used to determine spray coverage undercarriages and tires.

Note that deflection directly influences spray distance. The spray distance for a deflected nozzle is found using trigonometry.

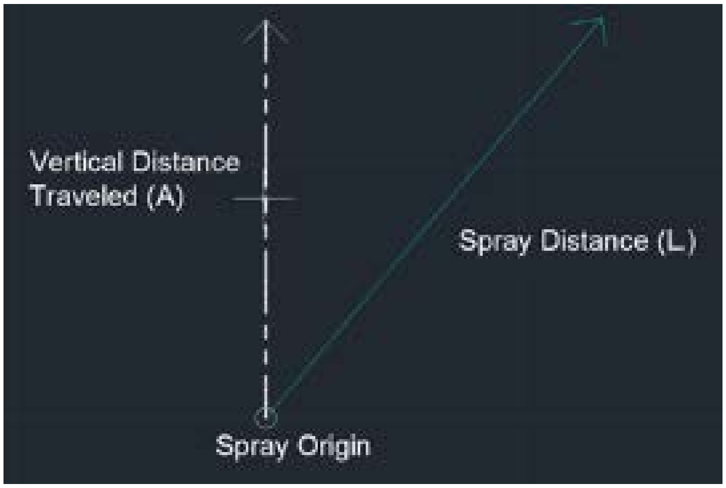


Figure 47: Reference for Deflected Spray

Using Figure 47 for reference, the Spray Distance (L) can be found with trigonometry when the Vertical Distance Traveled (A) and the nozzle's Deflection Angle (D) are known:

$$L = \frac{A}{\cos(D)}$$

This can be done with several vertical distances, and the spray distance found can be used to interpolate for several Actual Spray Coverages (ASCs). A sample table for the ASCs interpolated is given in Table 37. Using this table, a spray profile like the one shown in Figure 48 can be drawn in AutoCAD. Recall that this profile shows the approximate, actual spray coverage as the spray travels forwards (into the page) or backwards (out of the page).

Table 36: Interpolated Spray Widths for a 50 Degree Spray and Deflection Angle

Vertical Distance (in)	Spray Distance (in)	Spray Width (in)
3	4.7	4.3
6	9.3	8.7
9	14.0	13
12	18.7	17.4
15	23.3	21.4
18	28.0	26.2

21	32.7	30.5
24	37.4	34.8

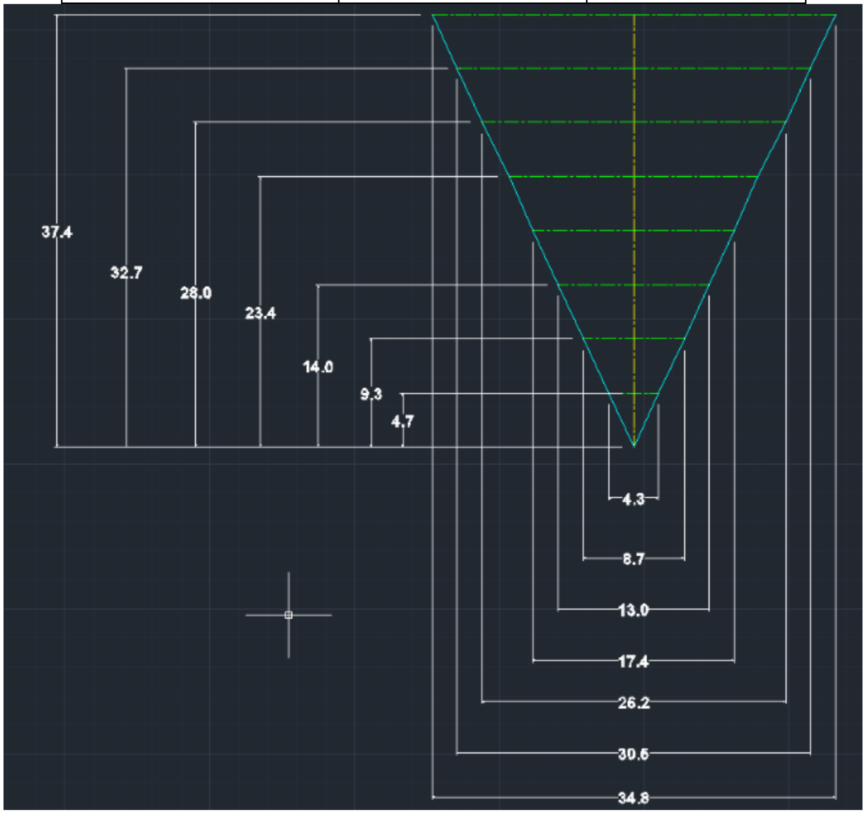


Figure 48: Spray Profile for a Nozzle with a 50 Degree TSA and Deflection

This spray profile can then be utilized in AutoCAD to determine the coverage widths for vehicle tires and undercarriages when vehicle and layout dimensions are known. Examples from the vehicle wash, design project are shown below:

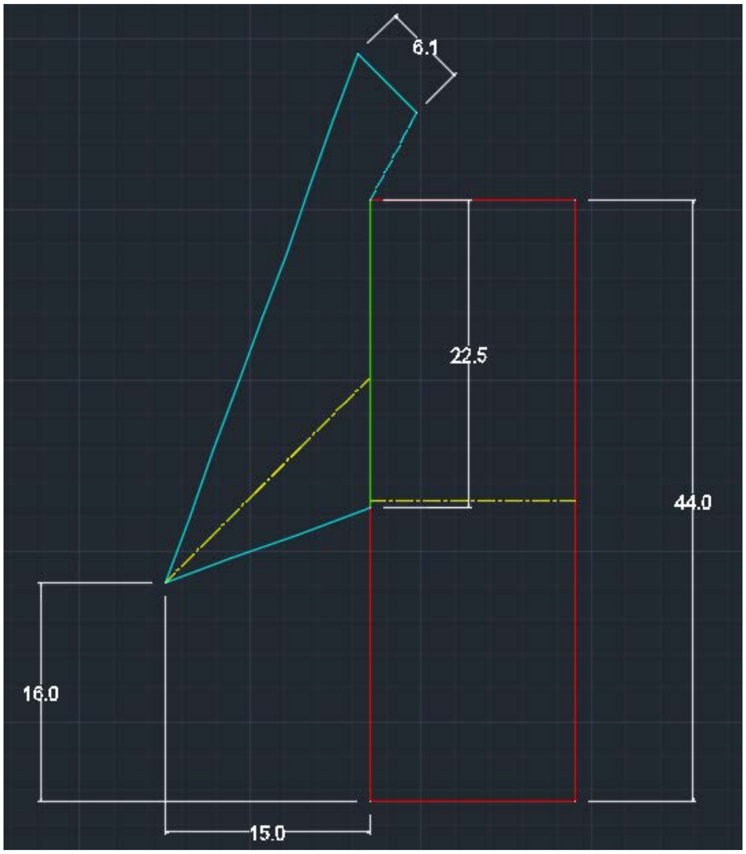


Figure 49: Coverage Width for a 44 Inch Diameter Tire

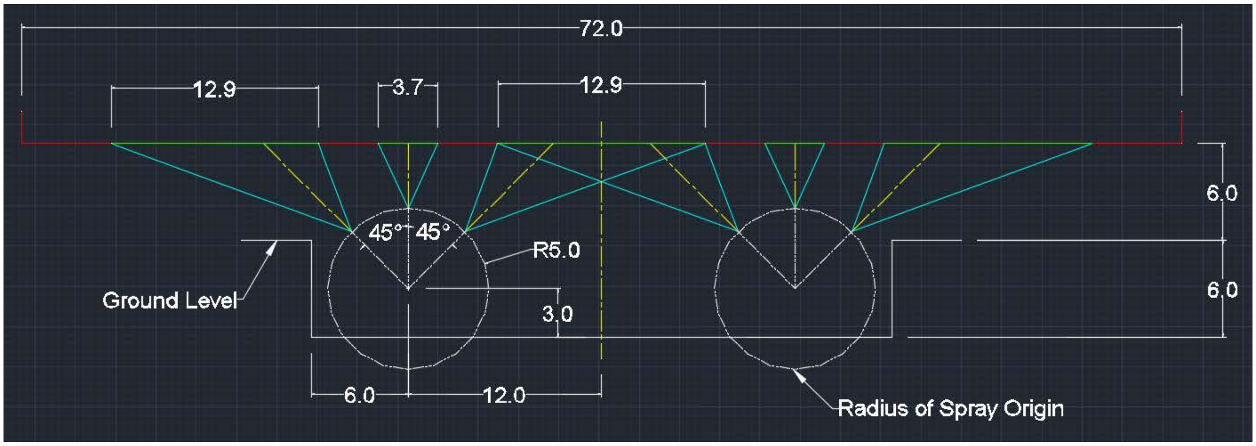


Figure 50: Undercarriage, Spray Coverage Width for the Average Car (64.02 % Covered)

