Statement of Work
Design, supply and installation of a new Hydraulic Distribution line For NRC's Automotive and Surface Transportation Portfolio

This Statement of Work (SOW) covers the requirements to install a new hydraulic distribution line from two new Hydraulic Power Units to six hydraulic actuators to be completed at the NRC AST U-89 building, 2320 Lester Road, located in Ottawa, ON.

1. About Automotive and Surface Transportation Portfolio

NRC Automotive and Surface Transportation (AST) performs research, technology development and demonstration aimed at helping the entire automotive supply chain, providing technology solutions ranging from targeted component development, advanced manufacturing process and prototype development, evaluation and testing, fuel efficiency, aerodynamic performance, power management, vehicle intelligence, climatic challenges, safety, and environmental impact.

2. Project Description

The National Research Council of Canada, Automotive and Surface Transportation Portfolio (NRC-AST), in Ottawa, ON recently installed two MTS 515.180 SilentFlo Hydraulic Power Units that will be used in the U-89 Dynamic's Bay facility. The two units have been installed in a new building and need to be connected to the main facility. The project includes the necessary hydraulic connections between U89-B to U89 as well as the necessary hydraulic lines to run along the interior wall of the testing facility and allow the pumps to be connected to the existing actuators.

3. Existing Documentation

NRC has received a detailed drawing package from the pump manufactures, MTS Corporate Services. This drawing package is part of this SOW and is the main reference to the development of this package.

Drawings provided as part of this SOW are not for construction. Selected contractor is responsible to review and confirm all site information, dimensions and limitations prior to commence any work.

The following drawings/documents are provided to assist in defining the scope of supply of this project.

Item	Format	Alternate format
MTS Hydraulic line drawings	Soft copy	.dwg
Installation location and future expansion boundaries	Soft copy	-
MTS 515 series catalog	Soft copy	-

MTS 515.180 General Assembly drawings	Soft copy	-
MTS 515 series complete specifications	Soft copy	-

3.1 Installed pump information

NRC purchased and installed two brand new Hydraulic power units. The units have been supplied by MTS Systems Corporation, and are part of the 515 series, model 515.180. A catalog/cut-sheet is provided as part of this statement of work in section E. The General assembly drawings are provided as part of Section G and the complete specification data information is provided as part of section F.

Pumps have been tested on site in March, 2017 for delivery acceptance. After hydraulic line installation a new test will be performed to verify working conditions. This test will be the responsibility of the pump manufacturer/supplier. Contract to provide site support during testing.

4. Proposal for the work

Before submitting a proposal a mandatory site visit is required to verify the details involved in this scope of work. Site visits will be specified in the tender package.

Questions raised during the visitation will be answered in 24 hrs.

Visit shall be confirmed with Mr. Alexander Nitsche via email: alexander.nitsche@nrc-cnrc.gc.ca

4.1 Scope of work

Scope of work shall be in accordance with section A of this Statement of work.

The following items are to be completed as part of this project

1. New Hydraulic distribution line from the Hydraulic power units installed at U-89B to the actuators installed in U-89, including:

- Design of the distribution line, based on the provided drawings, as per local and federal norms and regulations, including any requirements for engineering review and approval;
    - Design shall provide all dimensions, materials, processes to comply with local and federal norms and regulations and to allow easy substitution of materials and components.
- Design of two future hydraulic lines to be connected to the hydraulic line installed, as per NRC drawings, those two lines will not be installed under this scope;
- Fabrication of the main hydraulic line approved design and supply of any appurtenances needed to ensure proper functionality of the installed line, i.e.: valves, supports, manifolds, caps, etc.
- Hydraulic line testing and quality report.

2. Complete concrete drilling between U-89B and U-89 to allow hydraulic line access.

Work will be completed at NRC AST facility building U89 and U-89B located at:

Automotive and Surface Transportation
2320 Lester Road,
Ottawa Ontario.

5. Deliverables

- Assembly drawings including all appurtenances cut sheets and line supports drawings
    - Engineering stamped drawings (as needed)
- Project documents as specified in Section A
- Hydraulic distribution line components, as specified in the attached drawings, including any substitutions and other components identified as needed in the tender proposal.
- Assembly and installation of the hydraulic line at NRC AST U-89 building
- Site testing/commissioning procedure
- Final quality report

6. Project Schedule

The following is a suggested schedule for some tasks involved in this project. Contractor is expected to provide a detailed schedule as part of their response to the tender. This project is part of a larger installation project. Any deviations from the schedule below will need to be reviewed by the project team, prior to start, in order to ensure all schedule impacts have been taken into consideration.

All days below are business days

Contract issued	– Day 0
Drawings and documentation	– 10 to 15 days
Material preparation	– 10 to 15 days
Crew mobilization	– 3 to 5 days
Site installation	– 15 days
Testing and commissioning	– 5 days

Expected duration – 55 days (floating 12 days)

A. STATEMENT OF WORK TECHNICAL SECTION

1. WORK DESCRIPTION

This section cover the installation of two ∅76.2mm I.D. x 33.5 m long (∅3" I.D. x 110ft) hydraulic pipelines, supply and return, with four (4) distribution assemblies to feed a series of six (6) existing dynamic actuators. Along with a connection branch to connect the new hydraulic line to the existing MTS 515.180 Hydraulic power units.

2. EXISTING DRAWINGS

The Hydraulic distribution assembly line and its components design are to be based on the drawing package provided as part of section D. The following drawings are part of this package.

It	Title	Number	Rev	Pages
1	Hydraulic distribution assy-55867	100-342-836	A	9
2	Manifold-97mm w/(4) 2" C61 outlets	100-338-759	A	1
3	Manifold-90mm w/(4) 2" C61 outlets	100-338-760	A	1
4	Manifold, -32(2) with -12(4) outlets	100-338-769	A	1
5	Manifold, 90mm x 2" C61(2)	100-338-780	A	1
6	Manifold-line end, 97mm/2x 2" C61 outlets	100-338-781	A	1
7	Manifold-drain -20 (2), -32	100-338-782	A	1
8	Manifold-line end, 97mm/2x 2" C61 outlets	100-339-200	A	1
9	Manifold-offset, 90mm (2) x 2" C61(2)	100-339-202	A	1
10	Bracket-assy, hardline support 55867	100-342-776	A	1
11	Bracket-angle, hardline support 55867	100-342-778	A	1
12	Channel-support "C" channel 55867	100-342-779	A	1
13	Plate-bracket, hardline support 55687	100-342-780	A	1
14	Manifold-elbow 97 mm alum	100-166-276	A	1
15	Manifold-elbow 90 mm alum	100-166-277	A	1
16	Elbow-pipe weldment, 2" C61 sched 80	100-207-308	A	1
17	Hose Assy-drain, 1 1/4 nom, petro, base hydr. oil	068917-xx	E	1
18	Tubing-304 sst xxx 00 x xxx wall	100371-XX	D	3
19	Plug-port, 4 bolt flange	326985-xx	C	1
20	Adapter-4 Bolt to boss	351958-xx	A	1
21	Hose assy-pressure, 2" nom straight split flange, xx	439240-xx	H	2
22	Hose assy-return, 2" nom straight split flange, xx	439241-xx	J	2
23	Valve check 2 in	475732-xx	F	1
24	Flange kit-sae, with o-ring	527984-xx	C	1
25	Pipe assy-return, straight, 90mm O.D.	571371-xx	C	1
26	Accumulator-piston, T seal crn, 7" dia	575811-xx	F	2
27	Clamp assy-weld, 97/90/2.00"	579774-xx	A	1
28	Pipe assy-press, 97mm x 12 mm	579820-xx	D	1
29	Plate-blocking, pressure 97mm flange	545520-01	A	1
30	Hose assy-pressure, 2" nom straight split flange, xx"	439240-xx	H	2

31	Bill of Material ASSY 55867	n/a	n/a	1

Drawings and cut sheets provided as part of this package are for reference only (Not for construction). Supplier is expected to provide a set of construction drawings for approval prior to start of work and a set of as built drawing prior to project completion.

3. PROJECT MANAGEMENT REQUIREMENTS

After award of the contract, the selected supplier will assign a Project Manager as a single point of contact for all matters related to the project. The supplier Project Manager will be responsible to communicate any project information to the NRC Project Manager, including but not limited to: Status Reports, Meeting agendas and minutes, Change Orders, design drawings, design reviews, etc.

Potential suppliers are expected to provide the following project documentation

Document	Type/format	Due date	Purpose	Notes
List of references	PDF	With proposal	Review supplier experience	
Certificate of compliance	PDF	KOM	Control	Supplier shall identify all compliant and non-compliant items (if any), as well as all proposed substitutions in the certificate.
Project schedule with Milestone list	PDF	KOM	Review	Critical Path Method shall be used
Risk/issue Register	XLS/PDF	5 days after KOM	Control and review	Template to be issued by NRC
Design drawings and cut sheets	DWG/PDF	5 days After KOM	Approval	Mechanical drawings P&ID drawings (if applicable) Installation drawings Cut sheets as needed
Approved equals / alternates list	PDF	15 days after KOM	Approval	List all approved equals for pre-approval by NRC prior to commence fabrication
Health and safety plan	PDF	15 days prior to commence work on site	Review	NRC will provide comments, but is not responsible for the Health and Safety plan contents.
Site acceptance testing template	PDF	30 days prior to SCG	Review and control	Specify all steps required to complete the test.
Site acceptance testing Report	PDF	10 days after SCG	Control and documentation	The document used during test shall be signed and send to NRC for record purposes.
As built final drawings	DWG/PDF	10 days After SCG	Control and documentation	(same as design drawings) One hard copy + soft copy
KOM – Kick off meeting SCG – Site commissioning				

4. PROJECT MEETINGS

Four (4) meetings are expected as part of this contract

.1 Project kick off meeting;
.2 Site pre-installation meeting;
.3 Pre-testing meeting
.4 Project close-out meeting

.1 Contractor is responsible to schedule the meeting dates. NRC will support the contractor to identify a meeting location on site.

.2 Contractor is responsible to prepare meeting agenda and minutes for each meeting as specified below.

.1 Project close-out meeting will be NRC's Project Manager responsibility.

.3 Project kick off meeting

No longer than 5 days after award of Contract, request a meeting of parties in Contract to discuss and resolve administrative procedures and responsibilities prior to the commencement of the work.

.2 Attendees at Contract start-up meeting shall include the following:

.1 Contractor's project authority.

.2 NRC Departmental Representative(s).

.3 Inspection and testing company (as applicable).

.4 Manufacturer's representatives (as applicable).

.3 Agenda to include the following:

.1 Owner's guidelines and policies.

.2 Appointment of official representative of participants in this phase.

.3 Review of security clearances and procedures and review of hours of work at the NRC facility.

.4 Progress reporting and schedule review.

.5 Requirements for temporary facilities, signs, offices, storage sheds, utilities, fences.

.6 Security requirements at and for the site.

.7 Progress claims, administrative procedures, holdbacks.

.8 Insurances, transcripts of policies.

.9 Contractor's safety procedures.

.10 Workplace Safety.

.4 Pre-Installation Meetings

During the course of the work prior to substantial performance, schedule pre-installation meetings as required by the contract documents or as directed by the NRC Departmental Representative.

.1 Attendees at pre-installation meetings shall include the following:

.1 Contractor.

.2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.

.3 NRC Departmental Representative(s).

.4 Manufacturer's representatives (as applicable).

.5 Inspection and testing company (as applicable).

.2 Agenda to include the following

.1 Owner's guidelines and policies.

.2 Appointment of official representatives of participants in this phase.

.3 Review of existing conditions and affected work, and testing thereof as required.

.4 Review of installation procedures and requirements.

.5 Review of environmental and site condition requirements.

.6 Schedule of the applicable portions of the work.

.7 Schedule of submissions for NRC Departmental Representative's consideration.
.8 Requirements for temporary facilities, site sign, offices, storage shed, utilities, fences.
.9 Requirements for inspections and tests, as applicable. Schedule and undertake inspections and tests.
.10 Delivery schedule of specified equipment.
.11 Special safety requirements and procedures.

.5 Pre-testing meetings

After site installation has been completed, or nearly completed, and prior to site testing, schedule a pre-testing meeting as required by the contract documents or as directed by the NRC Departmental Representative.

.1 Attendees at pre-installation meetings shall include the following:
.1 Contractor.
.2 Subcontractors affected by the work for which the pre-installation meeting is being conducted.
.3 NRC Departmental Representative.
.4 Manufacturer's representatives, as applicable.
.5 Inspection and testing company, as applicable.

.2 Agenda to include the following:
.1 Owner's guidelines and policies.
.2 Appointment of official representatives of participants in the project.
.3 Review of completed work
.4 Review of testing procedures and requirements.
.5 Schedule of the applicable portions of the work.
.6 Special safety requirements and procedures.

.6 Special Meetings

NRC Departmental Representative reserve the right to require special meetings which may be held on short notice and at which attendance by Contractor and representatives of affected subcontractors and suppliers is mandatory. Contractor shall keep detailed and accurate meeting notes and distribute copies promptly to all in attendance and those affected by agreements made at such meetings.

5. PROJECT SUBMITTALS

Submit submittals as requested by the contract documents, as specified herein, and in accordance with the conditions of the Contract

5.1 NRC Departmental Representative's review of submittals:

.1 Review of submittals by NRC Departmental Representative is for the sole purpose of ascertaining conformance with the general design concepts and the general intent of the contract documents. This review shall not mean that NRC Departmental Representative approves the detail design inherent in the submittals, responsibility for which shall remain with the Contractor. Such review shall not relieve the Contractor of responsibility for errors or omissions in the submittals, or responsibility for meeting requirements of contract documents and federal and provincial standards and regulations.

.2 Contractor shall be responsible for dimensions to be confirmed and correlated at the site for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work.

.3 NRC Departmental Representative's review and markings on submittals do not authorize changes in the work or the contract time, and will be accommodated at no additional cost to NRC. If, in the opinion of the Contractor, the NRC Departmental Representative's markings on submittals constitute a change in the work or will effect a change in the contract time, then the Contractor shall so notify the NRC Departmental Representative in writing and request an interpretation. If the NRC Departmental Representative finds that the NRC Departmental Representative's markings on submittals do constitute a change in the work or will effect a change in the contract time, then a change order will be prepared therefore. The time taken to process such a request for interpretation shall not, in and of itself, constitute a change in the work nor increase the contract time.

.4 Prepare submittals using SI (metric) units.

5.2 Engineered submittals:

.1 It is the contractor responsibility to identify any items, within this project scope, that required engineering sealed drawings/calculations to comply with municipal and federal codes and regulations.

.2 If any items are identified to be designed and stamped by a professional engineer the following should be observed

.1 Submittals for items required to be sealed by professional engineer (engineered) shall be duly prepared, sealed, and signed under the direct control and supervision of a qualified professional engineer licensed in the jurisdiction in which the site is located, having in force, and professional liability insurance with minimum coverage limit of $1,000,000 per claim and annual aggregate.

.2 Include with engineered submittal, proof of insurance identifying insurer, policy number, policy term, and limit of liability, on duly signed letterhead and / or certificates of insurance.

.3 Engineered submittals shall include design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal.

5.3 Submission procedures

.1 Submittals included all relevant information and/or documentation that need to be review by NRC and its consultants such as, but not limited to: drawings, cut-sheets, and testing procedures.

.2 Submittals are to be sent electronically, via email, to NRC project authority.

.3 Submittals shall be sequentially numbered, number format to be specified by contractor.

.4 Files are to be submitted in PDF format, unless specified by NRC project authority.

.5 Accompany submittals with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each submittal.

.5 Other pertinent data.

.6 Make provisions in schedule for at least two (2) working days for NRC Departmental Representative's review of submittals. When submittals have to be reviewed by one or more of

NRC Departmental Representative's consultants, add 3 more working days for a total five (5) working day review period.

.7 If the NRC Departmental Representative requires resubmission of submittals, allow for an additional two (2) working days review for each resubmission.

.8 If, at any time, the Contractor submits a large enough number of submittals such that the NRC Departmental Representative cannot process these submittals within two (2) working days, the NRC Departmental Representative, in consultation with the Contractor within 24 hours of receipt of such submittal, will provide the Contractor with an estimate of the time necessary for processing same. The Contractor shall accommodate such necessary time at no increase in the contract time and at no additional cost to NRC.

5.4 Shop drawings and cut-sheet submittals

.1 Submit shop drawings as follows:

- .1 One (1) copy digitally in pdf format to NRC Departmental Representative using the NRC Departmental Representative's document management system.
- .2 NRC to provide drawing files templates for design and as built drawings submission.

.2 NRC Departmental Representative markings and resulting action required:

- .3 Shop drawings requiring no changes will be marked 'REVIEWED', and shall be submitted for as-built drawings purposes.
- .4 Shop drawings requiring several changes will be marked 'REVIEWED as NOTED' and shall be revised and submitted for as-built drawings purposes.
- .5 Shop drawings requiring substantial changes will be marked 'REVISE AND RESUBMIT' and shall be revised and resubmitted until NRC Departmental Representative stamps drawings with 'REVIEWED' or 'REVIEWED as NOTED'.

.3 Shop drawing size shall be multiple of 213 mm and 275 mm excluding 38 mm binding margin and not larger than 838 mm x 1117 mm. Leave minimum 150 mm x100 mm clear space for NRC Departmental Representative's comments.

.4 Upon completion of review by NRC Departmental Representative, 1 marked set of shop drawings will be returned to Contractor in digital format for reproduction and distribution.

.5 Submit copies of reviewed shop drawings to authorities having jurisdiction as required.

.6 Shop drawings shall include:

- .1 Fabrication and erection dimensions.
- .2 Design calculations prepared by professional engineer, as required.
- .3 Location and type of anchors, attachments and locations and types of fasteners, including concealed reinforcements to accept mounted fasteners. Assumed design loadings, dimensions of elements and material specifications for load-bearing components.
- .4 Adhesives, joinery methods and bonding agents.
- .5 Kinds, grades and dimensions of components and materials, their characteristics relative to their purpose, detailed description of finishes and other fabrication information.
- .6 A detailed bill of material identifying all components used and their part numbers.
    i. Where third party items have been used, identify manufacturer part number as well as contractor part number.
- .7 Configurations, types and sizes required; identify each unit type on drawing and on product.
- .8 Descriptive names of equipment and mechanical and electrical characteristics when applicable.

5.5 Certificates and Certification Submittals

Certificates and certifications submittals: When applicable, provide a statement that includes signature of entity responsible for preparing certification.

6. APPROVED ALTERNATES AND APPROVED EQUALS

The following shall be observed when proposing an alternative or approved equals

.1 Submit a list of all identified equals or alternates being suggested in the submitted document(s).
.2 When document is submitted for review, proposed substitutions should be named products alternates or equals, indicated by the phrases "or approved alternate by XYZ Manufacturing" or "or approved equal by XYZ Manufacturing".
.3 When items are “approved alternate by XYZ Manufacturing" or "or approved equal by XYZ Manufacturing it shall be interpreted to mean that named product alternate or equal, if selected for use in lieu of indicated or specified product, meets or exceeds performance, appearance, general arrangement, dimensions, availability, code and standards compliance, and colour of specified product.
.4 Contractor to be responsible for costs and modifications associated with the inclusion of named product alternate or equal at no additional cost to NRC.

6.1 Submission of substitutions: approved alternate or approved equal

Proposals for substitutions of products and materials must be submitted in accordance with procedures specified in this section.

NRC Departmental Representative may review submissions with the understanding that the contract time will not be altered due to the time required by the NRC Departmental Representative to review the submission and by the Contractor to implement the substitution in the work.

.1 Submission requirements:
    .1 Description of proposed substitution, including detailed comparative specification of proposed substitution with the specified product.
    .2 Manufacturer’s product data sheets for proposed products.
    .3 Confirm compliance with the building codes and requirements of authorities having jurisdiction.
    .4 Effect on contract time.
    .5 Reasons for the request.
    .6 Substitutions submitted on shop drawings without following requirements of this section
    .7 Proposed substitutions shall include costs associated with modifications necessary to other adjacent and connecting portions of the work, if applicable.
    .8 NRC Departmental Representative’s decision concerning acceptance or rejection of proposed substitutions is final.

7. Quality control

.1 Before starting any installation procedures, contractors are required to schedule a site pre-installation meeting to review details related to site work.

.2 Inspection and testing services will be used to verify compliance with requirements of the contract documents. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

.3 Before starting any testing procedures, contractors are required to schedule a pre-testing meeting to review details related of the work to be completed

.4 Inspection and testing required by codes or ordinances, or by an authority having jurisdiction, and made by a legally constituted authority, shall be the responsibility of the Contractor and shall be paid for by the Contractor and not be paid by NRC, unless otherwise specified in the contract documents.

.5 Inspection or testing performed exclusively for Contractor's convenience shall be sole responsibility of Contractor, and will not be paid by NRC.

.6 Final Inspection and testing, if required by NRC, shall be performed by a company qualified to perform the inspections or site tests specified or required.

.1 NRC will be responsible for the third party testing company to accompany the test.

.7 Where evidence exists that defective workmanship may have occurred, or that the work may have been carried out incorporating defective materials, or tests demonstrate that installed conditions do not comply with the requirements of the contract documents, the NRC Departmental Representative reserves the right to have appropriate inspections, tests, and surveys performed, analytical calculation of structural strength made and the like in order to help determine the extent of defect and whether such work must be replaced. Inspections, tests, and surveys carried out under these circumstances will be made at the Contractor's expense, and will not be paid by NRC, unless the results indicate that the work so tested, inspected or surveyed is not defective or that, in NRC Departmental Representative's opinion, the work so tested, inspected, or surveyed may be accepted, in which case tests, inspections or surveys will be paid by NRC.

7.1 Reports and documents

.1 Inspection and testing company shall submit site inspection reports within five (5) working days of each inspection.

.2 Inspection and testing companies shall submit a written report for each inspection or test, including pertinent data such as conditions at the site, dates, test references, locations of tested materials, actual product identification, testing methodology, procedures, and descriptions, site instructions given, recommendations and/or any other information required by standard applicable to reporting of tests and inspections.

.3 Report shall clearly indicate failure of product or procedures to meet applicable standards, give recommendations for retesting or correction. Inspector shall contact Contractor and NRC Departmental Representative immediately when product or product assembly fails to meet requirements of the contract documents.

.4 Upon completion of portions of the work subject to independent inspection and testing, submit to the NRC Departmental Representative duplicate certificates of acceptance of

.5 Contractor is responsible to receive and distribute the final testing reports as part of the project final quality control point.

7.2 Hydraulic Oil Cleanliness Verification

.1 Hydraulic oil cleanliness is critical to the safe operation of this equipment. Ensure that proper actions are taken to ensure clean oil, piping, and keep proper documentation of results.

.2 The aim of flushing is to remove contamination from the inside of pipes and components, which are introduced during system assembly or maintenance. This is accomplished by passing fluid through the system, usually at a velocity higher than that during normal operation.

.1 It is the responsibility of the contractor to provide all necessary equipment needed to complete the oil cleanliness procedure.

.3 Omission or curtailment of flushing will inevitably lead to rapid wear of components, malfunction and breakdown.

.4 The following steps pertain to the supplied piping – the essence is that we have clean piping. Is is the contractor responsibility to send a final flushing procedure, based on the list below, for NRC approval.

.5 Contractor is responsible to all cost related to the flushing set-up.

.1 Connect the fluid transfer pump to the return line low point ball valve and the nearest available HPU drain port

.2 Pump the fluid from the return hardline to the HPU reservoir

.3 Connect the fluid transfer pump to the drain line low point ball valve and the nearest available HPU drain port

.4 Pump the fluid from the drain hardline to the HPU reservoir

.5 Check for adherence to drawings and ECN's.

.6 Inspect basic assembly.

ii. free flow direction of check valves.

iii. critical bolt lengths and torque.

iv. check for missing plugs, caps, and proper torque.

.7 Connect pressure, return and drain hoses to flush/proof assemblies.

NOTE: all ball valves, should remain open during flushing unless noted.

.8 Prefill pressure, return and drain circuit:

NOTE: maximum drain proof pressure is 300 psi, do not over pressurize.

i. Start an HPU and adjust pressure to 300 psi setting.

ii. Run pump to fill hardline and hose assemblies with oil.

iii. Monitor fluid level in HPU reservoirs.

.9 Turn on the HPU's and flush the hardline until a cleanliness level of ISO 4406(c) 16/13/9 at the HPU is achieved.

.10 Close the pressure ball valves at the HSM's and adjust HPU pressure settings to operational pressures per system schematic.

.11 Shut HPU down and relieve pressure.

.12 Connect the fluid transfer pump to the pressure line low point ball valve and the nearest available HPU drain port

.13 Open the drain down breather ball valve along with all other hardline flushing ball valves

.14 Pump the fluid from the pressure hardline to the HPU reservoir

.15 Connect the fluid transfer pump to the return line low point ball valve and the nearest available HPU drain port

.16 Pump the fluid from the return hardline to the HPU reservoir

.17 Connect the fluid transfer pump to the drain line low point ball valve and the nearest available HPU drain port
.18 Pump the fluid from the drain hardline to the HPU reservoir
.19 Disconnect pressure, return and drain hoses from flush/proof assemblies and seal open ports and hoses.

.6 Components that can be damaged by high fluid velocity or by fluids containing moisture, particles or flushing chemicals should be isolated from the flushing circuit and cleaned individually.

.7 Manifolds, blocks, pump stations, motors, reservoirs, assemblies and components should be delivered clean according to a specific procedure. If not clean, they must be flushed separately.

7.3 Hardline quality testing procedure

The following steps pertain to the supplied piping. It is the contractor responsibility to send a final testing procedure, based on the list below, for NRC approval prior to commence the test.

.1 Contractor is responsible to all cost related to the testing set-up.
- .1 Install hardline, HSM connection hoses and connect single HPU.
  - i. It is the responsibility of the contractor to provide all necessary equipment, including the HPU, needed to complete the pressure testing.
- .2 Check for adherence to drawings and ECN's.
- .3 Inspect basic assembly.
  - i. Free flow direction of check valves.
  - ii. Critical bolt lengths and torque.
  - iii. Check for missing plugs, caps, and proper torque.
- .4 Connect pressure, return and drain hoses to flush/proof assemblies.

NOTE
- i. a) all ball valves should remain open during the proof test unless noted.
- ii. b) drain pressure accumulator pre-charge from HPU assembly being used for test.
- iii. c) install pressure gauge on HPU pressure output

NOTE: if a leak is detected at any time the test must be stopped. All residual pressure must be depleted and the system must be drained to the appropriate level to facilitate repairs. The leak must be repaired with the appropriate approved materials and procedures as necessary. The system should be prefilled again, slowly pressurized to one half of the leak occurrence pressure and held for five minutes. Then pressure should be increased to the leak occurrence pressure and the test resumed and completed.

- .5 prefill pressure, return and drain circuit:

NOTE:
- i. Adjust compensator pressure and pressure relief valve to lowest setting, start supply HPU.
- ii. Run pump to fill hardline and hose assemblies with oil.
- iii. Monitor fluid level in HPU reservoirs.

- .6 Proof pressure check for drain circuit:

NOTE: maximum drain proof pressure is 300 psi +50, do not over pressurize.

i. Block d & r at supply HPU. adjust (1) pump volume to lowest setting, use (1) motor/pump for H.S. test.
ii. Start supply HPU and adjust pressure to 100 psi. connect p & r at (1) outlet station.
iii. Increase pressure at 100 psi increments while observing for leaks.
iv. Hold pressure at 300 psi for 5 minutes.
v. Shut HPU down and relieve pressure.
vi. Validate test.

.7 Proof pressure check for return circuit:

NOTE: maximum return proof pressure is 1090 psi +100, do not over pressurize.

i. Connect p & r at (1) outlet station. block r at supply HPU.
ii. Start supply HPU and adjust pressure to 500 psi.
iii. Increase pressure at 500 psi increments while observing for leaks.
iv. Hold pressure at 1090 psi for 5 minutes.
v. Shut HPU down and relieve pressure.
vi. Validate test.

.8 Proof pressure check for pressure circuit.

NOTE: Maximum proof pressure is 4500 psi +200, do not over pressurize.

vii. Block p at all outlet stations
viii. Start supply HPU and adjust pressure to 500 psi.
ix. Increase pressure at 500 psi increments from 500 psi to 4500 psi while observing for leaks.
x. Hold pressure at 4500 psi for 5 minutes.
xi. Shut HPU down and relieve pressure.
xii. Adjust pump volume and pressure controls to standard setting.
xiii. Validate test.

7.4 Hydraulic power unit testing

.1 After installation is completed, NRC along with MTS, will perform a system functionality testing with the hydraulic power units.
.2 Hydraulic power unit testing is responsibility of MTS technical team
.3 The contractor is expected to have a technician on site to support the team during testing. Technician is expected to resolve minor technical issues, related to the hydraulic line installed under this scope, in order to ensure the testing can proceed
  .1 Any minor technical issues originating for installation workmanship from the contractor work shall be fully covered under the contractor warranty
  .2 Any minor technical issues originating from incorrect operation, incorrect parameters and/or instructions not related to the contractor's installation workmanship shall not be covered by the contractor.

.3 Major technical issues will be discussed by the parties involved and a plan will be developed with all parts in agreement on how to correct the issue.

8. Site conditions and work requirements

.1 Prior to start site work, contractor is responsible to obtain security clearance to their team. Time to obtain security clearances shall be clear identified in the project schedule.

.2 Contractor is responsible to set-up all temporary facilities needed for the work to be completed on site. The location of temporary facilities at site is to be discussed and approved by NRC team.

.1 A source of temporary power will be made available from building U89B. U89B has available 600V, 3 phase circuit, 1000 Amps. Contractor to bear all costs to make connections to the power source and perform distribution on site.

.2 Contractor to provide all load centres, breakers, conduit, wiring, disconnects, extension cords, transformers, as required from the source of power.

.3 Contractor to provide their own source of power if available source does not meet their equipment requirements.

.3 Contractor is expected to have all materials available and ready for installation prior to start as part of the mobilization scope. Storage location for any material needed for this project to be discussed and approved by NRC team.

.1 Contractor is expected to be able to replace any material damage during installation in 48hrs during installation to avoid delays.

.4 Contractor is responsible to visit the site prior to installation and review with NRC the minimum work area required.

.1 It is recommended that the contractor verifies the work interference during site visit and properly identify all major interferences prior to response to this SOW.

.2 Interferences shall be listed in the response to this SOW.

.3 If existing interferences have not been listed in the interference list, the contractor will be responsible to work with NRC to resolve them, without impacting the installation schedule.

.4 NRC is responsible to clean up installation area, to the extent possible, to allow contractor to perform the work in the proposed time frame.

.5 Any shutdowns shall be properly coordinate with NRC Departmental Representative and the ASPM authority on site. Contractor to provide 48hrs notice.

.6 Contractor is responsible to submit a Health and Safety plan to work in the area, which will be reviewed and approved by NRC.

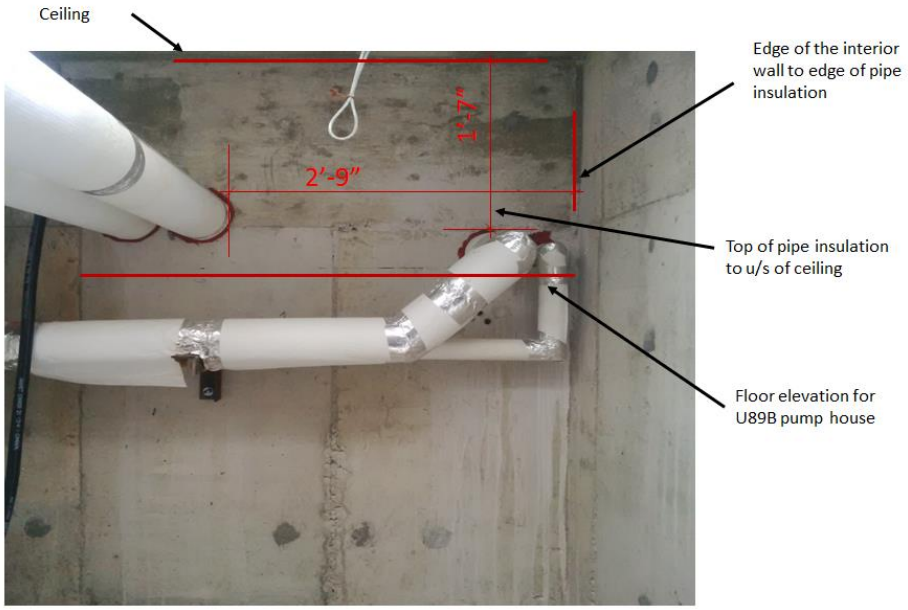
.7 The access between building U-89 and U-89B is currently blocked by a concrete wall; contractor is expected to drill the necessary holes for the new hydraulic installation. Contractor to remove weather proofing membrane, and concrete caps to access the duct bank between the buildings. Once the piping is installed, contractor to re-install concrete caps, weather proofing membrane and brown finishing cap to match existing. Section B shows some images of the area where the drilling shall take place. Contractor is responsible to visit the site and make all measurements necessary to evaluate the costing.

*** END OF SECTION ***

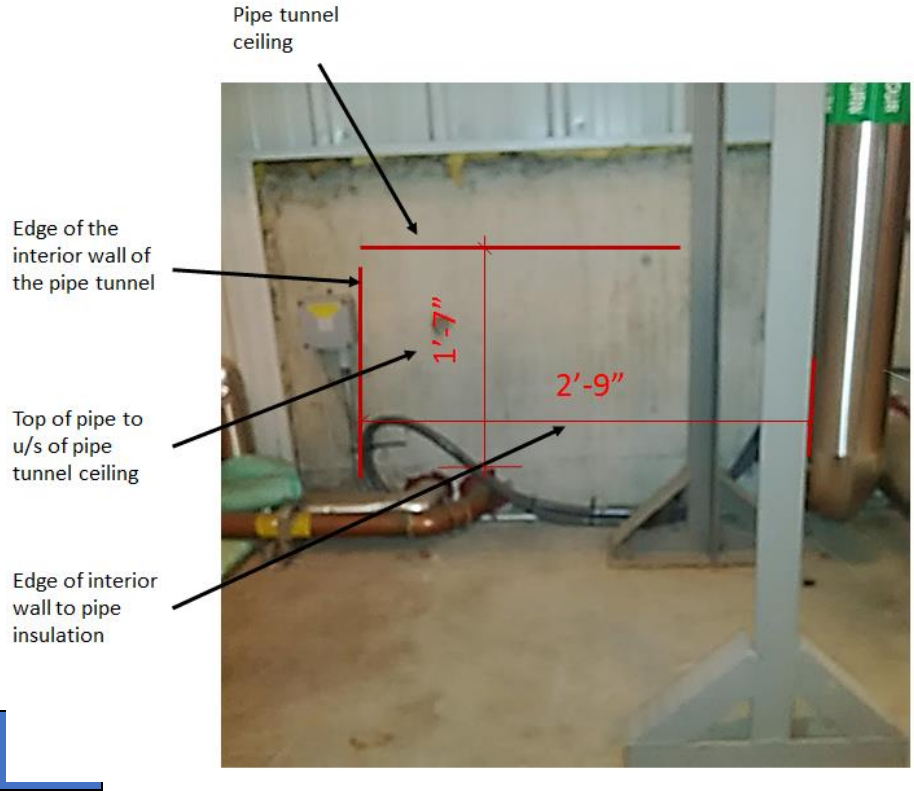
Section B: Site conditions Division between building U-89 and U-89B

The intent of this section is to give contractors a base understanding and a general overview of the work need to be completed between building U-89 and U-89B. It is the contractor responsibility to perform all measurements on site for costing purposes.

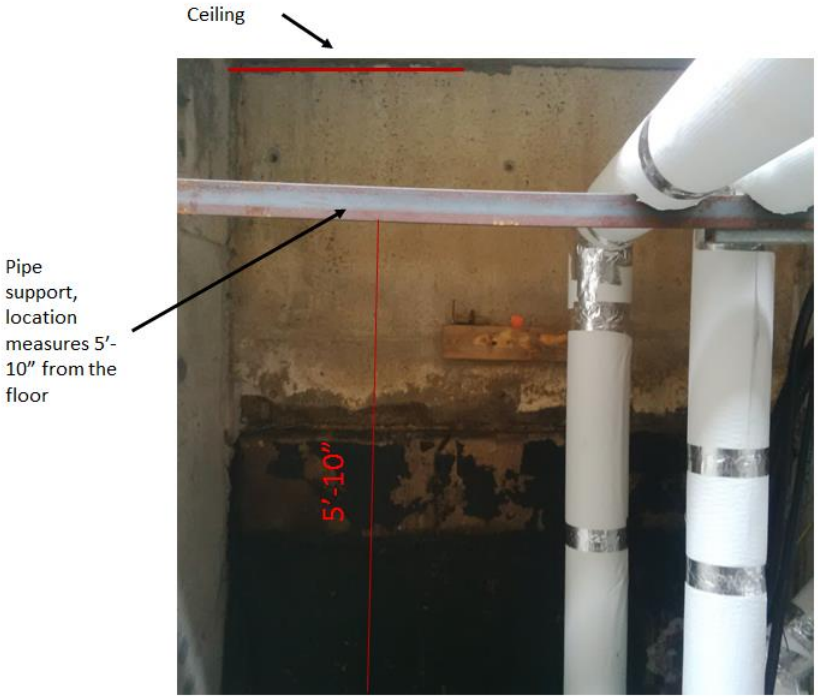
South Wall of Pipe Tunnel @ U-89B Pump House