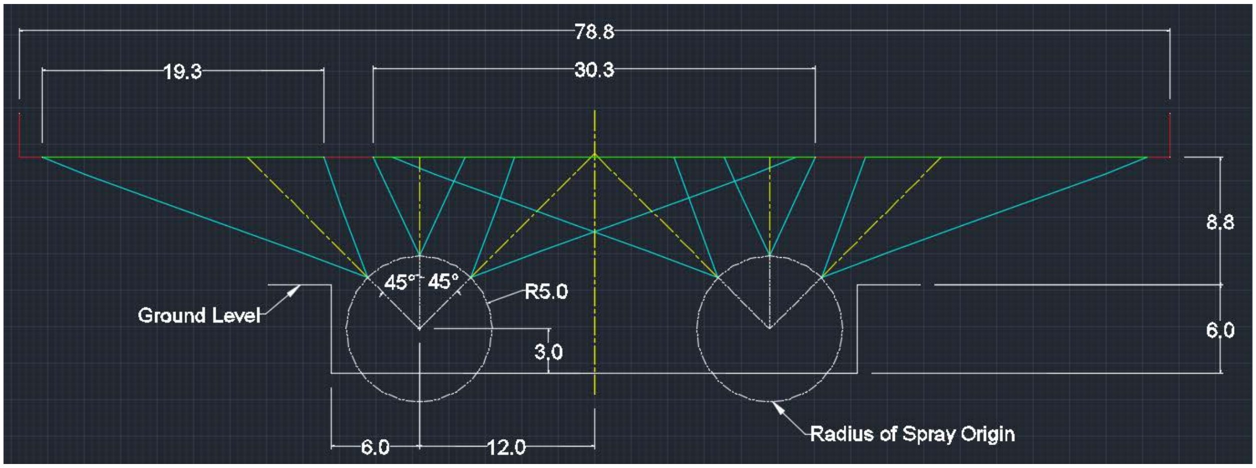


Figure 51: Undercarriage, Spray Coverage for the Average Pickup

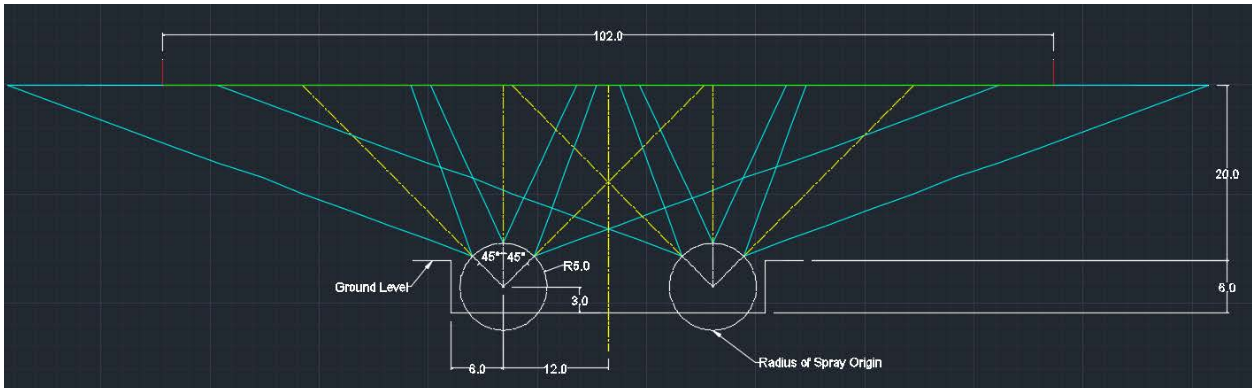


Figure 52: Undercarriage, Spray Coverage Width for the Average Cattle Trailer

(100 % Covered with Overshoot)

Appendix 11: Surge and Working Pressure Calculations

Calculating a working pressure specific to this system indicated that schedule 80 CPVC pipes were the best synthetic option, see Table 38.

Table 37: System Specific Working Pressure Calculation

	Schedule 80 CPVC	
Pipe Size (in)	**3 (Main)**	**2**
Recommended Working Pressure (psi)	400	370
Flow (GPM)	100	25
Operating Pressure (psi)	52	52
Surge Pressure (psi)	164	126
Working Pressure (psi)	216	178
Corrected Working Pressure at 120 F°	240.5	260
P_w/(Maximum P_w)	0.90	0.68

Surge Pressure (Engineering Data and Design, 2015)

Surge pressure results from a sudden change in can be minimized by reducing internal fluid speeds to less than 5 ft/s.

$$P_S = V\left(\frac{Et3960}{Et + 300000D_i}\right)$$

Where, P_s = Surge Pressure (psi)

E = Modulus of elasticity of Pipe Material (psi)

t = Wall Thickness (in)

V= Liquid Velocity (ft/s)

D_i = Inside Pipe Diameter (in)

Table 38: Temperature De-Rating Factors for PVC and CPVC

(Engineering Data and Design, 2015)

Temperature (°F)	CPVC	PVC
73-80	1	1
100	0.82	0.62
120	0.65	0.4
140	0.5	0.22
160	0.4	-
180	0.25	-
200	0.2	-

Working Pressure (Engineering Data and Design, 2015)

$$P_w \geq (P_S + P_o)$$

P_w = Working Pressure (psi)
P_S = Surge Pressure (psi)
P_o = Operating Pressure (psi)

Table 39: CPVC vs PVC Maximum Working Pressure

Max Working Pressure (psi)		
Nominal (in)	**CPVC**	**PVC**
2	400	280
3	370	260

Appendix 12: Pipe Scaling

From a neighboring well, the ground water has a hardness of 228 mg/L making it moderately hard. This specific well was tested in 2008 by West Texas A&M (Howell, 2015). Table 41 shows how water hardness is classified (MacAdam & Parson, 2004).

Table 40: Water Hardness

(MacAdam & Parson, 2004)

Classification of Water Hardness	
Concentration ($CaCO_3$/mg)	**Hardness**
0-50	Soft
50-100	Moderately Soft
100-150	Slightly Hard
150-250	Moderately Hard
250-350	Hard
350+	Excessively Hard

Scaling forms when dissolved mineral salts precipitate, or solidify out of solution and attach along pipe walls. Scaled pipes require additional pumping power and can even block flow entirely (Kinsela, Jones, Collins, & Waite, 2012). This increases pumping demands by restricting the flow. In Figure 53, ε is the average additional roughness introduced by scale that increases flow friction.

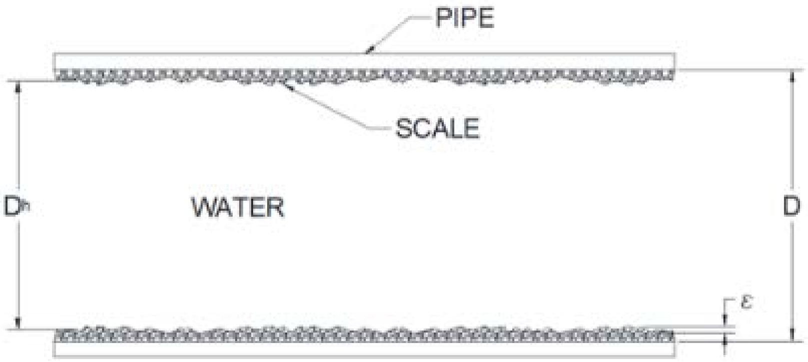


Figure 53: Pipe Scale

The main factor affecting scale formation is pH (Kinsela, Jones, Collins, & Waite, 2012). Calcium carbonate is an ionic compound similar to sodium chloride (table salt). Both of these compounds dissolve when mixed with water but their solubility depends on pH and temperature. For Calcium carbonate, a pH rise from 7 to 8 can decrease it's solubility by a factor of 15 causing dissolved solids to fall out of solution (MacAdam & Parson, 2004). Low pH levels below 7 – 7.5 have been shown to prevent scale formation, see Figure 54.