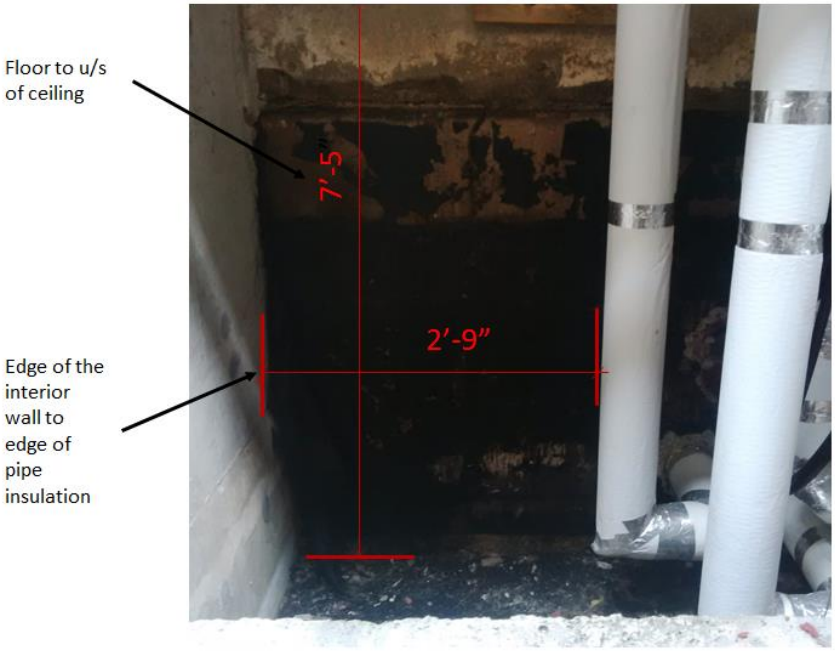
North Wall U-89B Pump House



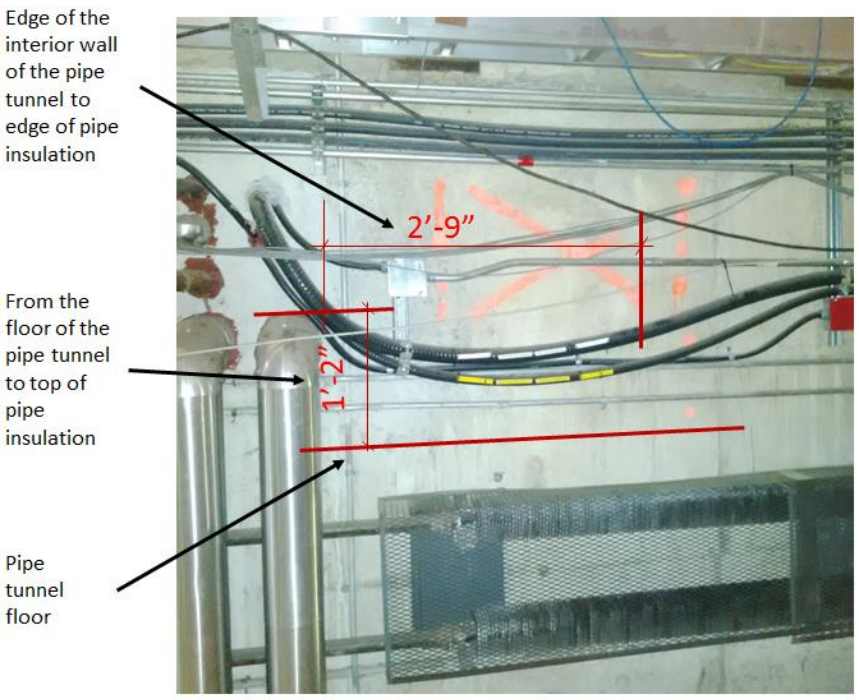
North Wall of Pipe Tunnel @ U-89



North Wall of Pipe Tunnel @ U-89



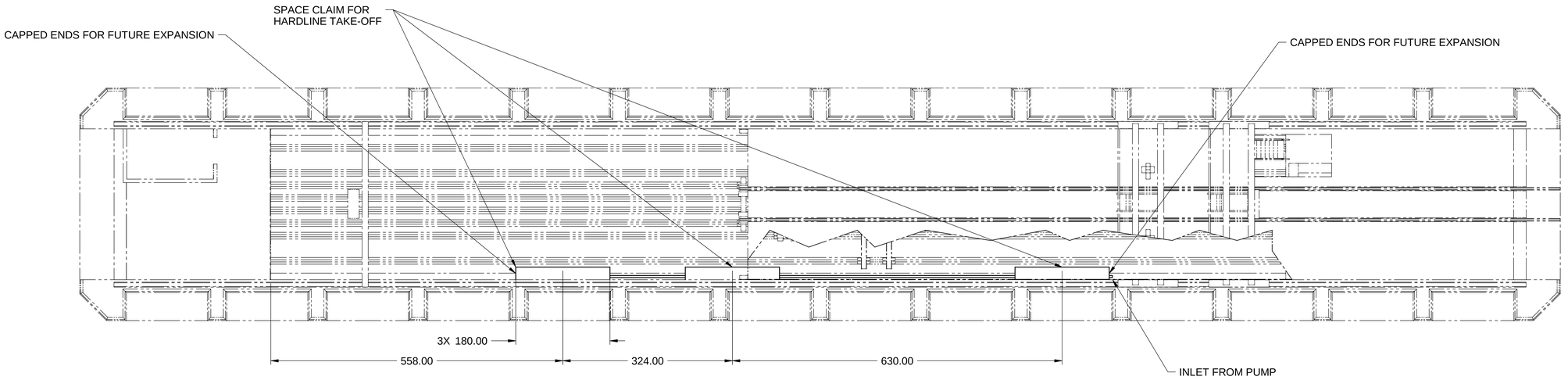
South Wall of U-89



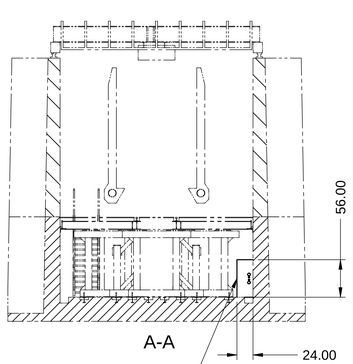
*** END OF SECTION ***

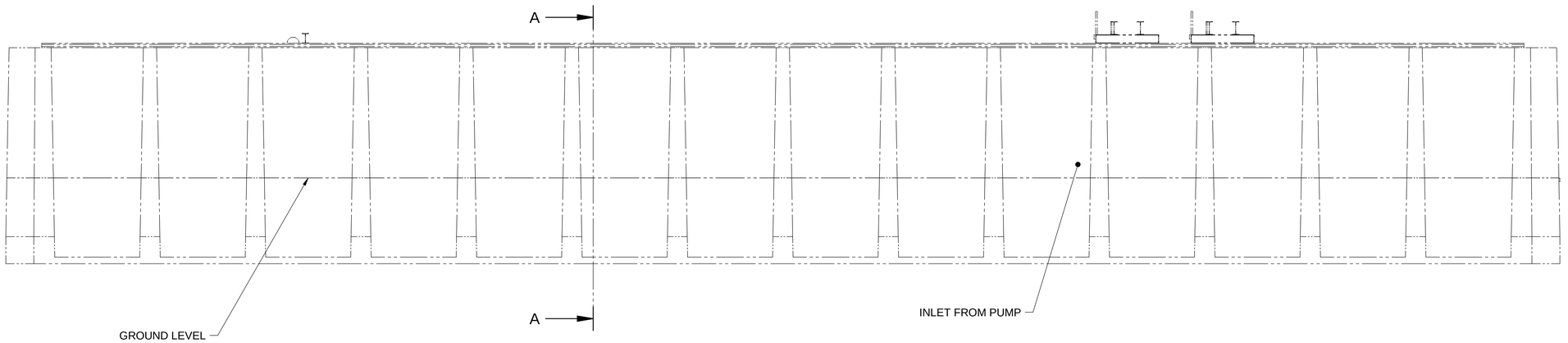
Section C: NRC Facility overview

-NO / QTY/QTE	ITEM NO DE L'ART	IDENTIFYING NO D'IDENTIFICATION	NOMENCLATURE/DESCRIPTION	SPECIFICATION	CODE IDENT CODE D'IDENT
-1					



DYNAMICS BAY TOP VIEW





DYNAMICS BAY SIDE VIEW

UNLESS OTHERWISE SPECIFIED/SAUF INDICATION CONTRAIRE:

1. DIMENSIONS ARE IN/DIMENSIONS SONT EN INCHES
2. TOLERANCE/TOLÉRANCES
   FRACTIONS ± ------
   DECIMALS XXX ± ------
   DÉCIMALES XX ± ------
   X ± ------
   ANGLES ± ------
3. SURFACE FINISH / FINIS DE SURFACES

INTERPRETATION/INTERPRÉTER CSA-B78.1-M83 AND CSA-B78.2-M91

APPLICATION/USAGE: ------

SCALE/ÉCHELLE: NTS

ZONE	LTR LET	REVISION	DATE	DWN DES	CKD VER	APPVL APP
-	-	FIRST RELEASE	17-11-30	P.K.	D.F.	D.F.

National Research Council Canada / Conseil national de recherches Canada
Surface Transportation / Transports de surface
Canada

DWN/DESS	CKD/VER	APPVL/APP	APPVL DATE D'APPROB	
P. KEHOE	D. FRIBERG	D. FRIBERG	17-11-30	A0

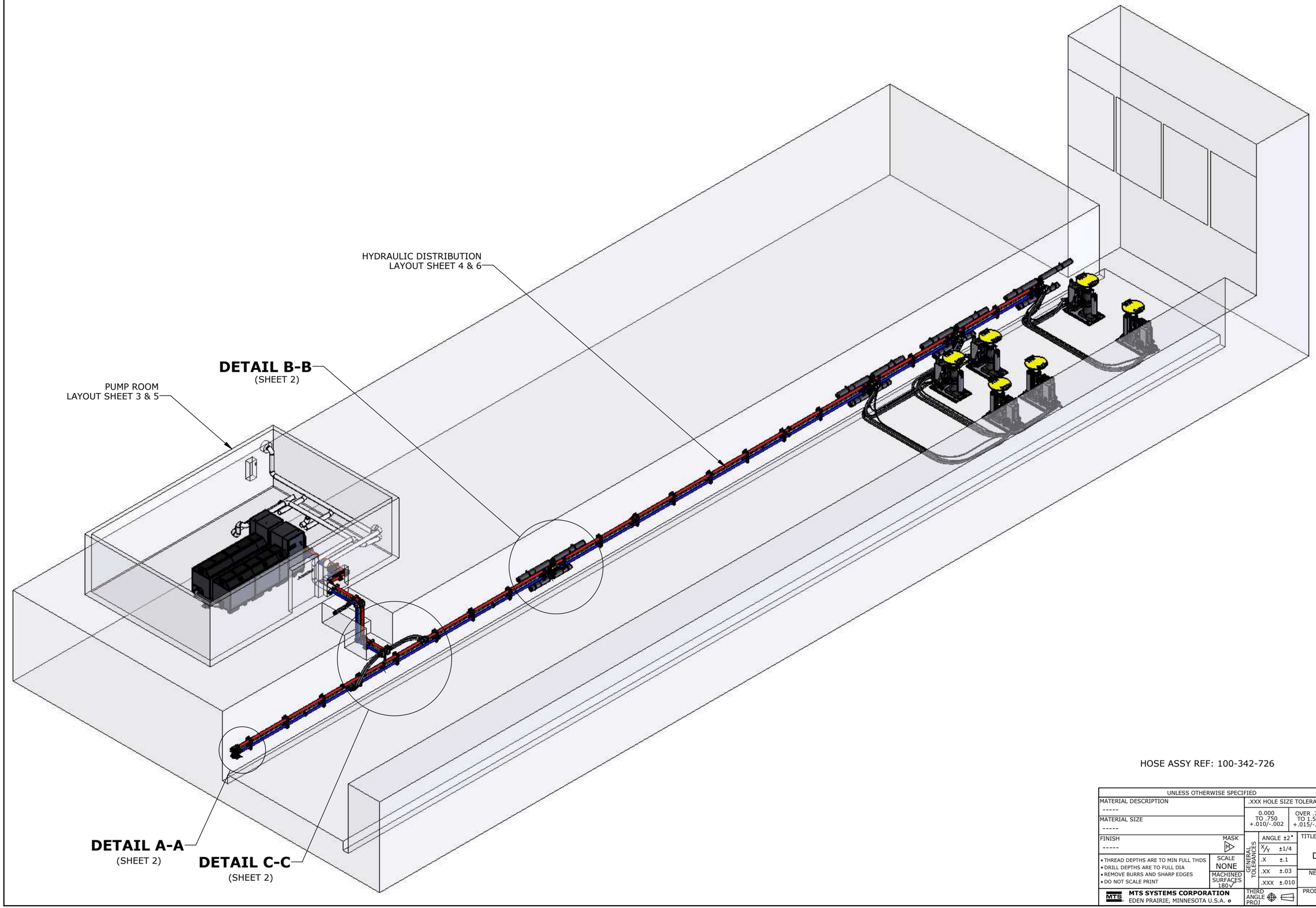
TITLE/TITRE: HYDRAULIC SYSTEM UPGRADE, DYNAMICS BAY

DRAWING NO DU DESSIN: 546332 | NSCM/CAOF: 3AT80

SHEET/FEUILLE 1 OF/DE 1

*** END OF SECTION ***

Section D: MTC Corporate Services, Hydraulic line drawings



HOSE ASSY REF: 100-342-726

REVISIONS

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DRAWN ENGR DATE		

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SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

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MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

	DRAWN	CHECK	ENGR	MFG
	RAP	-	JPG	-
DATE	9-23-16	-	9-23-16	-

TITLE: HYDRAULIC DISTRIBUTION ASSY-55867

NEXT LEVEL: -----

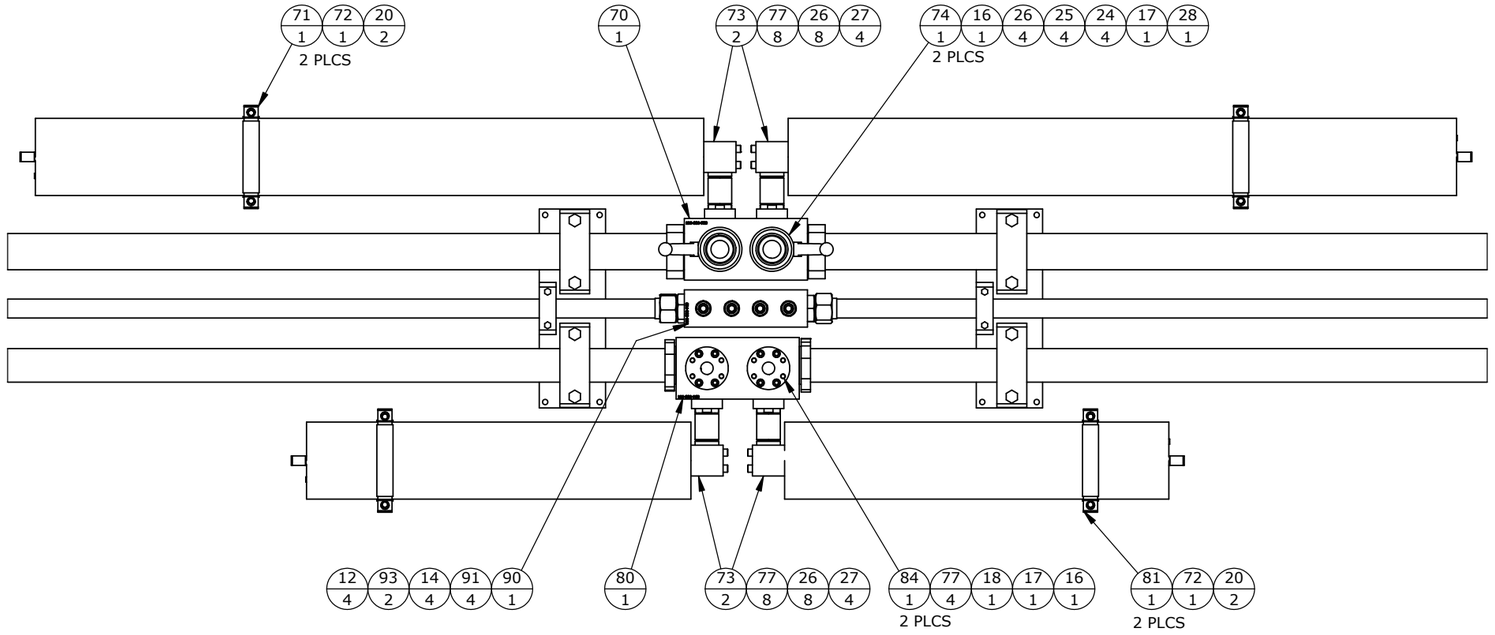
SIZE: D

NUMBER: 100-342-836 REV: A

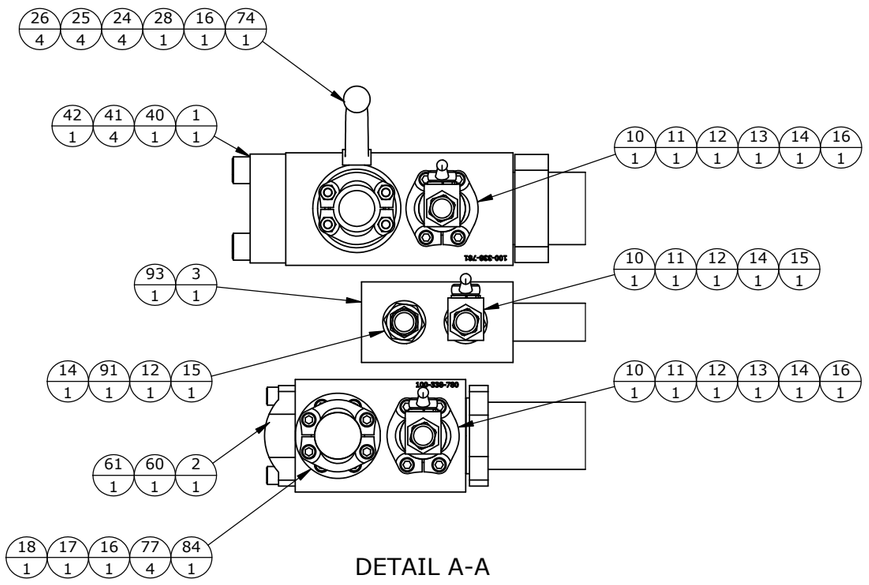
SHEET 1 OF 9

PRODUCT CODE: -----

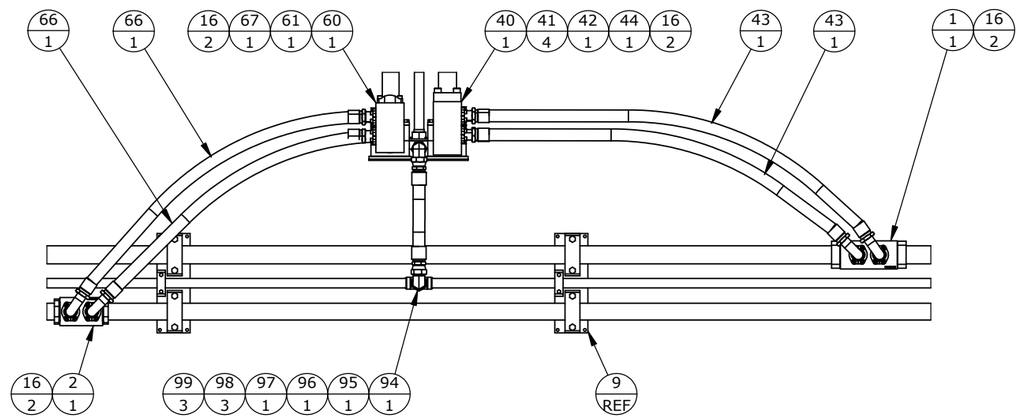
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.



DETAIL B-B
4 PLACES



DETAIL A-A



DETAIL C-C

REVISIONS					
DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

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SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

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MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180V

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE
HYDRAULIC
DISTRIBUTION ASSY-55867

NEXT LEVEL: -----

PRODUCT CODE: -----

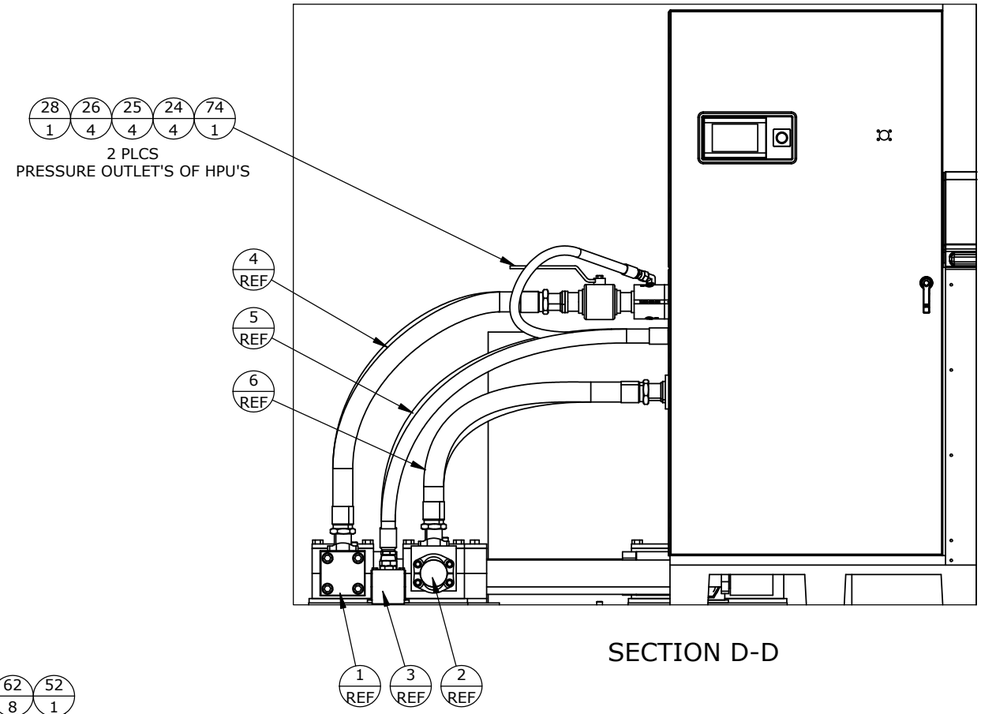
SIZE: D

NUMBER: 100-342-836

REV: A

SHEET 2 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.



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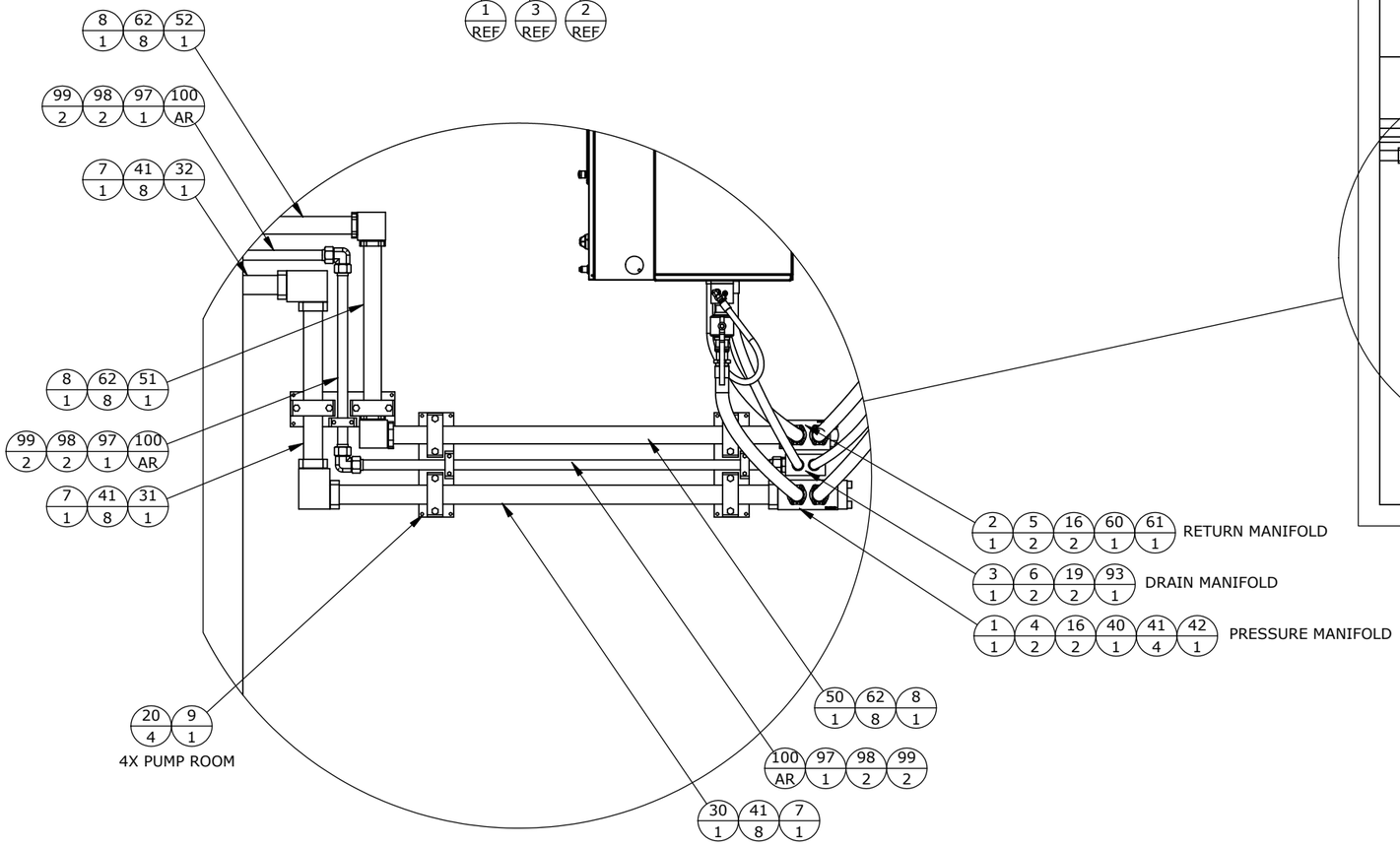

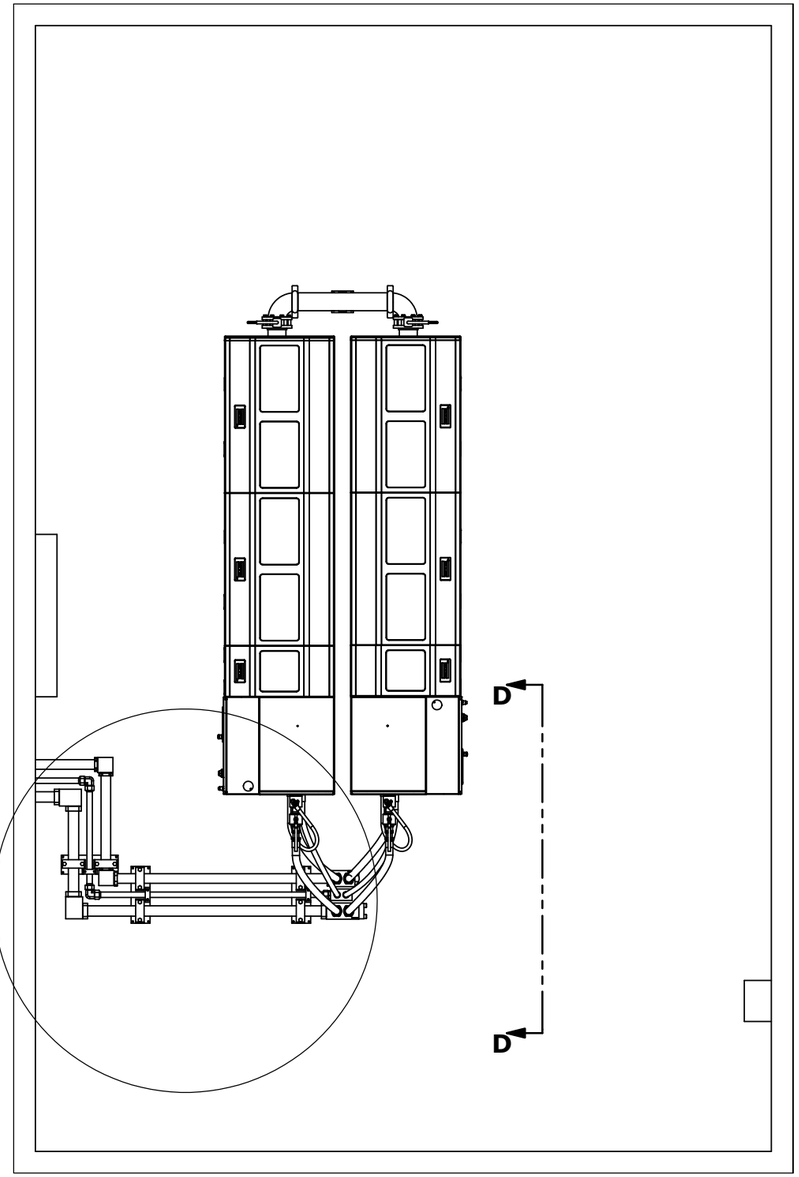

PUMP ROOM (GLYCOL PIPES HIDDEN FOR CLARITY)

REVISIONS

DESCRIPTION			LETTER	ECN NO
DRAWN	ENGR	DATE		

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SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

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MATERIAL SIZE: -----

FINISH: ----- MASK

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- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

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NEXT LEVEL: -----

SIZE: D

NUMBER: 100-342-836

REV: A

PRODUCT CODE: -----

SHEET 3 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

REVISIONS					
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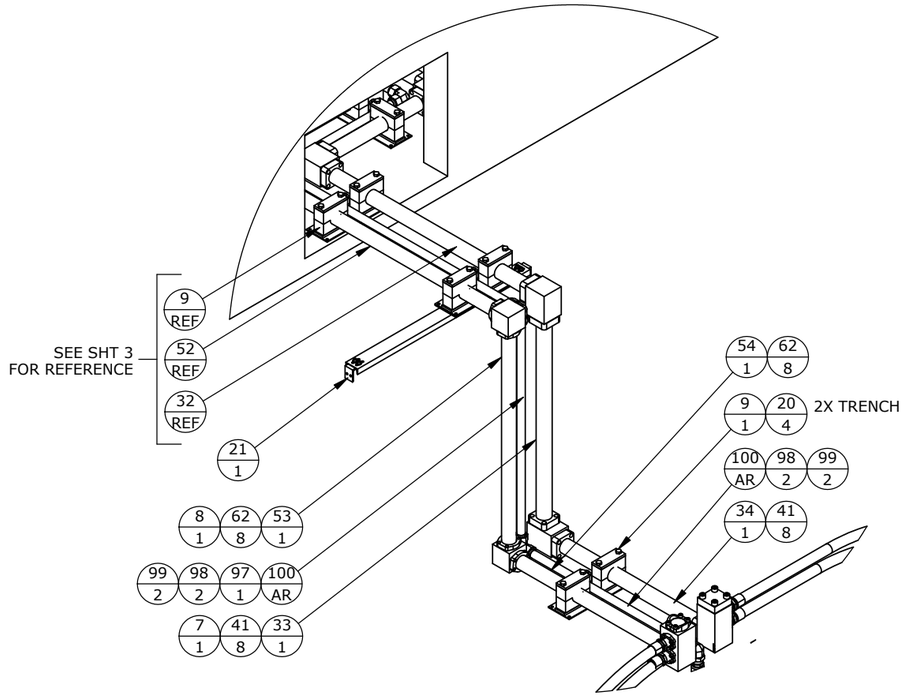

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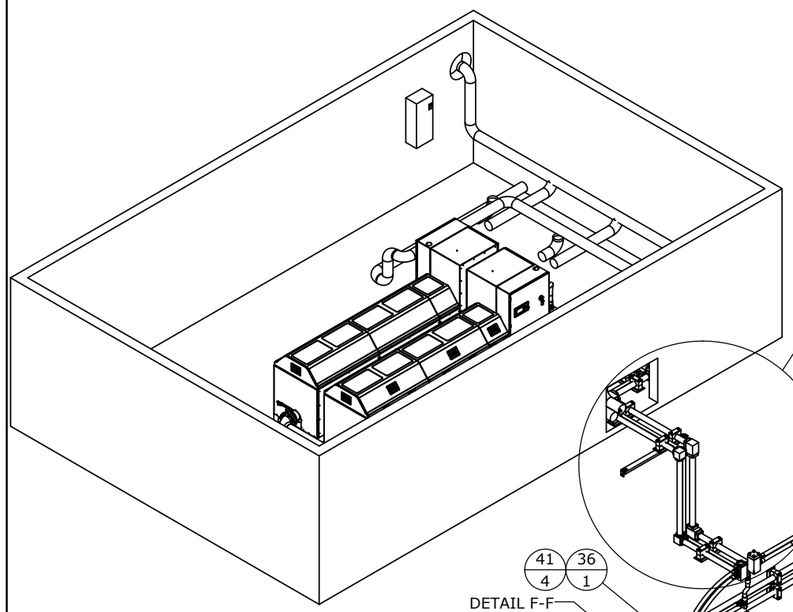
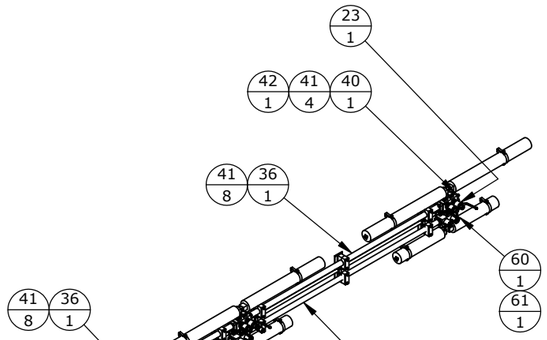
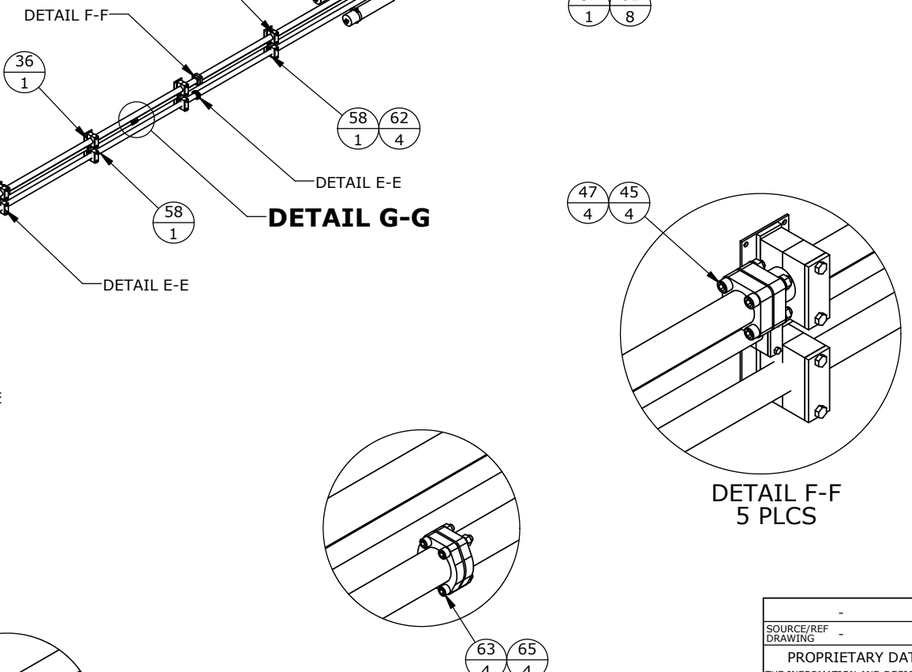


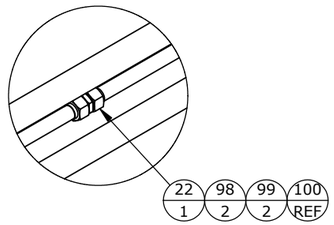




DETAIL G-G

DETAIL F-F
5 PLCS

DETAIL E-E
5 PLCS



DETAIL G-G
6 PLCS

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SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE

HYDRAULIC DISTRIBUTION ASSY-55867

NEXT LEVEL -----

PRODUCT CODE -----

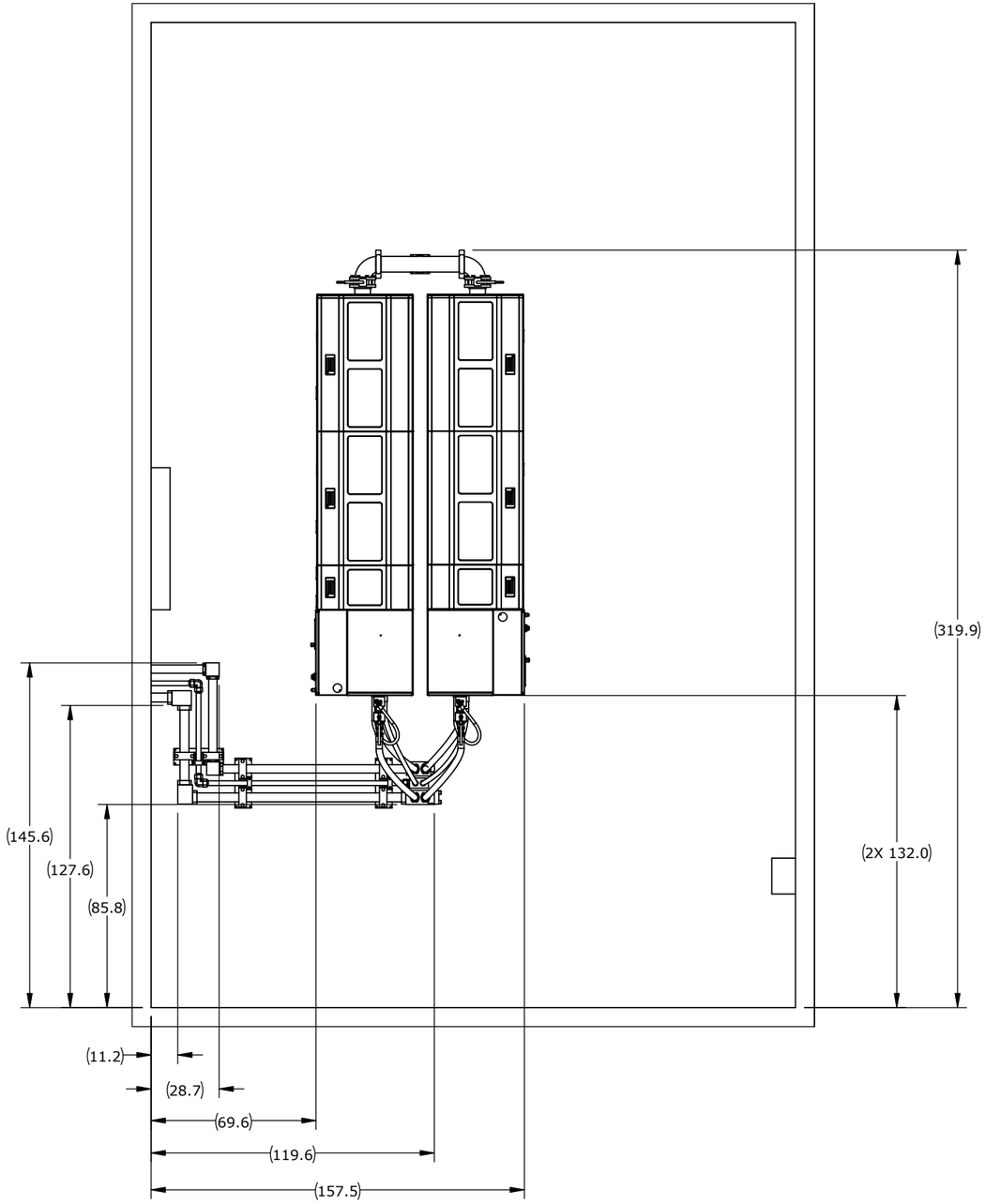
SIZE D

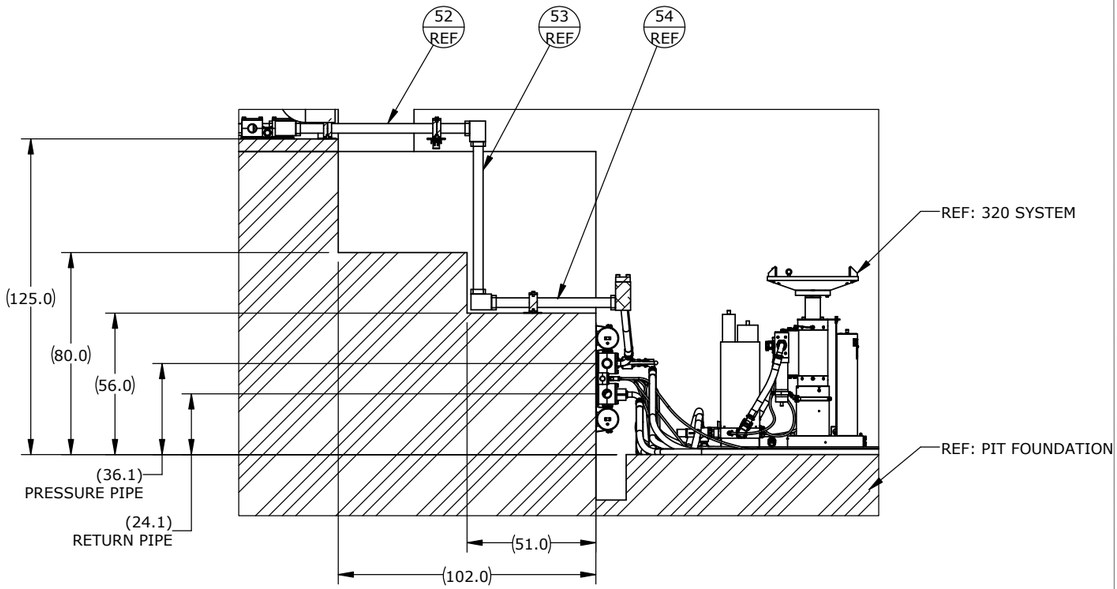
NUMBER 100-342-836

REV A

SHEET 4 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.





REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

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SOURCE/REF DRAWING -

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MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

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- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE

HYDRAULIC DISTRIBUTION ASSY-55867

NEXT LEVEL -----

PRODUCT CODE -----

SIZE D

NUMBER 100-342-836 REV A

SHEET 5 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

REVISIONS					
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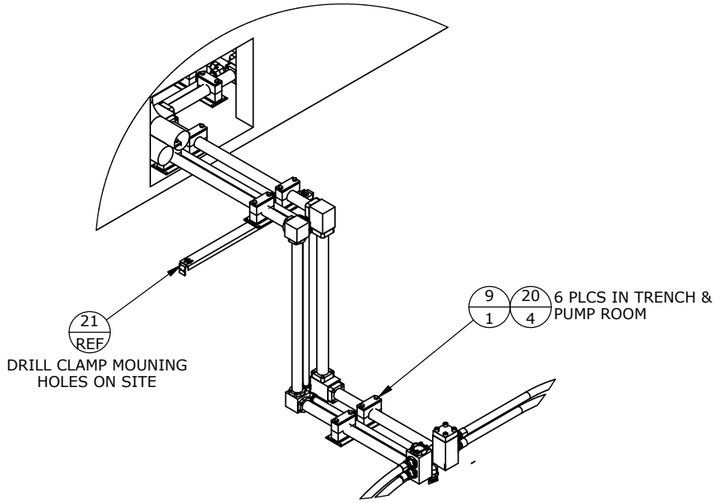
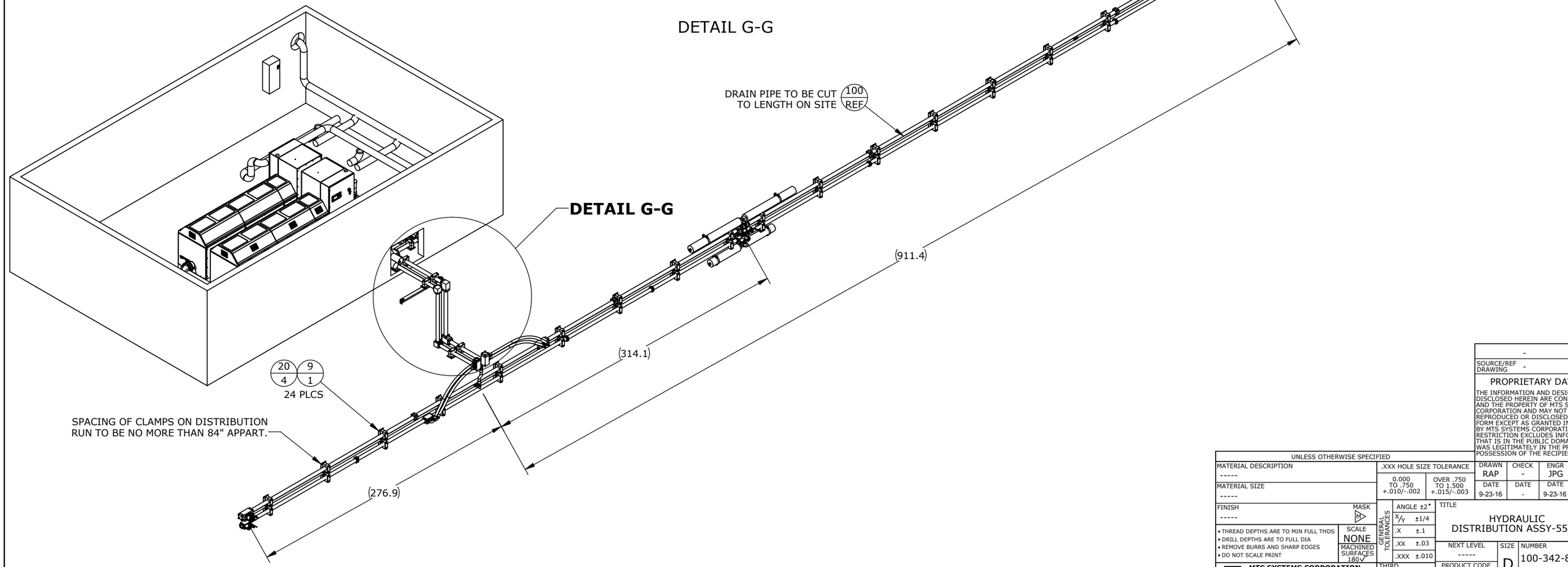
DRAWN	ENGR	DATE			



DETAIL G-G



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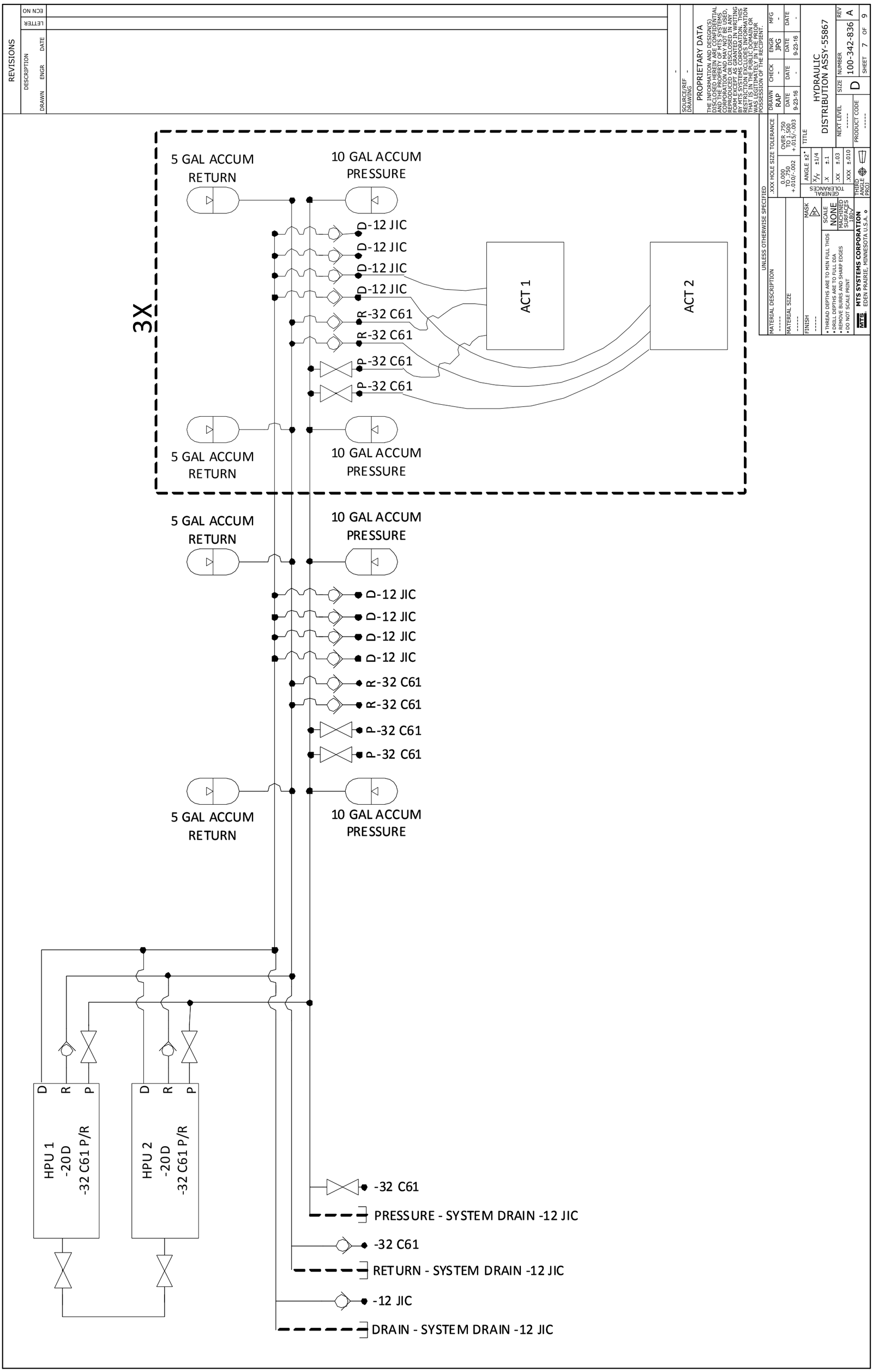
SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION	.XXX HOLE SIZE TOLERANCE		DRAWN	CHECK	ENGR	MFG
-----	0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003	RAP	-	JPG	-
MATERIAL SIZE -----			DATE 9-23-16	DATE -	DATE 9-23-16	DATE -
FINISH ----- MASK	GENERAL TOLERANCES	ANGLE ±2°	TITLE			
		X/y ±1/4	HYDRAULIC DISTRIBUTION ASSY-55867			
• THREAD DEPTHS ARE TO MIN FULL THDS • DRILL DEPTHS ARE TO FULL DIA • REMOVE BURRS AND SHARP EDGES • DO NOT SCALE PRINT	SCALE NONE	.X ±.1	NEXT LEVEL -----	SIZE D	NUMBER 100-342-836	REV A
	MACHINED SURFACES 180√	.XX ±.03				
		.XXX ±.010	PRODUCT CODE -----		SHEET 6 OF 9	
MTS MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A.	THIRD ANGLE PROJ					


REVISIONS
DESCRIPTION
DRAWN
ENGR
DATE
LETTER
ECN NO
SOURCE/REF
DRAWING
PROPRIETARY DATA
THE INFORMATION AND DESIGN(S) DISCLOSED HEREIN ARE CONFIDENTIAL AND PROPRIETARY TO MTS SYSTEMS CORPORATION AND MAY NOT BE USED, REPRODUCED OR DISCLOSED IN ANY MANNER EXCEPT AS EXPRESSLY PERMITTED BY MTS SYSTEMS CORPORATION. THIS RESTRICTION DOES NOT LIMIT INFORMATION THAT IS IN THE PUBLIC DOMAIN OR WAS LEGITIMATELY IN THE PRIOR POSSESSION OF THE RECIPIENT.
DRAWN RAP
CHECK -
ENGR JPG
MFG -
DATE 9-23-16
DATE -
DATE 9-23-16
DATE -
TITLE
HYDRAULIC DISTRIBUTION ASSY-55867
NEXT LEVEL -----
SIZE D
NUMBER 100-342-836
REV A
PRODUCT CODE -----
SHEET 7 OF 9
UNLESS OTHERWISE SPECIFIED
MATERIAL DESCRIPTION -----
MATERIAL SIZE -----
FINISH -----
• THREAD DEPTHS ARE TO MIN FULL THDS
• DRILL DEPTHS ARE TO FULL DIA
• REMOVE BURRS AND SHARP EDGES
• DO NOT SCALE PRINT
XXX HOLE SIZE TOLERANCE
0.000 TO 1.750 +.010/-.002
OVER .750 TO 1.500 +.015/-.003
MASK
SCALE NONE
MACHINED SURFACES 63 RMS
GENERAL TOLERANCES
ANGLE ±2°
X ±1
.XX ±.03
.XXX ±.010
THIRD ANGLE PROJ
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.
3X
5 GAL ACCUM RETURN
10 GAL ACCUM PRESSURE
D -12 JIC
D -12 JIC
D -12 JIC
D -12 JIC
R -32 C61
R -32 C61
P -32 C61
P -32 C61
ACT 1
ACT 2
5 GAL ACCUM RETURN
10 GAL ACCUM PRESSURE
5 GAL ACCUM RETURN
10 GAL ACCUM PRESSURE
D -12 JIC
D -12 JIC
D -12 JIC
D -12 JIC
R -32 C61
R -32 C61
P -32 C61
P -32 C61
5 GAL ACCUM RETURN
10 GAL ACCUM PRESSURE
HPU 1
-20D
-32 C61 P/R
D
R
P
HPU 2
-20D
-32 C61 P/R
D
R
P
-32 C61
PRESSURE - SYSTEM DRAIN -12 JIC
-32 C61
RETURN - SYSTEM DRAIN -12 JIC
-12 JIC
DRAIN - SYSTEM DRAIN -12 JIC

HARDLINE PROOF PROCEDURE

*NOTE:

HYDRAULIC SYSTEMS ARE INHERENTLY DANGEROUS DUE TO HIGH PRESSURE FLUIDS AND GASES. DO NOT ATTEMPT TO OPERATE THIS SYSTEM UNLESS ADEQUATELY TRAINED, HAVE KNOWLEDGE OF THE SYSTEMS INVOLVED AND CAN RECOGNIZE THE POTENTIAL RISKS INVOLVED IF MISHANDLED.

KNOW WHERE THE LOCKOUT/TAGOUT POINT IS FOR ALL OF THE SUPPLY ENERGIES ASSOCIATED WITH YOUR SYSTEM.

KNOW THE LOCATION OF ALL OF THE SYSTEM EMERGENCY STOP BUTTONS SO THAT YOU CAN STOP THE SYSTEM QUICKLY IN AN EMERGENCY.

HAVE FIRST AID AVAILABLE.

KEEP BYSTANDERS AT A SAFE DISTANCE FROM ALL EQUIPMENT.

WEAR APPROPRIATE PERSONAL PROTECTION. WEAR EYE PROTECTION WHEN YOU WORK WITH HIGH PRESSURE HYDRAULIC FLUID. WEAR EAR PROTECTION WHEN YOU WORK NEAR ELECTRIC MOTORS, PUMPS, OR OTHER DEVICES THAT GENERATE HIGH NOISE LEVELS.

AVOID LONG PERIODS OF WORK WITHOUT REST.

DO NOT USE HANDS OR FINGERS TO STOP SMALL LEAKS IN HYDRAULIC OR PNEUMATIC HOSES.

1) INSTALL HARDLINE, HSM CONNECTION HOSES AND CONNECT SINGLE HPU.
2) CHECK FOR ADHERENCE TO DRAWINGS AND ECN'S.
3) INSPECT BASIC ASSEMBLY.
   a) FREE FLOW DIRECTION OF CHECK VALVES.
   b) CRITICAL BOLT LENGTHS AND TORQUE.
   c) CHECK FOR MISSING PLUGS, CAPS, AND PROPER TORQUE.

4) CONNECT PRESSURE, RETURN AND DRAIN HOSES TO FLUSH/PROOF ASSEMBLIES.

*NOTE:

a) ALL BALL VALVES SHOULD REMAIN OPEN DURING THE PROOF TEST UNLESS NOTED.
b) DRAIN PRESSURE ACCUMULATOR PRECHARGE FROM HPU ASSEMBLY BEING USED FOR TEST.
c) INSTALL PRESSURE GAUGE ON HPU PRESSURE OUTPUT

*NOTE:

IF A LEAK IS DETECTED AT ANY TIME THE TEST MUST BE STOPPED. ALL RESIDUAL PRESSURE MUST BE DEPLETED AND THE SYSTEM MUST BE DRAINED TO THE APPROPRIATE LEVEL TO FACILITATE REPAIRS. THE LEAK MUST BE REPAIRED WITH THE APPROPRIATE APPROVED MATERIALS AND PROCEDURES AS NECESSARY. THE SYSTEM SHOULD BE PREFILLED AGAIN, SLOWLY PRESSURIZED TO ONE HALF OF THE LEAK OCCURRENCE PRESSURE AND HELD FOR FIVE MINUTES. THEN PRESSURE SHOULD BE INCREASED TO THE LEAK OCCURRENCE PRESSURE AND THE TEST RESUMED AND COMPLETED.
5) PREFILL PRESSURE, RETURN AND DRAIN CIRCUIT:

*NOTE:
a) ADJUST COMPENSATOR PRESSURE AND PRESSURE RELIEF VALVE TO LOWEST SETTING, START SUPPLY HPU.
b) RUN PUMP TO FILL HARDLINE AND HOSE ASSEMBLIES WITH OIL.
c) MONITOR FLUID LEVEL IN HPU RESERVOIRS.

6) PROOF PRESSURE CHECK FOR DRAIN CIRCUIT:

*NOTE:
MAXIMUM DRAIN PROOF PRESSURE IS 300 PSI +50, DO NOT OVER PRESSURIZE.

a) BLOCK D & R AT SUPPLY HPU. ADJUST (1) PUMP VOLUME TO LOWEST SETTING, USE (1) MOTOR/PUMP FOR H.S. TEST.
b) START SUPPLY HPU AND ADJUST PRESSURE TO 100 PSI. CONNECT P & R AT (1) OUTLET STATION.
c) INCREASE PRESSURE AT 100 PSI INCREMENTS WHILE OBSERVING FOR LEAKS.
d) HOLD PRESSURE AT 300 PSI FOR 5 MINUTES.
e) SHUT HPU DOWN AND RELIEVE PRESSURE.
f) VALIDATE TEST.