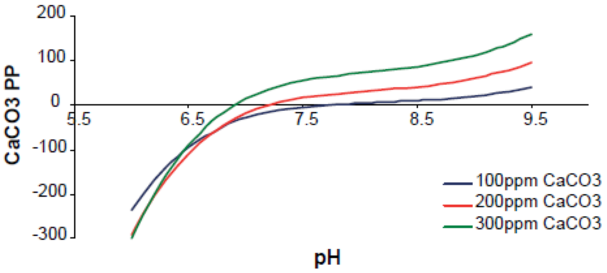


Figure 54: Calcium Carbonate Precipitation Potential vs pH
(MacAdam & Parson, 2004)

Pressure drops agitate the water, release dissolved carbon dioxide (carbonic acid), and increase pH levels in the solution. Less agitation means less scale. Metallic pipes also have a much higher surface free energy promotes scale formation (MacAdam & Parson, 2004) as opposed to synthetic materials such as CPVC.

Appendix 13: Pipe Network, Support Structures

Thrust Blocks

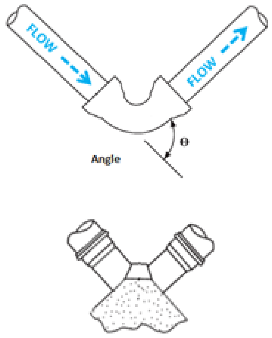


Figure 55: Underground Thrust Block Elbow
(USDA, 2013)

When large amounts of water change direction, a force is generated. Buried pipes can shift underground in areas where the soil bearing capacity is low. Adding concrete reinforces soil and prevents additional stress from the pipes from bending. Concrete is commonly used with no less surface area than 8 in^2. Their surface area is determined by using equations from the USDA. Each fitting is assumed an elbow with a 90 degree turn.

Thrust through an elbow (USDA, 2013).

$$A = \frac{2Pa\sin\left(\frac{\theta}{2}\right)}{q_{all}}$$

Where,
A = Required Thrust block area (ft^2)
P = Working Pressure (psi)
a = cross sectional area of the pipe (in^2)
θ=angle of pipe bend (degrees)
q_{all} = Allowable bearing pressure of the soil (psf)

Thrust through a tee (USDA, 2013)

$$A = \frac{Pa}{q_{all}}$$

Where,
A = Required Thrust block area (ft^2)
P = Working Pressure (psi)
a = cross sectional area of the pipe (in^2)
q_{all} = Allowable bearing pressure of the soil (psf)

Table 42: Thrust Block Specifications provides values calculated from a spreadsheet on the USDA's website. These values mimicked those from the Engineer's Toolbox. At operating pressures, these forces are generated at each turn in the pipes. The system will need subterranean thrust blocks matching the length, width, surface area, and volume prescribed below.

Table 41: Thrust Block Specifications

(USDA, 2013) (The Engineering Toolbox)

Thrust Block for 700 psf soil	**USDA**		**Engineering Toolbox**	
Nominal Diameter (in)	3	2	3	2
Volumetric Flow Rate (GPM)	100	25	100	25
Thrust (lb)	**468**	**212**	**474**	**211**
Length (ft)	1.57	1.49	1.57	1.49
Width (ft)	0.50	0.25	0.50	0.25
Area (ft^2)	**0.70**	**0.30**	**0.70**	**0.30**
Volume (ft^3)	1.35	0.18	1.35	0.18

Pipe Support of Thrust Loads

The pipe network's piping, fittings, and supports need to withstand thrust loading. The outer and inner nozzle row assemblies were analyzed using Finite Element Analysis (FEA) in Autodesk Inventor shown below::

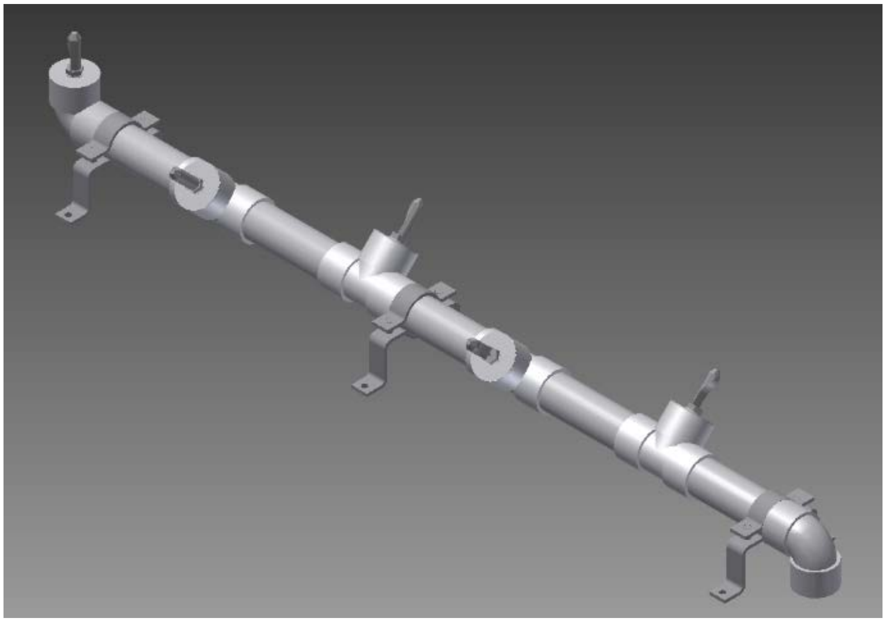


Figure 56: Inner Nozzle Row for FEA

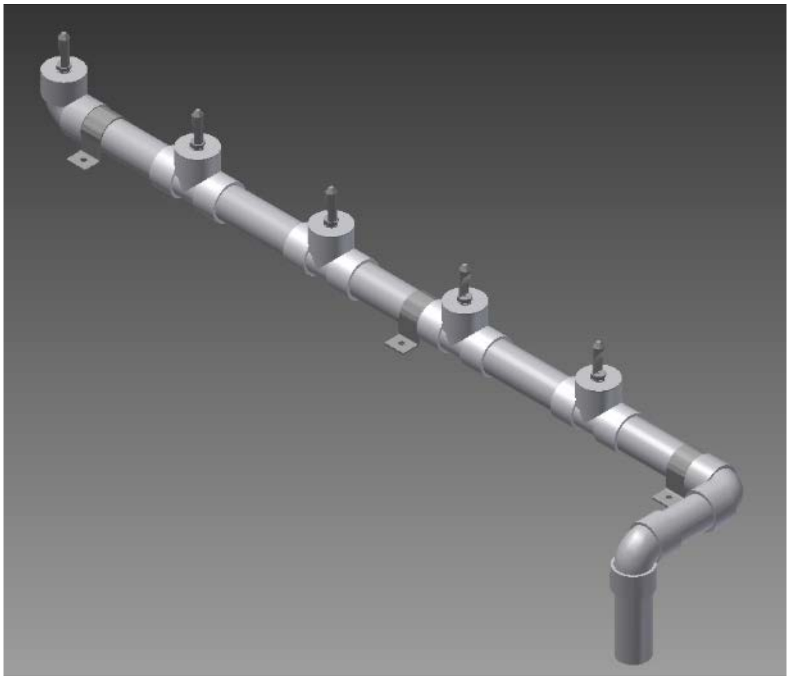


Figure 57: Outer Nozzle Row for FEA

Significant thrust loads occur at the entry elbows where water enters the 2 in nominal diameter elbows at 25 GPM. The resulting thrust load will have an absolute magnitude of 212 lbs. For the FEA analysis of the nozzle assemblies, the effects of thrust, gravity, and component materials were accounted for, and the effects of nozzle discharge were considered negligible. The following figures give the results for von Mises stress, deflection, and safety factors for these two assembly configurations:

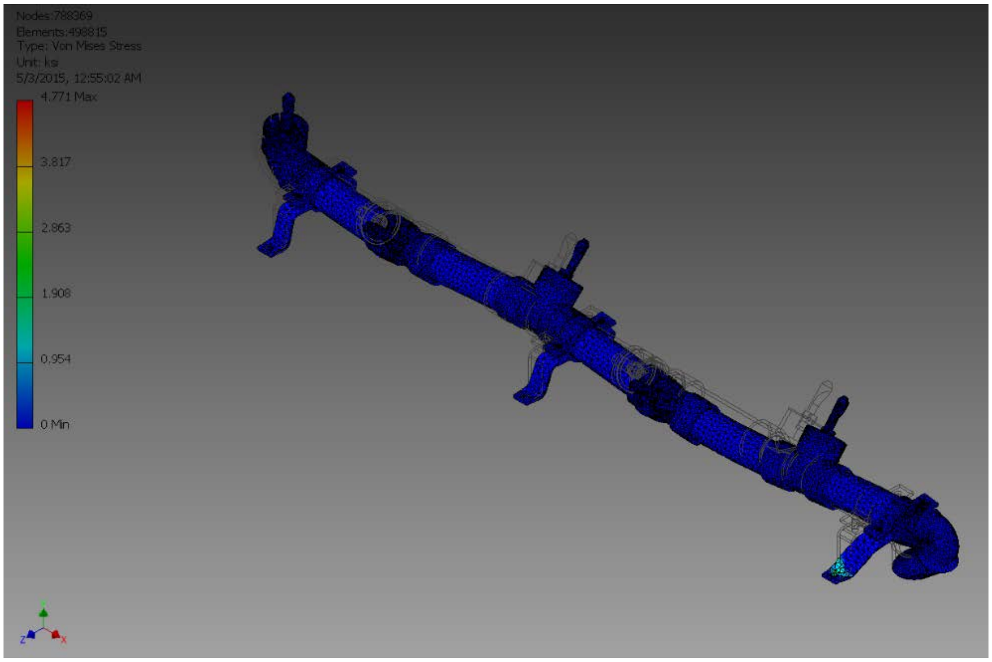


Figure 58: Inner Row von Mises Stress (4.771 ksi Maximum)

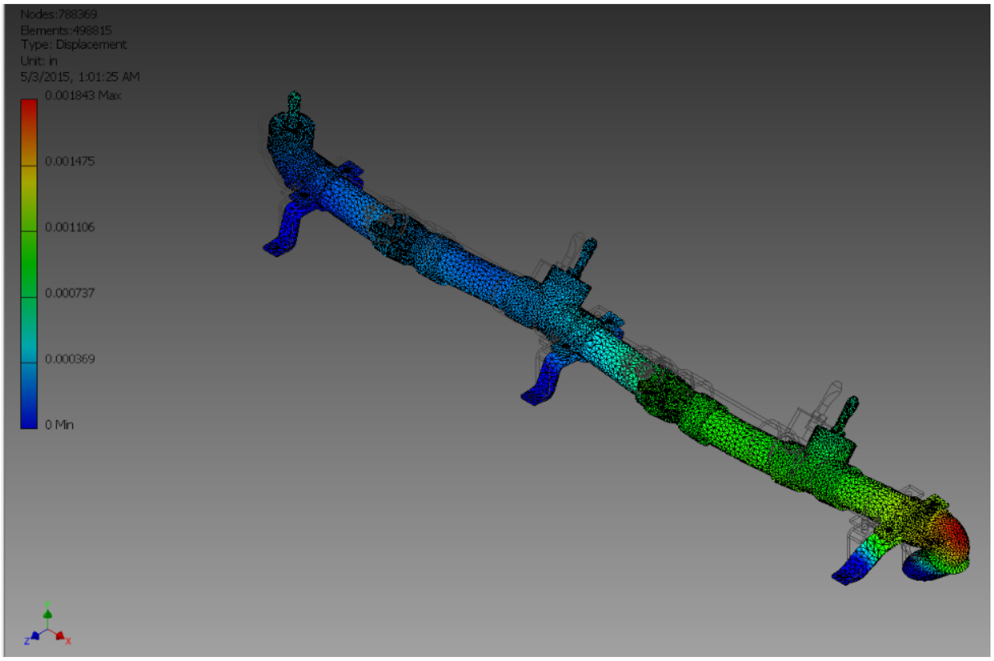


Figure 59: Inner Nozzle Row Displacement (0.001843 in Maximum)

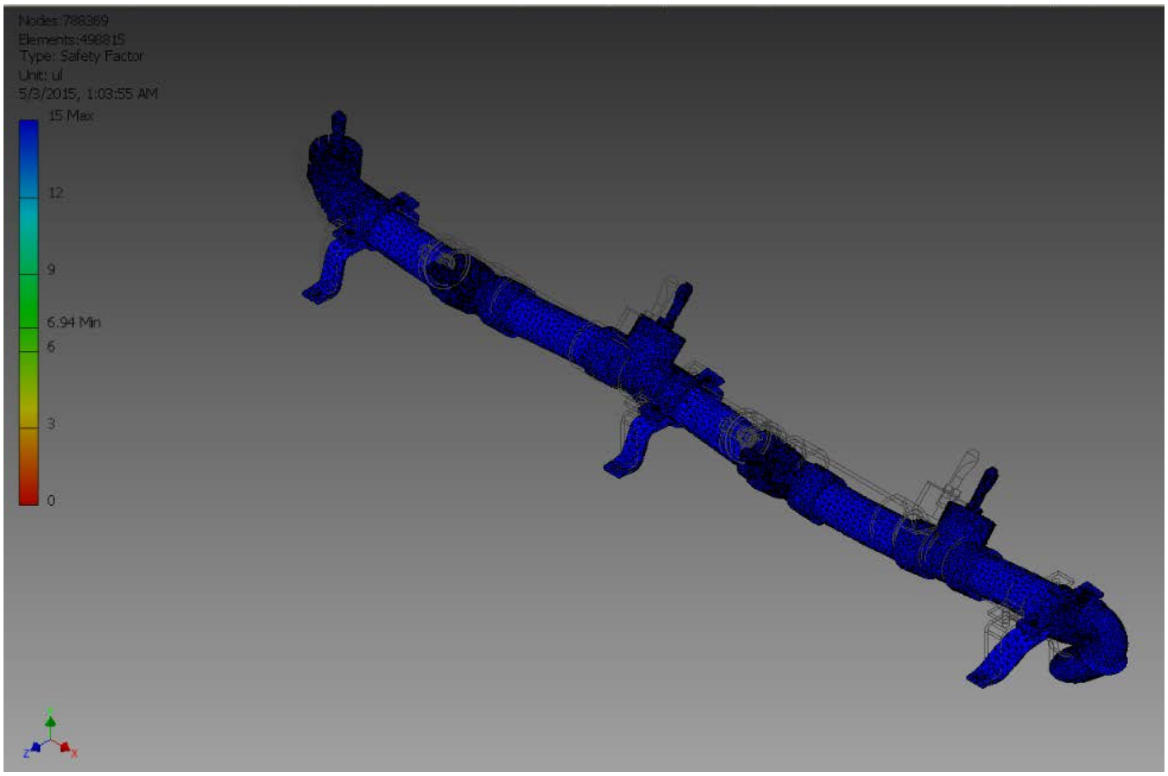


Figure 60: Inner Nozzle Row Safety Factor (6.94 Minimum)