7) PROOF PRESSURE CHECK FOR RETURN CIRCUIT:

*NOTE:
MAXIMUM RETURN PROOF PRESSURE IS 1090 PSI +100, DO NOT OVER PRESSURIZE.

a) CONNECT P & R AT (1) OUTLET STATION. BLOCK R AT SUPPLY HPU.
b) START SUPPLY HPU AND ADJUST PRESSURE TO 500 PSI.
c) INCREASE PRESSURE AT 500 PSI INCREMENTS WHILE OBSERVING FOR LEAKS.
d) HOLD PRESSURE AT 1090 PSI FOR 5 MINUTES.
e) SHUT HPU DOWN AND RELIEVE PRESSURE.
f) VALIDATE TEST.

8) PROOF PRESSURE CHECK FOR PRESSURE CIRCUIT.

*NOTE:
MAXIMUM PROOF PRESSURE IS 4500 PSI +200, DO NOT OVER PRESSURIZE.

a) BLOCK P AT ALL OUTLET STATIONS
b) START SUPPLY HPU AND ADJUST PRESSURE TO 500 PSI.
c) INCREASE PRESSURE AT 500 PSI INCREMENTS FROM 500 PSI TO 4500 PSI WHILE OBSERVING FOR LEAKS.
d) HOLD PRESSURE AT 4500 PSI FOR 5 MINUTES.
e) SHUT HPU DOWN AND RELIEVE PRESSURE.
f) ADJUST PUMP VOLUME AND PRESSURE CONTROLS TO STANDARD SETTING.
g) VALIDATE TEST.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE

HYDRAULIC DISTRIBUTION ASSY-55867

NEXT LEVEL -----

PRODUCT CODE -----

SIZE D

NUMBER 100-342-836

REV A

SHEET 8 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

HARDLINE FLUSH PROCEDURE

*NOTES:

1. CONNECT THE FLUID TRANSFER PUMP TO THE RETURN LINE LOW POINT BALL VALVE AND THE NEAREST AVAILABLE HPU DRAIN PORT

2. PUMP THE FLUID FROM THE RETURN HARDLINE TO THE HPU RESERVOIR

3. CONNECT THE FLUID TRANSFER PUMP TO THE DRAIN LINE LOW POINT BALL VALVE AND THE NEAREST AVAILABLE HPU DRAIN PORT

4. PUMP THE FLUID FROM THE DRAIN HARDLINE TO THE HPU RESERVOIR

5. CHECK FOR ADHERENCE TO DRAWINGS AND ECN'S.

6. INSPECT BASIC ASSEMBLY.
A.) FREE FLOW DIRECTION OF CHECK VALVES.
B.) CRITICAL BOLT LENGTHS AND TORQUE.
C.) CHECK FOR MISSING PLUGS, CAPS, AND PROPER TORQUE.

7. CONNECT PRESSURE, RETURN AND DRAIN HOSES TO FLUSH/PROOF ASSEMBLIES.

*NOTE: ALL BALL VALVES, SHOULD REMAIN OPEN DURING FLUSHING UNLESS NOTED.

8. PREFILL PRESSURE, RETURN AND DRAIN CIRCUIT:

*NOTE: MAXIMUM DRAIN PROOF PRESSURE IS 300 PSI, DO NOT OVER PRESSURIZE.

A.) START AN HPU AND ADJUST PRESSURE TO 300 PSI SETTING.
B.) RUN PUMP TO FILL HARDLINE AND HOSE ASSEMBLIES WITH OIL.
C.) MONITOR FLUID LEVEL IN HPU RESERVOIRS.

9. TURN ON THE HPU'S AND FLUSH THE HARDLINE UNTIL A CLEANLINESS LEVEL OF ISO 4406(c) 16/13/9 AT THE HPU IS ACHIEVED.

10. CLOSE THE PRESSURE BALL VALVES AT THE HSM'S AND ADJUST HPU PRESSURE SETTINGS TO OPERATIONAL PRESSURES PER SYSTEM SCHEMATIC.

11. SHUT HPU DOWN AND RELIEVE PRESSURE.

12. CONNECT THE FLUID TRANSFER PUMP TO THE PRESSURE LINE LOW POINT BALL VALVE AND THE NEAREST AVAILABLE HPU DRAIN PORT

13. OPEN THE DRAIN DOWN BREATHER BALL VALVE ALONG WITH ALL OTHER HARDLINE FLUSHING BALL VALVES

14. PUMP THE FLUID FROM THE PRESSURE HARDLINE TO THE HPU RESERVOIR

15. CONNECT THE FLUID TRANSFER PUMP TO THE RETURN LINE LOW POINT BALL VALVE AND THE NEAREST AVAILABLE HPU DRAIN PORT

16. PUMP THE FLUID FROM THE RETURN HARDLINE TO THE HPU RESERVOIR

17. CONNECT THE FLUID TRANSFER PUMP TO THE DRAIN LINE LOW POINT BALL VALVE AND THE NEAREST AVAILABLE HPU DRAIN PORT

18. PUMP THE FLUID FROM THE DRAIN HARDLINE TO THE HPU RESERVOIR

19. DISCONNECT PRESSURE, RETURN AND DRAIN HOSES FROM FLUSH/PROOF ASSEMBLIES AND SEAL OPEN PORTS AND HOSES.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180✓

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE

HYDRAULIC DISTRIBUTION ASSY-55867

NEXT LEVEL -----

PRODUCT CODE -----

SIZE D

NUMBER 100-342-836 REV A

SHEET 9 OF 9

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

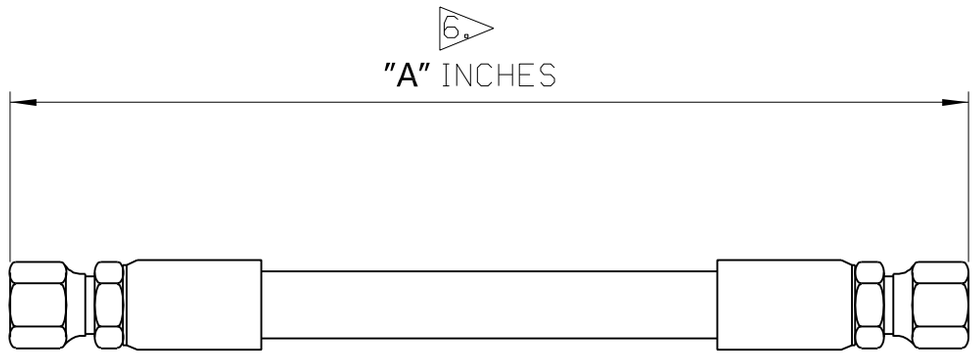
100-342-836 (HYDRAULIC DISTRIBUTION ASSY-55867)

BOM Item #	Material Number	BOM Qty	BOM Qty Unit	Material Description	Manufacturer Part Number	Manufacturer Name	DRW
1	100-338-781	3	EA	MANIFOLD-LINE END,97MM/2X 2"C61 OUTLETS			YES
2	100-338-780	3	EA	MANIFOLD- 90MM X 2"C61(2)			YES
3	100-338-782	2	EA	MANIFOLD-DRAIN -20 (2), -32			YES
4	100-306-158	2	EA	HOSE ASSY-PRESS,2" NOM STR/STR X 72.0			YES
5	043-924-107	2	EA	HOSE ASSY-RETURN,2" NOM STR/STR X 60.00			YES
6	006-891-752	2	EA	HOSE ASSY-DRAIN,1-1/4" NOM,66" LG,PETRO			YES
7	100-166-276	4	EA	MANIFOLD-ELBOW 97MM ALUM			YES
8	100-166-277	4	EA	MANIFOLD-ELBOW 90MM ALUM			YES
9	057-977-401	30	EA	CLAMP ASSY-WELD, 97/90/2.00" PAINTED			YES
10	011-336-542	3	EA	VALVE-BALL,4500 PSI -12 IBOSS,DEL/VIT,CS	KHB-20SAE-1114-11X	HYDAC	NO
11	010-024-106	3	EA	ADAPTER-BOSS/TUBE -12 MBOSS X -12 TUBE	12 F5OX-S	PARKER	NO
12	010-024-304	20	EA	CAP-TUBE -12 TUBE(2-PIECE DESIGN)	12 FNTX-S	PARKER	NO
13	035-195-803	2	EA	ADAPTER-4 BOLT TO BOSS 2 IN 4 BOLT TO-12			YES
14	010-026-203	21	EA	NIPPLE-BOSS -12 MBOSS	12 F5OHAO-S	PARKER	NO
15	010-027-306	2	EA	REDUCER-BOSS,M/F -20 MBOSS X -12 FBOSS	6410-20-12-O	BRENNAN	NO
16	052-798-403	32	EA	SAE FLANGE KIT W/O-RING 2" C61 SOC. HD B			YES
17	032-698-506	18	EA	PLUG-PORT,4 BOLT FLANGE 2 IN SIZE	P-32	MACHINE,M.W.	YES
18	011-008-526	9	EA	PLATE-SEAL,2"NOM,CODE 61 4 BOLT	ISP-A-6132-S-N	ADACONN/INSERTA	YES
19	010-024-111	2	EA	ADAPTER-BOSS/TUBE -20 MBOSS X -20 TUBE	20 F5OX-S	PARKER	NO
20	100-108-936	140	EA	ANCHOR-MASONRY,KWIK BOLT,1/2-13 X 5 1/2	45369	HILTI	NO
21	100-342-776	1	EA	BRACKET-ASSY, HARDLINE SUPPORT 55867			YES
1	100-342-779	1	EA	CHANNEL-SUPPORT, "C" CHANNEL 55867			YES
2	100-342-778	2	EA	BRACKET-ANGLE, HARDLINE SUPPORT 55867			YES
3	100-342-780	1	EA	PLATE-BRACKET HARDLINE SUPPORT 55867			YES
4	100-108-936	4	EA	ANCHOR-MASONRY,KWIK BOLT,1/2-13 X 5 1/2	45369	HILTI	NO
5	010-014-606	4	EA	SCR-SKTHD,1/2-13UNC 1 3/4 LG,A574,BLKOX	8016	SPS UNBRAKO	NO
6	100-049-612	6	EA	NUT-HEX, 1/2-13 UNC, GR-5, ZINC PL	95462A033	MCMASTER-CARR	NO
7	010-045-805	8	EA	WASHER-FLT,.531 ID X1.12 ODX.187,STL,HDN	FW-4	REID TOOL SUPPLY	NO
8	010-018-401	2	EA	SCR-CAP,FLH,82,SKT 1/2-13 UNC X 1" LG	2630	SPS UNBRAKO	NO
22	011-152-103	10	EA	NIPPLE-TUBE,HEX -32 TUBE	32 HTX-S	PARKER	NO
23	010-026-909	1	EA	PLUG-BOSS,INTL WR -32 BOSS,2 1/2 SAE	32 HP5ON-S 3/4BROACH	PARKER	NO
24	010-022-057	44	EA	NUT-HEX,1/2-13UNC SAE J995 GR8,BL			NO
25	011-011-602	44	EA	FLG-SPLIT,HLF,4 BLT,C61, 2 SAE,2 REQ D	32SF-2	ANCHOR FLANGE	YES
26	010-014-607	108	EA	SCR-SKTHD,1/2-13UNC 2 LG,A574,BLKOX	2464	SPS UNBRAKO	NO
27	010-010-936	32	EA	O-RING, .139X 90D BUNA-N 2.234ID ARP-228	AS568A-228	SEALS-GENERIC	NO
28	011-358-001	10	EA	CONNECTOR PLATE-SPLIT FLG 2 SAE FLG	32CP	ANCHOR COUPLING	YES
30	057-982-016	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 90.33"			YES
31	057-982-017	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 33.78"			YES
32	057-982-018	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 69.14"			YES
33	057-982-021	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 60.63"			YES
34	057-982-022	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 49.40			YES
35	057-982-019	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 104.00"			YES
36	057-982-020	8	EA	PIPE ASSY-PRESS,97MM X 12MM X 180.00"			YES
37	057-982-023	1	EA	PIPE ASSY-PRESS,97MM X 12MM X 236.00"			YES
40	054-552-001	4	EA	PLATE-BLOCKING,PRESSURE 97MM FLANGE			YES
41	010-094-528	100	EA	SCR-CAP,SKTHD,DIN912 M24 X3.00MM X90MMLG	3163	SPS UNBRAKO	NO
42	010-010-935	4	EA	O-RING, .139X 90D BUNA-N 3.484ID ARP-238	AS568A-238	SEALS-GENERIC	NO
43	043-924-093	2	EA	HOSE ASSY-PRESS,2" NOM STR/STR X 96.0			YES
44	100-339-200	1	EA	MANIFOLD-OFFSET,97MM/2X 2"C61 OUTLETS			YES
45	010-094-520	20	EA	SCR-CAP,SKTHD,DIN912 M24X3.00MM X130MMLG	3168	SPS UNBRAKO	NO
47	011-365-001	20	EA	NUT-HEX,M24 X 3.00MM,DIN 934,CL-10,BLACK			NO
50	057-137-118	1	EA	PIPE ASSY-RETURN,STR 90MM X 80.00 FA/A			YES
51	057-137-119	1	EA	PIPE ASSY-RETURN,STR 90MM X 36.15 FA/A			YES
52	057-137-120	1	EA	PIPE ASSY-RETURN,STR 90MM X 83.65 FA/A			YES
53	057-137-125	1	EA	PIPE ASSY-RETURN,STR 90MM X 63.00 FA/A			YES
54	057-137-126	1	EA	PIPE ASSY-RETURN,STR 90MM X 51.00 FA/A			YES
55	057-137-121	1	EA	PIPE ASSY-RETURN,STR 90MM X 197.65 FA/A			YES
56	057-137-122	1	EA	PIPE ASSY-RETURN,STR 90MM X 157.50 FA/A			YES
57	057-137-123	3	EA	PIPE ASSY-RETURN,STR 90MM X 179.82 FA/A			YES
58	057-137-124	3	EA	PIPE ASSY-RETURN,STR 90MM X 179.82 FA/B			YES
60	052-798-465	4	EA	SAE FLG KIT-MET,W/O-RING,3.00"C61,SHCS			YES
61	032-698-508	4	EA	PLUG-PORT,4 BOLT FLANGE 3 IN SAE FLG, C6			YES
62	011-362-213	100	EA	SCR-CAP,SKTHD,DIN912 M16X2.00MM X55MM LG	39719	FASTENAL	NO
63	011-362-208	20	EA	SCR-CAP,SKTHD,DIN912 M16X2.00MM X80MM LG	25658	SPS UNBRAKO	NO
65	011-343-904	20	EA	NUT-HEX,M16 X 2.00 MM,DIN 934,CL-10,BLK			NO
66	043-924-122	2	EA	HOSE ASSY-RETURN,2" NOM STR/STR X 90.00			YES
67	100-339-202	1	EA	MANIFOLD-OFFSET,90MM(2) X 2"C61(2)			YES
68	057-137-127	2	EA	PIPE ASSY-RETURN,STR 90MM X 124.50 FA/B			YES
69	057-137-128	1	EA	PIPE ASSY-RETURN,STR 90MM X 100.00 FA/B			YES
70	100-338-759	4	EA	MANIFOLD-97MM W/(4) 2" C61 OUTLETS			YES
71	057-581-106	8	EA	ACCUMULATOR-PIST0N,CRN 7"DIA, 10 GAL			YES
72	011-963-915	16	EA	CLAMP-ACCUMULATOR 8.11 ID	AMP/D206	STAUFF	NO
73	100-207-308	16	EA	ELBOW-PIPE WELDMENT,2" C61 SCHED 80			YES
74	011-950-362	11	EA	VALVE-BALL,3000 PSI,C61 2 IN FLG,DEL/VIT	KHM-50F3-1114-16X	HYDAC	YES
77	010-014-631	100	EA	SCR-SKTHD,1/2-13UNC 4 1/4LG,A574,BLKOXD	7772	SPS UNBRAKO	NO
80	100-338-760	4	EA	MANIFOLD-90MM W/(4) 2" C61 OUTLETS			YES
81	057-581-103	8	EA	ACCUMULATOR-PIST0N,CRN 7"DIA, 5 GAL			YES
84	047-573-204	9	EA	VALVE-CHECK, 2" SAE, 0 ORIF, 3 PSI	JEM951213	JEM TECHNICAL MARK	YES
90	100-338-769	4	EA	MANIFOLD, -32(2) WITH -12(4) OUTLETS			YES
91	010-032-926	17	EA	VALVE-CHECK 3/4 JIC X 3/4 IJIC	1712C-1	KEPNER	NO
93	010-024-116	9	EA	ADAPTER-BOSS/TUBE -32 MBOSS X -32 TUBE	32 F5OX-S	PARKER	NO
94	006-891-747	1	EA	HOSE ASSY-DRAIN,1 1/4 NOM 30 IN,PETRO BA			NO
95	010-025-610	1	EA	ELBOW-90,TUBE,SWVL -32 TUBE,SWVL	32 C6X-S	PARKER	NO
96	010-028-409	1	EA	TEE-TUBE -32 TUBE	32 JTX-S	PARKER	NO
97	010-025-409	5	EA	ELBOW-90,TUBE -32 TUBE	32 ETX-S	PARKER	NO
98	010-026-709	32	EA	NUT-TUBE CPLG -32 TUBE	32 BTX-S	PARKER	NO
99	010-027-709	32	EA	SLEEVE-TUBE -32 TUBE	32TX	PARKER HANNIFIN	NO
100	010-037-136	400	FT	TUBING-304 SST,HYD FLUID 2.00 OD X .065			YES

SUB COMPONENTS TO 100-342-776

PART NO	REV	"A" LENGTH	APPD	DATE
068917-01		12		
068917-02		24		
068917-03	A	36	SMP	7-87
068917-04	A	48	SMP	7-87
068917-05	A	60	KKL	7-87
068917-06	A	72	SMP	7-87
068917-07	A	84	SMP	12-86
068917-08	A	96	SMP	7-87
068917-09	A	108	KKL	7-87
068917-10	A	120	JWI	7-87
068917-11	A	180	SMP	7-87
068917-12	A	240	KKL	7-87
068917-13		300		
068917-14		360		
068917-15		420		
068917-16		480		
068917-17		540		
068917-18	A	600	CHB	REAC 11/15
068917-19	A	76	SMP	12-88
068917-20	A	156	KKL	6-89
068917-21	A	30	KKL	6-89
068917-22	A	52	JWI	7-92
068917-23	A	54	JWI	7-92
068917-24	A	75	JWI	11-92
068917-25	A	70	JWI	11-92
068917-26	A	144	JHS	5-92
068917-27	A	80	JWI	8-93
068917-28	A	192	KKL	9-93
068917-29	A	37.75	JWI	12-93
068917-30	A	39.50	TRN	12-93
068917-31	A	56	KKL	3-95
068917-32	A	132	KKL	5-95
068917-33	A	216	KKL	5-95
068917-34	A	26	KKL	5-95
068917-35	A	32	KKL	5-95
068917-36	A	38	KKL	5-95
068917-37	A	44	KKL	5-95
068917-38	A	42	TRN	1-96
068917-39	A	163	TRN	10-96
068917-40	A	12	JS	3-97
068917-41	A	58.00	TRN	1-98
068917-42	A	102	CLC	9-98
100-001-710	A	168	RAA	1-99
068917-43	A	264	SMP	6-99
068917-44	A	292	SMP	6-99
068917-45	A	384	RAA	6-00
068917-46	A	173	SJS	5-01
068917-47	A	30	JWI	9-02
068917-48	A	34	RAA	9-02
068917-49	A	400	SMP	12-2-05

PART NO	REV	"A" LENGTH	APPD	DATE
068917-50	A	234	DMH	7-08
068917-51	A	86	DMH	7-08
068917-52	A	66	RAA	2-28-12
068917-53	A	63	NJG	5-14-12
068917-54	A	90	JEV	2/4/14
068917-55	A	128	MV	6-1-15
068917-56	A	82	DAK	2-10-16
068917-57	A	210	MV	6-14-16



NOTES:

1. SEE C068899-01 FOR ENGINEERING SPECIFICATIONS.
2. MINIMUM BEND RADIUS = 16.50 IN.
3. WORKING PRESSURE= 100 PSI
4. I.D. AND O.D. TO BE COMPATIBLE WITH PETROLEUM BASE HYDRAULIC OIL (TEXACO RANDO HDA OR EQUIVALENT)
5. HOSE ENDS: (a) 37° JIC FEMALE SWIVEL
   (b) CRIMPED ON, OR REUSABLE
6. LENGTH TOLERANCE ±1/8 INCH PER FT OF LENGTH
7. HOSE ASSY TO BE FLUSHED TO A CLEANLINESS OF 30 MICRONS OR LESS, AND THEN THE ENDS PLUGGED.
8. HOSE TO BE MARKED OR TAGGED WITH THE FOLLOWING INFORMATION:
   (a) P.O.#/MTS P/N /100WP/DRAIN
   (b) FLUSHED/MICRON LEVEL/BY WHO(COMPANY-PERSON)/DATE
   [EXAMPLE: FLUSHED/30m/ACME-BILL/11-25-71]

* SEE "APPROVED SOURCE CARD" LISTED UNDER C068899-01 IN PURCHASING FOR ACCEPTED VENDORS.