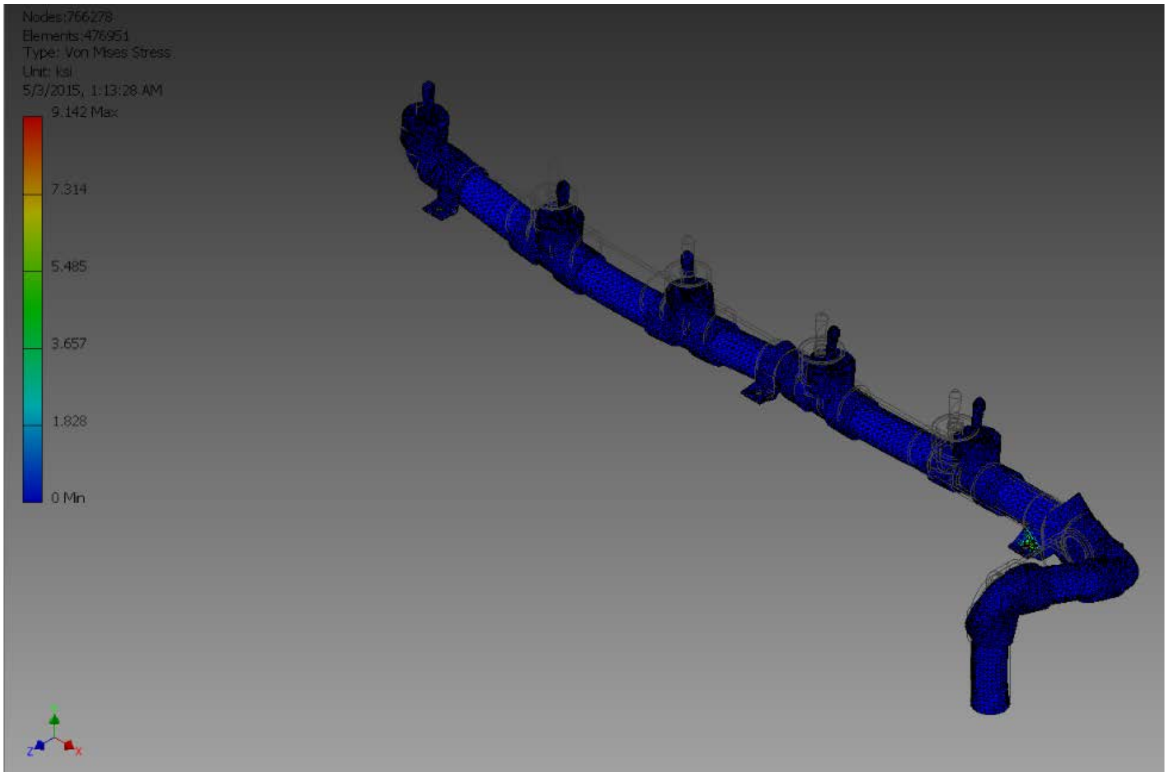


Figure 61: Outer Nozzle Row von Mises Stress (9.142 ksi Maximum)

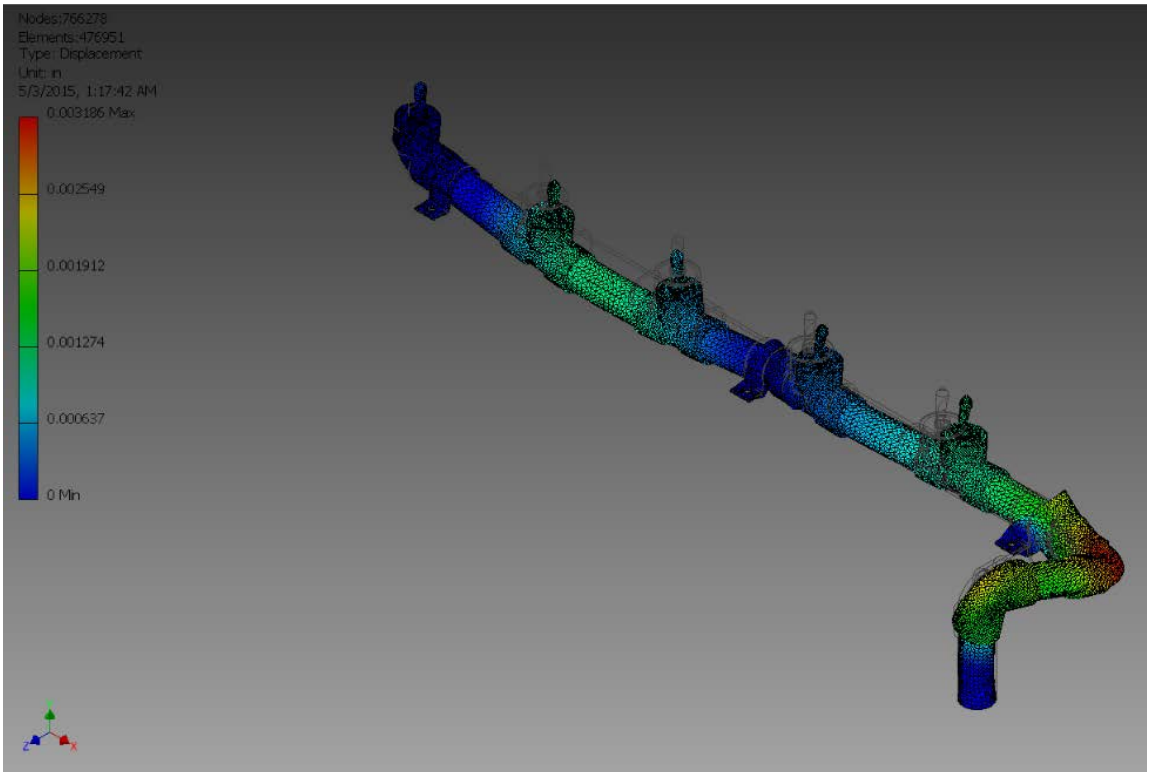


Figure 62: Outer Nozzle Row Displacement (0.003186 in Maximum)

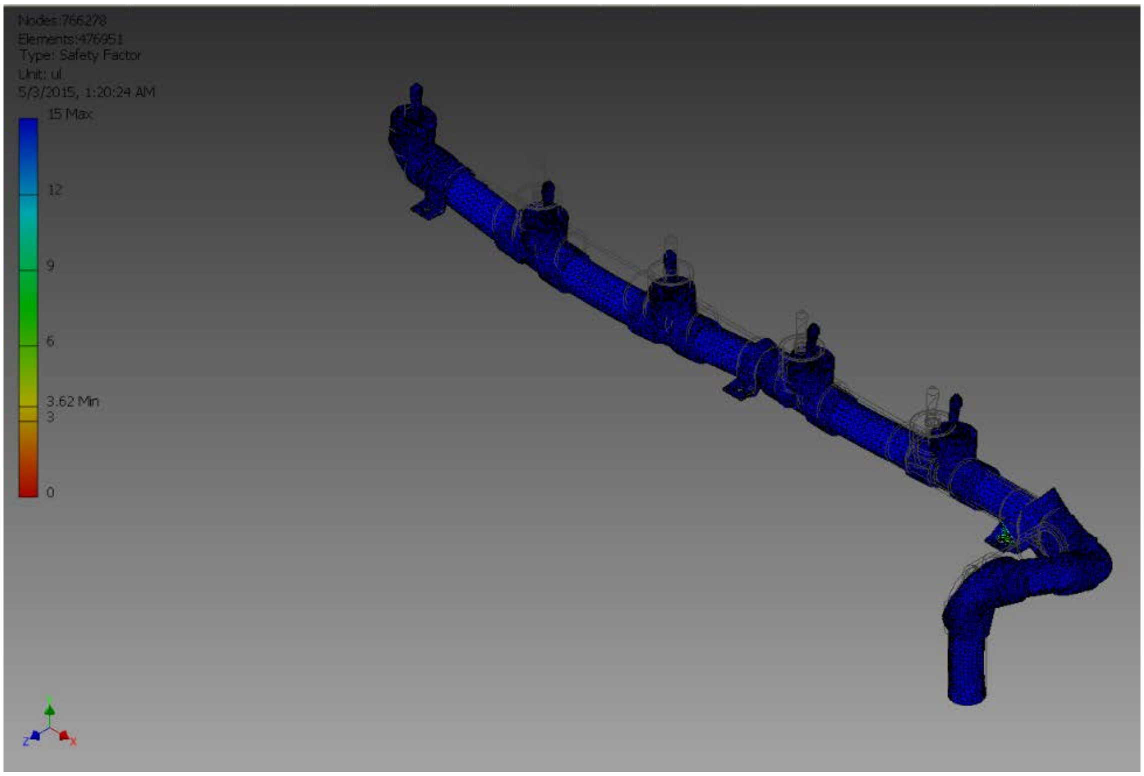


Figure 63: Outer Nozzle Row Safety Factor (3.62 Minimum)

Cost Analysis

Table 42: Foundation Cost Analysis

Foundation Work				
Description	**Item**	**Quantity**	**Unit Cost**	**Cost**
Main Wash Bay	4000psi	4.61 CY	$ 105.00	$ 484.05
	Chairs	0.5 BX	$ 50.00	$ 25.00
	Sand	1.54 CY	$ 15.00	$ 23.10
	Excavation	4 HR	$ 120.00	$ 480.00
	Labor	10 HR	$ 89.00	$ 890.00
	WWM	3 SH	$ 30.00	$ 90.00
Treatment Supplies	4000psi	3.85 CY	$ 105.00	$ 404.25
	Chairs	0.5 BX	$ 50.00	$ 25.00
	Sand	2.05 CY	$ 15.00	$ 30.75
	Excavation	8 HR	$ 120.00	$ 960.00
	Labor	7 HR	$ 89.00	$ 623.00
	Dowel	9 EA	$ 1.00	$ 9.00
	#4 Rebar	244.69 LB	$ 0.41	$ 100.32
Pre-Cast Vault	Excavation	2 HR	$ 120.00	$ 240.00
	Labor	3 HR	$ 89.00	$ 267.00
	Pre-Cast Vault	1 EA	$ 1,412.00	$ 1,412.00

Table 43: Road Approaches Cost Analysis

Approaches				
Approaches	Crushed Concrete	146 CY	$ 26.00	$ 3,796.00
	Excavation	20 HR	$ 120.00	$ 2,400.00
	Labor	10 HR	$ 89.00	$ 890.00

Table 44: Treatment System Cost Analysis

Treatment System				
Treatment System	Above Ground Storage Tank	1 EA	$ 1,325.99	$ 1,325.99
	CWR-15 Treatment	1 EA	$ 26,047.00	$ 26,047.00
	750 Gal. Tanks	2 EA	$ 1,290.00	$ 2,580.00
	Labor	10 HR	$ 89.00	$ 890.00

Table 45: Sensors Cost Analysis

Sensors					
Sensors	Transmitter	2	EA	$34	$68
	Receiver	2	EA	$53	$106
	Amplifier	2	EA	$111	$222
	Amplifier socket	2	EA	$6	$12
	Solenoid Switch	2	EA	$25	$50
	Power supply	1	EA	$180	$180
	Relay and bases	2	EA	$25	$50
	Enclosure	1	EA	$200	$200
	Fence Post Cap	4	EA	$4	$16
	Fence Post	3	EA	$22	$66
	Quikrete (For Posts)	4	EA	$4	$16
	Labor	32	HR	$95	$3,040

Table 46: Wash System Cost Analysis

Wash System					
Wash System	CPVC Pipe 2 in per foot	40.6	FT	$ 4.02	$ 163.21
	CPVC Pipe 3 in per foot	24.5	FT	$ 7.57	$ 185.47
	CPVC 2 inch Tee	20	EA	$ 9.78	$ 195.60
	CPVC 3 inch Tee	3	EA	$ 24.89	$ 74.67
	CPVC 90 degree 2 inch Elbows	4	EA	$ 7.35	$ 29.40
	CPVC 90 degree 3 inch Elbows	2	EA	$ 19.15	$ 38.30
	CPVC Reducer Bushings 1/2 to 3/8 inch	20	EA	$ 3.47	$ 69.40
	CPVC Reducer Bushings 2 to 1/2 inch	20	EA	$ 10.52	$ 210.40
	Tranisition Female Adapter 3/8 inch	20	EA	$ 7.74	$ 154.80
	CPVC Cement 32 Oz.	2	EA	$ 20.34	$ 40.68
	Pipe Cleaner 32 Oz.	2	EA	$ 17.74	$ 35.48
	Primer 32 Oz.	2	EA	$ 16.25	$ 32.50
	Reducing Tee 3x4	4	EA	$ 37.26	$ 149.04
	Stainless Steel 316 Short Clip	6	EA	$ 0.38	$ 2.28
	Pump	1	EA	$ 2,700.00	$ 2,700.00
	Concrete Mix 60 lb. bag	2	EA	$ 3.16	$ 6.32
	Chemical Injection System	1	EA	$ 2,500.00	$ 2,500.00
	Anchoring Epoxy 8.6 Oz.	2	EA	$ 22.12	$ 44.24
	Stainless Steel Wedge-All Anchor	36	EA	$ 1.96	$ 70.56
	SPN40 Spoon Nozzles	20	EA	$ 55.00	$ 1,100.00
	Macropoxy 646 per gallon	1	EA	$ 64.00	$ 64.00
	Acrolon 218 HS per gallon	1	EA	$ 83.00	$ 83.00
	Accel 55 gallons	2	EA	$ 1,400.00	$ 2,800.00
	Strainer for 3 in pipe	1	EA	$ 184.00	$ 184.00
	Shut Off Valve for 3 in pipe	1	EA	$ 110.00	$ 110.00
	Check Valve for 3 in pipe	1	EA	$ 315.00	$ 315.00
	Stainless Steel 316 2 in Offset Pipe Clamp	6	EA	$ 1.55	$ 9.30
	CPVC ANSI Flange 1.25 in.	1	EA	$ 35.86	$ 35.86
	CPVC ANSI Flange 2 in.	1	EA	$ 48.22	$ 48.22
	Labor	15	HR	$ 110.00	$ 1,650.00

The total for the base model is $61,120.19

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- Tommy A. Sherwood, Senior Systems Consultant and Regional Sales Manager of Hotsy Cleaning Systems, for sharing his knowledge about applying detergents

Disclaimer

West Texas A&M University does not endorse any company mentioned in this report.

Appendix D – Land Use Agreement Between West Texas A&M University and Quien Sabe Feeders

LAND USE AGREEMENT

This Land Use Agreement (the "Agreement") is made entered into between LS Quien Sabe, LLC d/b/a Quien Sabe Feeders, a Texas limited liability company ("QSF") and West Texas A&M University, a public university located in Canyon, Texas ("WTAMU") (collectively, the "Parties" and individually a "Party"), as of and to be effective 6 - 28, 2016 (the "Effective Date").

RECITALS

A. WTAMU desires to design, construct, and test a low-maintenance, low-cost, vehicle tire and undercarriage cleaning and disinfection facility to enhance biosecurity at concentrated animal feeding operations (the "Research").

B. QSF operates a Concentrated Animal Feeding Operation ("CAFO") located in Randall County, Texas.

C. WTAMU has requested that QSF allow WTAMU to use a specific and limited area of QSF's property (the "Site") to install, maintain and test a vehicle tire and undercarriage cleaning and disinfection facility to be funded in whole or in part with Federal funds from the Department of Homeland Security under BOA No. HSHQDC-10-A-BOA33, Task Order No. HSHQDC-15-J-00092.

D. On the terms and conditions set forth hereinafter QSF has agreed to allow WTAMU to use the Site solely for the purpose of installing, maintaining and testing a vehicle tire and undercarriage cleaning and disinfection facility to be funded in whole or in part with Federal funds from the Department of Homeland Security under BOA No. HSHQDC-10-A-BOA33, Task Order No. HSHQDC-15-J-00092.

Agreement

In consideration of the mutual promises; in reliance on the representations, warranties, covenants, and conditions contained in this Agreement; and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree as follows:

Article I
Term and Termination

1.1 This Agreement takes effect immediately as of the Effective Date and remains in full force and effect until the earlier to occur of a) the Research being completed; or b) 8/26/2016, unless earlier terminated pursuant to this Agreement.

1.2 Either Party may terminate this Agreement on thirty (30) days written notice, provided that either Party may terminate this Agreement on ten (10) days written notice if the other Party: (a) is in material breach of this Agreement and has failed to cure such breach within five (5) days after its receipt of written notice of such breach provided by the non-breaching Party; (b) engages in any unlawful business practice related to that Party's performance under the Agreement; or (c) files a petition for bankruptcy, becomes insolvent, acknowledges its insolvency in any manner, ceases to do business, makes an assignment for the benefit of its creditors, or has a receiver, trustee or similar party appointed for its property.