SOURCE/REF DRAWING: 068899-01

REVISIONS

LETTER	DESCRIPTION	DRAWN	APPVL	DATE
—	RE-DRAWN ON CAD NO CHANGE NON-ECN#1479	DKH	KLO	12-2-96
A	ADDED TAB -53 -XX TO REV A	KKL	NJG	5-14-12
B	ADDED TAB -54 AT REV A XX TO REV B CORRECTED SPELLING ERRORS IN NOTES.	MRI	MCW	2/4/14
C	ADDED TAB -55 AT REV A XX TO REV C	TRN	MV	6-1-15
D	ADDED TAB -56 -XX TO REV D	KKL	DAK	2-10-16
E	ADDED TAB -57 TO REV A -XX TO REV E	TRN	MV	6-14-16
ECN NO.	RULE 2	500000591	500017647	500033071	500042759	500048129

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION

MATERIAL SIZE

FINISH MASK M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

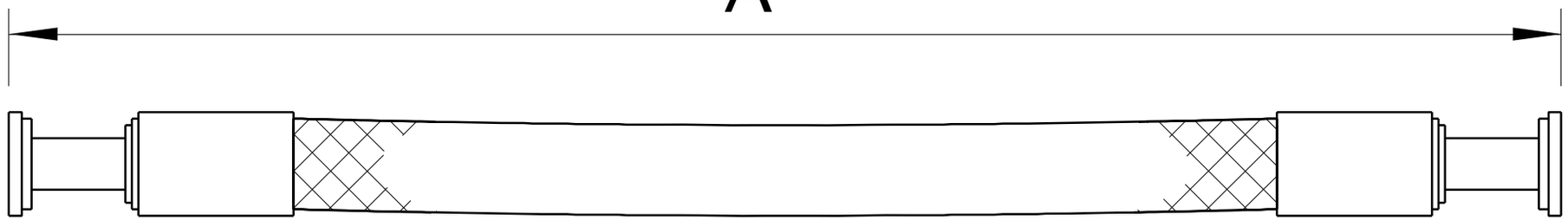
ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
DKH		BART	
DATE	DATE	DATE	DATE
12-2-96		11-71	

TITLE
HOSE ASSY-DRAIN, 1¼NOM, PETRO, BASE HYDR. OIL

NEXT LEVEL	SIZE	NUMBER	REV
	C	068917-XX	E
PRODUCT CODE		SHEET 1 OF 1	



PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-25	A	82.0	RAA/ 9-95
C439240-24	A	77.0	RAA/ 9-95
C439240-23	A	114.0	JHS/ 7-95
C439240-22	A	168.0	JHS/ 7-95
C439240-21	A	70.0	JWI 3-95
C439240-20	A	720.00	MMG 10-94
C439240-19	A	79.00	KKL 4-94
C439240-18	A	121.00	JWI 12-93
C439240-17	A	109.00	JWI 12-93
C439240-16	A	312.00	MV 10-93
C439240-15	A	106.00	RAA 8-92
C439240-14	A	84.00	JWI 5-92
C439240-13	A	69.00	JWI 10-91
C439240-12	A	37.00	WER 2-91
C439240-11	A	156.00	JWI 12-90
C439240-10	A	198.00	JWI 4-90
C439240-09	A	38.00	JWI 8-89
C439240-08	A	57.00	JWI 8-89
C439240-07	A	240.00	PER 4-89
C439240-06	A	65.50	PER 4-89
C439240-05	A	252.00	JWI 2-89
C439240-04	A	144.00	JWI 2-89
C439240-03	A	216.00	JWI 2-89
C439240-02	A	54.00	JWI 4-88
C439240-01	A	48.00	JWI 10-87

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-50	A	264.0	SMP 3-01
C439240-49	A	236.0	SVH 5-00
C439240-48	A	154.0	JWI 5-00
C439240-47	A	840.0	NSF 10-99
C439240-46	A	90.00	SVH 11-98
C439240-45	A	39.00	KDS 11-98
C439240-44	B	402.00	NSF 9-98
C439240-43	A	140.00	TRN 10-97
C439240-42	A	102.00	JWI 9-97
C439240-41	A	394.00	JWI 9-97
C439240-40	A	197.00	JWI 9-97
C439240-39	A	276.00	RAA 7-97
C439240-38	A	60.00	GLB 3-97
C439240-37	A	129.00	KKL 1-97
C439240-36	A	192.00	RAA 1-97
C439240-35	A	80.00	KKL 11/96
C439240-34	A	92.00	KKL 11/96
C439240-33	A	98.00	KKL 11/96
C439240-32	A	360.00	SMP 8/96
C439240-31	A	50.50	RAA 7-96
C439240-30	A	300.0	JJR/6-96
C439240-29	A	230.0	JWI/ 6-96
C439240-28	A	181.0	JWI/ 6-96
C439240-27	A	150.0	JWI/ 6-96
C439240-26	A	40.0	TRN/ 1-96

NOTES:

1. SEE STD 7ES FOR ENGINEERING SPECIFICATIONS.
2. MINIMUM BEND RADIUS=28.00 IN.
3. WORKING PRESSURE= 3000 PSI; BURST= 12000 PSI. REF: SAE100R11, MEET OR EXCEED.
4. I.D. & O.D. TO BE COMPATIBLE WITH PETROLEUM BASED HYDRAULIC OIL- (MOBIL D.T.E. OR EQUIVALENT).
5. HOSE ENDS: "O"-RINGED FLANGED HEAD (SAE J518C), CODE 61, CRIMPED ONLY
6. HOSE TO BE MARKED OR TAGGED WITH THE FOLLOWING INFORMATION:
   (A). MTS P/N / 3000 W.P. / PRESS
   (B.) COMPANY / DATE [EXAMPLE: ACME / 6-10-82].
7. HOSE TO BE POWER FLUSHED WITH FLUID FILTERED TO 10 MICRONS.
8. HOSE TO BE CAPPED OR SEALED WITH A POSITIVE LOCKING ENCLOSURE: HOSES RECEIVED OPEN WILL BE RETURNED TO THE SUPPLIER.
9. REFERENCE SOURCES:*
   1) IMPERIAL EASTMAN N832
   2) STRATOFLEX 238-32
   3) AEROQUIP FC 323-32
   4) GATES 32C11
   *HOSES & COUPLINGS MUST BE FROM THE SAME MANUFACTURER!

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	DFTSMN	APPVL	DATE
-44 TO REV B CHANGED "A" LENGTH	JAS	NSF	10-98
-94 TO REV B CHANGED "A" LENGTH	KKL	DAK	7-23-10
ADDED TAB -99 -XX TO REV B	KKL	KKL	4-11-13
ADDED TAB -78 -XX TO REV C	MCW	MCW	11-20-13
ADDED TABS 100-285-612 & 100-285-613 -XX TO REV D	TRN	MV	1-3-14
ADDED TABS 100-304-519 AND 100-304-520 AT REV A XX TO REV E	MRI	MV	1/7/15
ADDED TAB 100-306-158 AT REV A XX TO REV F	TRN	MV	1-26-15
ADDED TAB 100-309-988 AT REV A XX TO REV G	TRN	MV	4-17-15
ADDED TAB 100-318-855 AT REV A XX TO REV H	TRN	MV	8-13-15
LETTER	—	—	B	C	D	E	F	G	H
ECN NO.	RULE 1	RULE 1	500009153	500016031	500016962	500028332	500028938	500031689	500035356

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: NOTED
MATERIAL SIZE:
FINISH: MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE:
MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

TITLE: HOSE ASSY-PRESSURE,2" NOM STRAIGHT SPLIT FLANGE,XX"

NEXT LEVEL:
PRODUCT CODE: HMPG
SIZE: C
NUMBER: 439240-XX
REV: H
SHEET 1 OF 2

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE	PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-51	A	265.0	SMP 3-01	C439240-84	A	42.0	RAA 8-06
C439240-52	A	94.5	DJW 12-01	C439240-85	A	205.0	RAA 11-06
C439240-53	A	62.0	RLT 3-02	C439240-86	A	89.0	RAA 11-06
C439240-54	A	65.0	DAK 5-02	C439240-87	A	104.0	RAA 2-07
C439240-55	A	63.5	DAK 5-02	C439240-88	A	188.0	MFN 8-07
C439240-56	A	224.0	JDH 7-02	C439240-89	A	284.0	JDH 2-09
C439240-57	A	242.0	JDH 7-02	C439240-90	A	302.0	JDH 2-09
C439240-58	A	41.0	DCP 11-02	C439240-91	A	38.0	GNS 2-25-09
C439240-59	A	429.0	DCP 11-02	C439240-92	A	396.0	BKB 4-20-10
C439240-60	A	413.0	DCP 11-02	C439240-93	A	96.0	LNH 7-19-10
C439240-61	A	132.0	DCP 11-02	C439240-94	B	62.0	DAK 7-20-10
C439240-62	A	142.0	DCP 11-02	C439240-95	A	93.0	JEV 9-15-10
C439240-63	A	171.0	DCP 11-02	C439240-96	A	194.0	NJG 10/1/10
C439240-64	A	67.0	JHS 11-18-02	C439240-97			
C439240-65	A	160.0	DAP 01-21-03	C439240-98	A	120.0	RAA 2-28-12
C439240-66	A	135.0	DAP 01-21-03	C439240-99	A	984.0	KKL 4-11-13
C439240-67	A	75.0	RLT 4-01-03	100-285-612	A	220.0	MV 1-3-14
C439240-68	A	281.0	JDH 06-16-03	100-285-613	A	237.0	MV 1-3-14
C439240-69	A	279.0	JDH 06-16-03	100-304-519	A	44.0	MV 1-12-15
C439240-70	A	600.0	RAA 7-17-03	100-304-520	A	55.0	MV 1-12-15
C439240-71	A	320.0	RAA 9-17-03	100-306-158	A	72.0	MV 1-26-15
C439240-72	A	174.0	RAA 7-22-04	100-309-988	A	480.0	MV 4-17-15
C439240-73	A	420.0	BKB 8-2-04	100-318-855	A	636.0	MV 8-13-15
C439240-74	A	42.5	RAA 1-31-05				
C439240-75	A	68.0	RAA 5-26-05				
C439240-76	A	137.0	RAA 8-05				
C439240-77	A	34.0	SMP 10-12-05				
C439240-78	A	180.0	JAO 11-20-13				
C439240-79	A	247.0	RAA 9-05				
C439240-80	A	398.0	JDH 11-05				
C439240-81	A	99.0	RAA 1-06				
C439240-82	A	56.0	RAA 2-15-06				
C439240-83	A	58.0	RAA 2-15-06				

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	APPVL	DATE
LETTER		
ECN NO.		

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: NOTED
MATERIAL SIZE:
FINISH: MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE:
MACHINED SURFACES 180 ✓

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

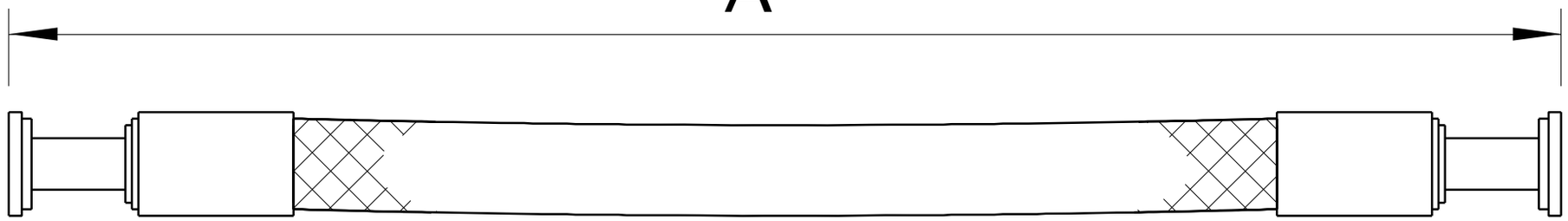
ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

TITLE: HOSE ASSY-PRESSURE,2" NOM STRAIGHT SPLIT FLANGE,XX"

NEXT LEVEL	SIZE	NUMBER	REV
	C	439240-XX	H
PRODUCT CODE: HMPG		SHEET 2 OF 2	



PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-25	A	82.0	RAA/ 9-95
C439240-24	A	77.0	RAA/ 9-95
C439240-23	A	114.0	JHS/ 7-95
C439240-22	A	168.0	JHS/ 7-95
C439240-21	A	70.0	JWI 3-95
C439240-20	A	720.00	MMG 10-94
C439240-19	A	79.00	KKL 4-94
C439240-18	A	121.00	JWI 12-93
C439240-17	A	109.00	JWI 12-93
C439240-16	A	312.00	MV 10-93
C439240-15	A	106.00	RAA 8-92
C439240-14	A	84.00	JWI 5-92
C439240-13	A	69.00	JWI 10-91
C439240-12	A	37.00	WER 2-91
C439240-11	A	156.00	JWI 12-90
C439240-10	A	198.00	JWI 4-90
C439240-09	A	38.00	JWI 8-89
C439240-08	A	57.00	JWI 8-89
C439240-07	A	240.00	PER 4-89
C439240-06	A	65.50	PER 4-89
C439240-05	A	252.00	JWI 2-89
C439240-04	A	144.00	JWI 2-89
C439240-03	A	216.00	JWI 2-89
C439240-02	A	54.00	JWI 4-88
C439240-01	A	48.00	JWI 10-87

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-50	A	264.0	SMP 3-01
C439240-49	A	236.0	SVH 5-00
C439240-48	A	154.0	JWI 5-00
C439240-47	A	840.0	NSF 10-99
C439240-46	A	90.00	SVH 11-98
C439240-45	A	39.00	KDS 11-98
C439240-44	B	402.00	NSF 9-98
C439240-43	A	140.00	TRN 10-97
C439240-42	A	102.00	JWI 9-97
C439240-41	A	394.00	JWI 9-97
C439240-40	A	197.00	JWI 9-97
C439240-39	A	276.00	RAA 7-97
C439240-38	A	60.00	GLB 3-97
C439240-37	A	129.00	KKL 1-97
C439240-36	A	192.00	RAA 1-97
C439240-35	A	80.00	KKL 11/96
C439240-34	A	92.00	KKL 11/96
C439240-33	A	98.00	KKL 11/96
C439240-32	A	360.00	SMP 8/96
C439240-31	A	50.50	RAA 7-96
C439240-30	A	300.0	JJR/6-96
C439240-29	A	230.0	JWI/ 6-96
C439240-28	A	181.0	JWI/ 6-96
C439240-27	A	150.0	JWI/ 6-96
C439240-26	A	40.0	TRN/ 1-96

NOTES:

1. SEE STD 7ES FOR ENGINEERING SPECIFICATIONS.
2. MINIMUM BEND RADIUS=28.00 IN.
3. WORKING PRESSURE= 3000 PSI; BURST= 12000 PSI. REF: SAE100R11, MEET OR EXCEED.
4. I.D. & O.D. TO BE COMPATIBLE WITH PETROLEUM BASED HYDRAULIC OIL- (MOBIL D.T.E. OR EQUIVALENT).
5. HOSE ENDS: "O"-RINGED FLANGED HEAD (SAE J518C), CODE 61, CRIMPED ONLY
6. HOSE TO BE MARKED OR TAGGED WITH THE FOLLOWING INFORMATION:
   (A). MTS P/N / 3000 W.P. / PRESS
   (B.) COMPANY / DATE [EXAMPLE: ACME / 6-10-82].
7. HOSE TO BE POWER FLUSHED WITH FLUID FILTERED TO 10 MICRONS.
8. HOSE TO BE CAPPED OR SEALED WITH A POSITIVE LOCKING ENCLOSURE: HOSES RECEIVED OPEN WILL BE RETURNED TO THE SUPPLIER.
9. REFERENCE SOURCES:*
   1) IMPERIAL EASTMAN N832
   2) STRATOFLEX 238-32
   3) AEROQUIP FC 323-32
   4) GATES 32C11
   *HOSES & COUPLINGS MUST BE FROM THE SAME MANUFACTURER!