1.3 Upon the termination of this Agreement at any time, all rights and obligations of the respective parties hereunder shall cease, *provided however* that notwithstanding any contrary provision hereof, all of the rights and obligations of the respective parties under 1.4; 1.5; 2.12 and Site Rules (f) shall survive expiration or termination (for any reason) of the Agreement and remain in full force and effect.

1.4 Upon the termination of this Agreement resulting from the completion of the Research, ownership of the vehicle tire and undercarriage cleaning and disinfection facility and all equipment utilized therein shall vest in QSF.

1.5 Upon the termination of this Agreement for any reason other than the completion of the Research, WTAMU under Task Order No. HSHQDC-15-J-0092, at its cost and expense, shall promptly remove the vehicle tire and undercarriage cleaning and disinfection facility and all equipment, instrumentation and other items from the Site and restore the Site to as good or better condition as it was on the Effective Date.

Article II
Use of the Site

2.1 QSF agrees to allow WTAMU the non-exclusive use of a specific and limited area of its property (the "Site") solely for the purpose of installing, maintaining and testing a vehicle tire and undercarriage cleaning and disinfection facility to be funded in whole or in part with Federal funds from the Department of Homeland Security under BOA No. HSHQDC-10-A-BOA33, Task Order No. HSHQDC-15-J-00092. WTAMU shall have no right to use the Site for any other purpose. Any use of the Site beyond the term or scope of this Agreement shall be pursuant to further negotiation and agreement.

2.2 WTAMU shall have the right of ingress and egress to the Site on the route or routes designated by QSF and shall not access the property from any other route.

2.3 Location of the Site and the routes of ingress and egress shall be in the sole and absolute discretion of QSF. WTAMU shall consult with QSF on its Site development plan prior to construction or installation, showing QSF the proposed location of the facility, equipment and instrumentation.

2.4 QSF makes no representations or warranties about the Site, the routes of ingress or egress or the real property in gross upon which the Site will be located (the "Property"), including but not limited suitability for any purpose or its use by WTAMU. WTAMU acknowledges and agrees that its use of the Site and the routes of ingress and egress is "as is," and "with all faults".

2.5 WTAMU shall have access to the Site during QSF's normal business hours.

2.6 WTAMU's use of, and access to, the Site shall not be disruptive to, or impede or interfere with QSF's business. WTAMU shall be responsible for safety and security measures to the risk of damage, injury or death to people, livestock, other animals and property.

2.7 WTAMU's use of, and access to, the Site shall be at no cost to QSF.

2.8 Prior to commencement of any access to, or activity on, the Site, WTAMU shall provide QSF in writing the name of each person that will be on the Property and the name of each project partner, independent contractor, subcontractor and project sponsor that will enter upon the Property, with a contact person for each.

2.9 The only vehicles that shall be cleaned and disinfected on the Site shall be those owned by QSF and those coming to, or going from, QSF's Property in the ordinary course of QSF's business.

2.10 WTAMU agrees to be bound by and shall abide by the Site Rules attached hereto. WTAMU shall publish for all WTAMU personnel, employees, project partners, agents, contractors and the contractors' employees and agents, and all other personnel of third parties authorized to enter the Site by WTAMU a copy of the Site Rules attached hereto.

2.11 All access to the Site and work on the Site shall be under the supervision of WTAMU, with WTAMU's contractor installing the undercarriage cleaning and disinfection facility. WTAMU will be responsible for furnishing the necessary equipment and labor to install and maintain the vehicle tire and undercarriage cleaning and disinfection facility and instrumentation to collect required Research data. WTAMU will be responsible for the installation, operation, and maintenance of the facility and equipment in a safe and workmanlike manner during the term of this Agreement.

2.12 WTAMU shall keep the Site and all of QSF's Property free and clear of all liens and claims of liens for labor and services performed on, and materials, supplies or equipment furnished to, any portion of the Property in connection with WTAMU's use of the Site pursuant to this Agreement.

2.13 WTAMU shall comply with all laws, ordinances, statutes, orders and regulations of any Governmental Authority, including any federal, state or local law, ordinance or regulation relating to the generation, manufacture, production, use, storage, release or threatened release, discharge, disposal, transportation or presence of any substance, material or waste which is now or hereafter classified as hazardous or toxic, or which is regulated under current or future federal, state or local laws or regulations, on or under the Property.

2.14 WTAMU shall maintain its improvements on the Site in good repair and keep the facility and ingress and egress routes free from refuse, litter and debris at all times during the term of this agreement.

Article III
Miscellaneous Provisions

3.1 Notice. Any notice, communication, request, reply or advice (severally and collectively referred to as "**Notice**") in this Agreement provided or permitted to be given, made or accepted by either Party to the other must be in writing. Notice may, unless otherwise provided herein, be given or served: (i) by depositing the same in the United States Mail, certified, with return receipt requested, addressed to the Party to be notified and with all charges prepaid; (ii) by depositing the same with Federal Express or another service guaranteeing "next day delivery", addressed to the Party to be notified and with all charges prepaid; (iii) by delivering the same to such Party; or (iv) by transmitting the same to the Party to be notified by telecopy during normal business hours, provided that receipt for such telecopy is verified by the sender. Notices hereunder shall be effective on the date of delivery, in the manner described hereinabove. For the purposes of notice, the addresses of the Parties shall, until changed as provided below, be as follows:

Quien Sabe Feeders
P. O. Box 308
Happy, Texas 79042
FAX: (806) 558-2209
bfsleigh@qsfeeders.com

WTAMU
2501 4th Avenue
WTAMU Box 60217
Canyon, TX 79016-001
srs@wtamu.edu

3.2 DISPUTE RESOLUTION. The dispute resolution process provided in Chapter 2260, Texas Government Code, and the related rules adopted by the Texas Attorney General pursuant to Chapter 2260, shall be used by WTAMU and QSF to attempt to resolve any claim for breach of contract made by QSF that cannot be resolved in the ordinary course of business. QSF shall submit written notice of a claim of breach of contract under this Chapter to the University Vice President of Research and Compliance at WTAMU at (address), who shall examine QSF's claim and any counterclaim and negotiate with QSF in an effort to resolve the claim.

3.3 Applicable Law and Venue. The construction and validity of this Agreement shall be governed by the laws of the State of Texas, without resort to conflict of laws principles. Venue shall be in a court of appropriate jurisdiction in Randall County, Texas.

3.4 Assignment. WTAMU shall not assign this Agreement or any rights or privileges granted herein.

LS QUIEN SABE LLC d/b/a Quien Sabe Feeders

By: ____________________
Richard Winter, Manager

WEST TEXAS A & M UNIVERSITY

By: Angela Spaulding
Printed Name: _Dr. Angela Spaulding
Title: ____VP Research and Compliance____________________

SITE RULES

WTAMU and all WTAMU personnel, WTAMU's employees, agents, contractors and the contractors employees and agents, and all other personnel of third parties authorized to enter the Site by WTAMU, shall follow the following rules while on the Site or on any Property owned by QSF. QSF may bar further access to the Site to any individual who violates the following rules while on the Property. In addition, any individual violating rules (b) or (e), shall be immediately expelled from the Property and only allowed back on the Property with QSF's written consent.

(a) All persons shall be respectful towards animals on the Property, shall not chase any animal and shall avoid any contact with any animals or wildlife on the Property, and shall avoid causing any unnecessary loud noises on the Property.

(b) At no time shall any person carry firearms, hunt, or use illegal drugs or alcohol on the Property, or be under the influence of illegal drugs or alcohol, or to remove livestock, crops, wood, water, archaeological artifacts (including, but not limited to arrowheads, petrified rocks, stones and gems), wildlife, plants, or any other property of QSF from the Property. Further, at no time shall any person entering the Property bring any of the following onto the Property:

- i. Weapons of any type, including but not limited to, guns, bows and arrows, or sling shots.
- ii. Dogs, cats or other animals.
- iii. Alcoholic beverages.
- iv. Illegal drugs or related paraphernalia.

If any person violates this rule, WTAMU shall remove or exclude such party and QSF shall have the right to eject such party from the Property and thereafter prohibit such party from entering the Property.

(c) Smoking is prohibited. WTAMU will employ prudent precautions to prevent fires, including avoiding the build-up of plant material under vehicles. In the event a fire is started, QSF shall be promptly notified.

(d) WTAMU shall keep the Property clean and free of all trash and litter which may emanate from WTAMU or its employees, agents, contractors or invitees operations on the Property. Under no circumstances will WTAMU bury or burn any trash, debris or foreign material of any nature on the Property.

(e) WTAMU, its employees, contractors, agents and any individual allowed onto the Property by WTAMU shall not bury, dump, spill or discharge any gasoline, oil, hydraulic fluid, fuel, paint or other foreign, toxic, or other waste substances on the Property.

(f) WTAMU agrees to restore or repair any damage to buildings, barns, windmills, tanks and other structures, as well as be responsible for any damage, loss or injury to crops, cattle, or other livestock, incurred as a result of its operations on the Property or occasioned by reason of such operations, or such damage as QSF may incur by reason of WTAMU's failure to comply with the terms of this Agreement.

(g) In exercising the rights herein granted, WTAMU is limited to such use or usage as is reasonably necessary and which will be conducted with due regard for the superior rights of the QSF.

(h) At QSF's request WTAMU or its contractors shall provide its employees with portable toilet facilities during construction of the facility.

Appendix E – Stanton Systems STB 30 Photographs of Unit and Vehicles Washed

Figure 1. Water jets at Earnhardt Grading Undercarriage and Wheel Wash in Ft. Mill, SC.

Figure 2. Left: STB 30 in FT. Mill, SC. Notice there is no central channel. Right: Unit install in Texas with central channel. The central channel was requested by the feed yard manager.

Figure 3. Concrete Truck Being Washed. The "Before" picture did not really capture how dirty the truck was. A lot of debris was removed.

Figure 4. Unit installed at cooperating feedyard prior to installation of the concrete aprons. Note the dark colored 3000 gal tank to the left.

Figure 5. Left: To provide more water from beneath the vehicles, nozzles on the side wash were removed and replaced with plugs. Right: The installation in South Carolina with all side nozzles operational. To add the central channel required either adding another pump and changing the electrical requirement or diverting water from the side wash to the bottom. The feedyard manager preferred the latter.

Figure 6. Polymer flocculation injection pump.

Figure 7. Waste discharge point. Material is discharged with 2% to 3% moisture content.

Figure 8. Pickup being washed at cooperating feedyard. Before wash.

Figure 9. Pickup being washed at cooperating feedyard after wash. There is improvement, but it is important to remember that two-thirds of the side nozzles have been plugged to provide water for underneath the vehicle.

Figure 10. Pickup truck entering wsh.

Figure 11. Pickup truck exiting wash.

Figure 12. Water jets in undercarriage wash system.

Appendix F – Cold Weather Guidance & Hazardous Material Compliance

Design, Construction, and Testing of a low-maintenance, low-cost, vehicle tire and undercarriage cleaning and disinfection facility to enhance biosecurity at concentrated animal feeding operations

Contract #HSHQDC-10-A-BOA33; Order #HSHQDC-15-J-00092

Background and Purpose:

The Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Chemical and Biological Division (CBD) Agricultural Defense Branch is supporting a low-maintenance, low-cost, vehicle tire and undercarriage cleaning and disinfection system to be installed at an agricultural facility entrance to promote routine and emergency biosecurity to protect America's food and agricultural infrastructure. Requirements include the ability to conserve water and cleaning/disinfection products; resistance to freezing temperatures down to -25^{o}C; filtering and re-use of rinse water; containment of effluent; and automatic start/shut-off. The use of coagulant to remove solids from spent water so that it may be reused is considered to meet the filtering and re-use requirement above. DHS has indicated that the system should be designed in such a way that it can be retrofitted with a shelter for full-vehicle processing if needed. To achieve operational temperature requirements, water may be heated and applied within the retrofitted structure, which may also be heated for more extreme temperature environments. Additional options include use of approved additives that reduce the freezing point of the wash liquid, although no amendments are known to have passed field tests. The outcome of this work is intended to meet this identified need, and will include installation and testing of such a system, a final report of design assumptions and lessons learned during testing, and an installation/user guide as provided by the manufacturer.

Requirements:

Requirements include that the under carriage and wheel wash be low cost (KPP #1) and adequately remove debris so that cleaning is effective (KPP#2). Cleanliness is outlined in the USDA-APHIS-VS-NCAHEM Foreign Animal Disease Preparedness and Response Plan (FAD PReP) under section 9.4.2.2.2.2.1 in "Visitor Biosecurity in a Quarantined Area." This describes vehicles being "clean and free of dirt, debris, and organic material" to include "tires, wheel wells, and undercarriages of all vehicles and trailers…immediately prior to arrival and immediately after departure." Cleanliness will be evaluated by visual inspection. Going from visibly soiled to visibly free of surface debris is correlated with 2-4 log reduction in pathogen load according to work presented at the 4th International Symposium on Managing Animal Mortality, Products, By Products, and Associated Health Risk (Rohonczy, et. al., 2012). Validation of visual observations and disinfection are not applicable at this phase of this program, but could be determined by standard protocols for pathogen(s) of interest in future research (e.g., a potential Phase 3 of this program).

#	Key Performance Parameters (KPP)	Threshold	Objective
KPP #1	Cost of apparatus	$100,000	$50,000
KPP #2	Undercarriage and wheel cleanliness	100% clean	Minimal debris allowing effective disinfection**

***Disinfection stage is not applicable at this phase, but will be for future research*

An additional requirement is resistance to freezing temperatures. For cold weather temperatures experienced in the panhandle of Texas where this unit is to be installed (*average winter temperature of 3°C with an average minimum of -5°C and maximum of 11°C in January*, the following are modifications are proposed for use:

- Install the water tank at a minimum depth of 5.5 feet to achieve a more stable temperature, which is a normal specification for the unit to be installed
- Include a recirculation pump, which will also conserve water and any cleaning/disinfection products
- An immersion or submersible heater is likely not needed for Panhandle temperatures, but could be considered
- If future studies warrant, retrofit to install a shelter for the undercarriage and wheel wash unit

As installed the undercarriage and wheel wash has a 3000 gal above ground tank, which adds substantial thermal mass. The tank with the wash is installed at the 5.5 ft depth recommended.

For use at colder weather down to temperatures of -25°C, additional modifications will be necessary. The most viable options in terms of what is determined to be most implementable and practical, will be addressed as cold weather guidance in the draft and final project report. Field testing of these modifications at a site that experiences more extreme cold temperatures is not applicable at this phase of the program, but could be of interest in future research (e.g., a potential Phase 3 of this program). It is considered that these modifications may include the ones above as well as:

- An immersion or submersible heater
- Enclosure of the wash unit in a heated shelter
- Addition of a chemical additive

The materials washed from the undercarriages and wheels are largely composed of caked mud and some organic matter associated with animal feeding operations. Those materials are not classified as hazardous waste in the Code of Federal Regulations (40 CFR 261). The wash system does not have routine effluent. The solid material is discharged with two to three percent moisture content. The feedyard will transfer solid wastes for land application. When the tank needs to be drained for routine maintenance and cleaning, that water will be transferred to the facility retention pond and be used for irrigation or allowed to evaporate.

References:

USDA-APHIS-VS-NCAHEM. Foreign Animal Disease Preparedness and Response Plan (FAD PReP). Foot-and-Mouth Disease Standard Operating Procedures: 9. Biosecurity. Section 9.4.2.2.2.1, *Visitor Biosecurity in a Quarantined Area*. Draft December 2010.

Rohonczy E, Brooks B, Guan J, Chan M, Theirault S, Cutts T, Carruthers B-A, Gordon-Pappas D, and Miller L. (2012). Cold Weather Decontamination (Validation of Decontamination Processes in the Agri-Food Context), presented at the *4th International Symposium on Managing Animal Mortality, Products, By Products and Associated Health Risk*, Dearborn, MI. May 21-24.

Code of Federal Regulations, Title 40 – Protection of the Environment. Chapter I – Environmental Protection Agency. Subchapter I – Solid Wastes. Part 261 – Identification and Listing of Hazardous Waste.