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	DFTSMN	APPVL	DATE
-44 TO REV B CHANGED "A" LENGTH	JAS	NSF	10-98
-94 TO REV B CHANGED "A" LENGTH	KKL	DAK	7-23-10
ADDED TAB -99 -XX TO REV B	KKL	KKL	4-11-13
ADDED TAB -78 -XX TO REV C	MCW	MCW	11-20-13
ADDED TABS 100-285-612 & 100-285-613 -XX TO REV D	TRN	MV	1-3-14
ADDED TABS 100-304-519 AND 100-304-520 AT REV A XX TO REV E	MRI	MV	1/7/15
ADDED TAB 100-306-158 AT REV A XX TO REV F	TRN	MV	1-26-15
ADDED TAB 100-309-988 AT REV A XX TO REV G	TRN	MV	4-17-15
ADDED TAB 100-318-855 AT REV A XX TO REV H	TRN	MV	8-13-15
LETTER	—	—	B	C	D	E	F	G	H
ECN NO.	RULE 1	RULE 1	500009153	500016031	500016962	500028332	500028938	500031689	500035356

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: NOTED
MATERIAL SIZE:
FINISH: MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE:
MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

TITLE: HOSE ASSY-PRESSURE,2" NOM STRAIGHT SPLIT FLANGE,XX"

NEXT LEVEL:
PRODUCT CODE: HMPG
SIZE: C
NUMBER: 439240-XX
REV: H
SHEET 1 OF 2

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE	PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439240-51	A	265.0	SMP 3-01	C439240-84	A	42.0	RAA 8-06
C439240-52	A	94.5	DJW 12-01	C439240-85	A	205.0	RAA 11-06
C439240-53	A	62.0	RLT 3-02	C439240-86	A	89.0	RAA 11-06
C439240-54	A	65.0	DAK 5-02	C439240-87	A	104.0	RAA 2-07
C439240-55	A	63.5	DAK 5-02	C439240-88	A	188.0	MFN 8-07
C439240-56	A	224.0	JDH 7-02	C439240-89	A	284.0	JDH 2-09
C439240-57	A	242.0	JDH 7-02	C439240-90	A	302.0	JDH 2-09
C439240-58	A	41.0	DCP 11-02	C439240-91	A	38.0	GNS 2-25-09
C439240-59	A	429.0	DCP 11-02	C439240-92	A	396.0	BKB 4-20-10
C439240-60	A	413.0	DCP 11-02	C439240-93	A	96.0	LNH 7-19-10
C439240-61	A	132.0	DCP 11-02	C439240-94	B	62.0	DAK 7-20-10
C439240-62	A	142.0	DCP 11-02	C439240-95	A	93.0	JEV 9-15-10
C439240-63	A	171.0	DCP 11-02	C439240-96	A	194.0	NJG 10/1/10
C439240-64	A	67.0	JHS 11-18-02	C439240-97			
C439240-65	A	160.0	DAP 01-21-03	C439240-98	A	120.0	RAA 2-28-12
C439240-66	A	135.0	DAP 01-21-03	C439240-99	A	984.0	KKL 4-11-13
C439240-67	A	75.0	RLT 4-01-03	100-285-612	A	220.0	MV 1-3-14
C439240-68	A	281.0	JDH 06-16-03	100-285-613	A	237.0	MV 1-3-14
C439240-69	A	279.0	JDH 06-16-03	100-304-519	A	44.0	MV 1-12-15
C439240-70	A	600.0	RAA 7-17-03	100-304-520	A	55.0	MV 1-12-15
C439240-71	A	320.0	RAA 9-17-03	100-306-158	A	72.0	MV 1-26-15
C439240-72	A	174.0	RAA 7-22-04	100-309-988	A	480.0	MV 4-17-15
C439240-73	A	420.0	BKB 8-2-04	100-318-855	A	636.0	MV 8-13-15
C439240-74	A	42.5	RAA 1-31-05				
C439240-75	A	68.0	RAA 5-26-05				
C439240-76	A	137.0	RAA 8-05				
C439240-77	A	34.0	SMP 10-12-05				
C439240-78	A	180.0	JAO 11-20-13				
C439240-79	A	247.0	RAA 9-05				
C439240-80	A	398.0	JDH 11-05				
C439240-81	A	99.0	RAA 1-06				
C439240-82	A	56.0	RAA 2-15-06				
C439240-83	A	58.0	RAA 2-15-06				

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	APPVL	DATE
LETTER		
ECN NO.		

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: NOTED
MATERIAL SIZE:
FINISH: MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE:
MACHINED SURFACES 180 ✓

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

TITLE: HOSE ASSY-PRESSURE,2" NOM STRAIGHT SPLIT FLANGE,XX"

NEXT LEVEL	SIZE	NUMBER	REV
	C	439240-XX	H
PRODUCT CODE: HMPG		SHEET 2 OF 2	

MTS PART NO.	REV.	"A" X "C" O.D. (IN) X WALL SIZE (IN)	"C" DIMENSION (WALL THICKNESS) IN GAUGE	"B" I.D. (IN) REF.	MIN. BURST PRESSURE (PSI)	MAX.SYSTEM OPERATING PRESSURE (PSI)	ENG.	DATE	NOTES
100371-01	C	1/4 X .035	20 GAUGE	.180	21,000	5250	RAA	3-29-71	2
100371-02	C	3/8 X .035	20 GAUGE	.305	14,000	3,500	RAA	3-29-71	2
100371-03	A	1/2 X .035	20 GAUGE	.430	10,500	2,625	RAA	3-29-71	OBSOLETE SUPERCEDED BY 100371-19
100371-04	A	3/4 X .049	18 GAUGE	.652	9,800	2,450	RAA	3-29-71	OBSOLETE SUPERCEDED BY 100371-18
100371-05	C	1 X .095	13 GAUGE	.810	14,252	3,563	RAA	3-29-71	2
100371-06	D	1 X .049	18 GAUGE	.902	7,352	1,838	RAA	3-29-71	4
100371-07	C	1 1/4 X .120	11 GAUGE	1.010	14,400	3,600	RAA	3-29-71	2
100371-08	C	1 1/4 X .083	14 GAUGE	1.084	9,960	2,490	RCS	3-29-71	
100371-09	A								
100371-10	D	1 1/2 X .083	14 GAUGE	1.334	8,300	2,075	RAA	3-29-71	4
100371-11	A								
100371-12	A	3/4 X .095	13 GAUGE	.560	19,000	4,750			OBSOLETE SUPERCEDED BY 100371-33
100371-13	A								
100371-14	A	3 X .216	———		10,800	2,700			1
100371-15	C	1/2 X .083	14 GAUGE	.334	24,900	6,225	RAA	12-9-76	
100371-16	C	1/4 X .065	16 GAUGE	.120	39,000	9,750	RCS	12-9-76	
100371-17	C	3/8 X .049	18 GAUGE	.277	19,600	4,900	SMP	10-11-77	
100371-18	C	3/4 X .065	16 GAUGE	.620	13,000	3,250	MMM	11-9-78	2
100371-19	C	1/2 X .049	18 GAUGE	.402	14,700	3,675	HSC	11-17-78	2
100371-20	C	1 1/2 X .120	11 GAUGE	1.260	12000	3000	RAA	11-17-78	2
100371-21	A	2 X .188	———	1.624	14,100	3,525			3
100371-22	A								
100371-23	C	1/4 X .078	———	.094	46,800	11,700	RAA	1-9-80	3
100371-24	D	2 X .095	13 GAUGE	1.810	7,125	1,781	RAA	5-2-85	1 4
100371-25	A	3/4 X .083	14 GAUGE	.584	16,600	4,150			
100371-26	C	1/2 X .065	16 GAUGE	.370	19,500	4,875	RAA	5-2-85	
100371-27	A	1 X .109	12 GAUGE	.782	16,350	4,087			OBSOLETE SUPERCEDED BY 100371-34
100371-28	A	3/8 X .059	17 GAUGE	.257	23,600	5,900	RAA	5-2-85	OBSOLETE
100371-29	C	2 X .165	———	1.670	12,375	3,093	RAA	5-2-85	1 2 3
100371-30	A	1/8 X .049	18 GAUGE	.027	58,800	14,700			3
100371-31	C	1/8 X .035	20 GAUGE	.055	42,000	10,500	RAA	5-2-85	

SOURCE/REF. DRAWING:

REVISIONS

DFTSMN	APPVL	DATE	DESCRIPTION	LETTER	ECO NO.
SME	RAA	10-14-85	REVISED PER ECO	———	86-0065
DKB	RAA	6-19-95	OBSOLETED TAB -32, SUPERCEDED BY 100371-26.	———	PM95-15
DKB	RAA	4-11-97	OBSOLETED TAB -28, NOT SUPERCEDED	———	PM97-20
			OBSOLETED TAB -12 SUPERCEDE BY 100371-33. ADDED .560 IN "B" COLUMN. OBSOLETED TAB -27 SUPERCEDED BY 100371-34. TAB -33 CHG'D "B" FROM .655 TO .560. TAB -34 CHG'D "B" FROM .891 TO .782. PER PART MAINTENANCE	———	PM97-27
DKB	RAA	5-22-97	OBSOLETE NO FOLLOW UP O SIMILAR TO NUMBERS	———	14-OBS28
MRI	RAA	2/18/14	ADDED NOTE COLUMN AND NOTE TO TABS 6,10,24,36 & 37 ALL TO REV B -XX TO REV B	B	500024441
TRN	RAA	8-26-14	CHANGED LAYOUT OF DRAWING ADDED SHEET 3 UPDATED ENGINEERING DATA SEE ECM REDLINE FOR DETAILS -01,02,05,07,08 TO REVB -06,10,24,36 & -37 TO REV C -15 THRU 20 TO REV B -23,26,29,31 TO REV B -33,38 THRU 42 TO REV B	C	500031106
TRN	RAA	4-02-15	ADDED WALL THICKNESS "C" IN GAUGE COLUMN -1,2,5,7,8,15 THRU 20,23 26,29,31,33,38,39,40,41,42 TO REV C -6,10,24,36,37 TO REV D	D	500033631
TRN	RAA	6-18-15			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION ----------

MATERIAL SIZE ----------

FINISH ---------- MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		RAA	
DATE 10-85	DATE	DATE 10-85	DATE

TITLE

TUBING-304 SST

XXX Ø0 X XXX WALL

NEXT LEVEL	SIZE	NUMBER	REV
PRODUCT CODE	C	100371-XX	D

SHEET 1 OF 3

MTS PART NO.	REV.	"A" X "C" O.D. (IN) X WALL SIZE (IN)	"C" DIMENSION (WALL THICKNESS) IN GAUGE	"B" I.D. (IN) REF.	MIN. BURST PRESSURE (PSI)	MAX.SYSTEM OPERATING PRESSURE (PSI)	ENG.	DATE	NOTES
100371-32	A	½ X .065	16 GAUGE	.435	19,500	4,875	JDH	10-9-85	OBSOLETE SUPERCEDED BY 100371-26
100371-33	C	¾ X .095	13 GAUGE	.560	19,000	4,750	JDH	10-9-85	
100371-34	A	1 X .109	12 GAUGE	.782	16,350	4,087	JDH	10-9-85	OBSOLETE
100371-35	A	1½ X .134	10 GAUGE	1.232	13,400	3,350			▷3
100371-36	D	2 X .065	16 GAUGE	1.870	4875	1219	JWI	2-23-87	▷4
100371-37	D	1½ X .065	16 GAUGE	1.370	6500	1625	JWI	2-23-87	▷4
100371-38	C	¾ X .109	12 GAUGE	.532	21,800	5,450	JDH	9-14-89	
100371-39	C	⅜ X .083	14 GAUGE	.209	32,760	8,190	JDH	9-10-93	▷3
100371-40	C	1¼ X .156	————	.938	20,000	5,000	SMP	6-19-95	▷3
100371-41	C	1 X .120	11 GAUGE	.760	18,000	4,500	JJR	11-30-95	
100371-42	C	3/16 X .035	20 GAUGE	.117	28,000	7,000	MMG	10-15-96	

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	DFTSMN	APPVL	DATE
SEE SHEET 1			
LETTER			
ECO NO.			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION

MATERIAL SIZE

FINISH ---
MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE
MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		RAA	
DATE 10-85	DATE	DATE 10-85	DATE

TITLE
TUBING-304 SST
XXX ØØ X XXX WALL

NEXT LEVEL
PRODUCT CODE

SIZE C

NUMBER 100371-XX

REV D

-MATERIAL REQUIREMENTS-

1) ANNEALED 304, 304L OR 316 STAINLESS STEEL TUBING.

2) SEAMLESS PER ASTM A269

3) INSIDE WALL MUST BE FREE OF MANUFACTURING (DRAW) LINES.

4) TUBING SHALL BE CAPABLE OF WITHSTANDING A STD. SINGLE FLARE OF 37°, MANUFACTURED PER SAE J533, WITH NO VISIBLE EVIDENCE OF CRACKING.

5) END USE IS HYDRAULIC FLUID LINES PER ASTM A450.

6) MIN ULTIMATE TENSILE STRENGTH 75,000 PSI

TUBING IDENTIFICATION

TUBING MUST BE MARKED WITH TUBE SIZE, WALL THICKNESS & HEAT NUMBER PER ASTM A269

PRESSURE EQUATION

* USE BARLOW EQUATION TO CALCULATE TUBE'S WORKING PRESSURE WITH 4:1 SAFETY FACTOR

* ASME B31.3

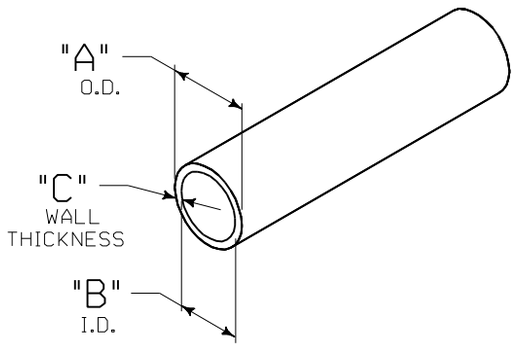
$$P = \frac{2ST}{D}$$

D= NOM. O.D. OF TUBE,(IN)
P= HYDROSTATIC WORKING PRESSURE (PSI)
S= ULTIMATE TENSILE STRENGTH OF MATERIAL, (75,000 PSI MIN)
T= NOM. WALL THICKNESS OF TUBING, (IN)

PRESSURE BASED ON TEMPERATURE OF < 300 DEG. F PER ASME B31.3

NOTES:

1. 2 INCH AND LARGER DIAMETER TUBES HAVE LONGER LEAD TIMES AND HIGHER COST.
2. STANDARD MTS TUBING SIZE.
3. NORMALLY NOT SUITABLE FOR FLARING 37° FLARE PER SAE J533 UNLESS MANUFACTURED PER SAE J533, STANDARD SECTION 3.1.3 FIGURE 3
4. NOT SUITABLE FOR BENDING WITH MTS EQUIPMENT.
5. NOMENCLATURE



DERATING FACTORS

°F.	304SST ASTM A269	316SST ASTM A269
200°	1.00	1.00
400°	.94	.94
600°	.83	.83
800°	.77	.77
1000°	.71	.70
1200°	.19	.38
1400°	.06	.10
1600°	——	——

TO FIND ALLOWABLE WORKING PRESSURE AT A SPECIFIED TEMP., FIND WORKING PRESSURE AND MULTIPLY BY APPROPRIATE DERATING FACTOR PER ASME B31.3

SOURCE/REF.
DRAWING:

REVISIONS

DESCRIPTION	APPVL	DATE
DFTSMN		
LETTER		
ECO NO.		

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION

MATERIAL SIZE

FINISH

MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180 √

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

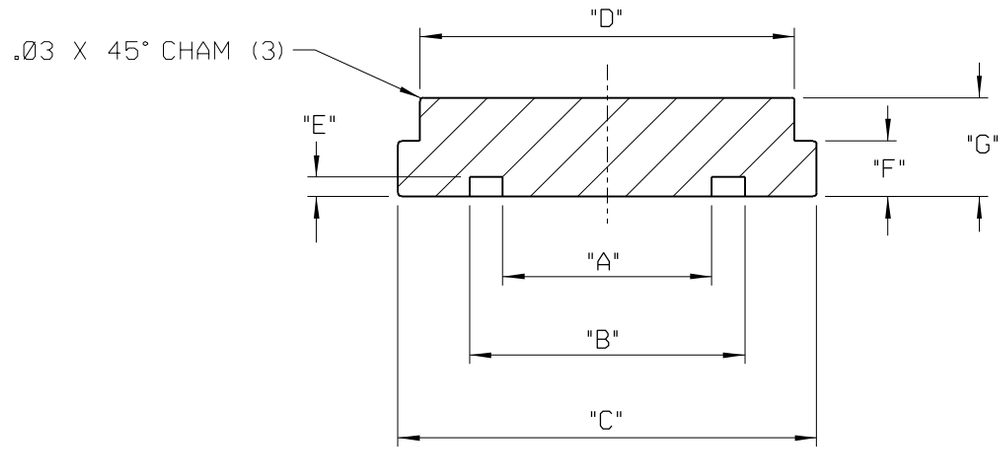
THIRD ANGLE PROJ.

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

DRAWN	CHECK	ENGR	MFG
TRN	RAA	RAA	
DATE	DATE	DATE	DATE
3-23-15	3-23-15	3-23-15	

TITLE
TUBING-304 SST
XXX ØØ X XXX WALL

NEXT LEVEL	SIZE	NUMBER	REV
	C	100371-XX	D
PRODUCT CODE		SHEET 3 OF 3	



PART NO.	REV	PRESSURE RATING	FLANGE SIZE	"A"	"B"	"C"	"D" MAX	"E"	"F"	"G"	"H"	O'RING SIZE	APPD	DATE
326985-15	B	3000 PSI	3½	3.750 DIA	4.115 DIA	4.500 DIA	4.000 DIA	.110/.115	.442 ±.005	.88	ASTM A108 12L14	241 REF	JWI	5-96
326985-14	C	6000 PSI	2	2.125 DIA	2.500 DIA	3.125 DIA	2.625 DIA	.110/.115	.495 ±.005	1.44	000-003-406 1018	228REF	JAB	11-87
326985-13	C	6000 PSI	1½	1.750 DIA	2.125 DIA	2.500 DIA	2.000 DIA	.110/.115	.495 ±.005	1.06	ASTM A108 12L14	225REF	SMP	1-89
326985-12	C	6000 PSI	1¼	1.375 DIA	1.750 DIA	2.125 DIA	1.718 DIA	.110/.115	.405 ±.005	.94	ASTM A108 12L14	222REF	JWI	1-89
326985-11	C	6000 PSI	1	1.125 DIA	1.562 DIA	1.875 DIA	1.500 DIA	.110/.115	.375 ±.005	.88	ASTM A108 12L14	219 REF	MMG	11-89
326985-10	C	6000 PSI	¾	.875 DIA	1.250 DIA	1.625 DIA	1.250 DIA	.110/.115	.345 ±.005	.75	ASTM A108 12L14	214 REF	TRN	3-96
326985-09		6000 PSI	½	.625 DIA	1.000 DIA	1.250 DIA	.937 DIA	.110/.115	.305 ±.005	.62	ASTM A108 12L14	210 REF		
326985-08	C	3000 PSI	3	3.250 DIA	3.625 DIA	4.000 DIA	3.546 DIA	.110/.115	.375 ±.005	.88	000-000-137 1018/1020	237REF	SMP	10-88
326985-07	B	3000 PSI	2½	2.625 DIA	3.000 DIA	3.312 DIA	2.922 DIA	.110/.115	.375 ±.005	.75	ASTM A108 12L14	232REF	RAA	8-87
326985-06	B	3000 PSI	2	2.125 DIA	2.500 DIA	2.812 DIA	2.453 DIA	.110/.115	.375 ±.005	.62	C.D. ASTM A311 CLASS B GR 1144	228REF	RAA	11-77
326985-05	B	3000 PSI	1½	1.750 DIA	2.125 DIA	2.375 DIA	1.984 DIA	.110/.115	.315 ±.005	.62	C.D. ASTM A311 CLASS B GR 1144	225REF	RAA	4-78
326985-04	B	3000 PSI	1¼	1.375 DIA	1.750 DIA	2.000 DIA	1.703 DIA	.110/.115	.315 ±.005	.56	C.D. ASTM A311 CLASS B GR 1144	222REF	JWI	5-79
326985-03	B	3000 PSI	1	1.187 DIA	1.562 DIA	1.750 DIA	1.500 DIA	.110/.115	.315 ±.005	.56	000-001-158 11L17	219 REF	JWI	4-85
326985-02	B	3000 PSI	¾	.875 DIA	1.250 DIA	1.500 DIA	1.250 DIA	.110/.115	.265 ±.005	.56	ASTM A108 12L14	214 REF	JWI	8-94
326985-01	B	3000 PSI	½	.625 DIA	1.000 DIA	1.187 DIA	.937 DIA	.110/.115	.265 ±.005	.50	ASTM A108 12L14	210 REF	CPD	4-94

REVISIONS

DESCRIPTION	DRAWN	APPVL	DATE
RE-DRAWN ON CAD NO CHANGE NON-ECN#1479	DKH	KLG	12-5-96
-08 ITEM 37 WAS BILL COMMENT TRY LA TOOL,DOCK TO STOCK,VENDOR MERCURY TOOL- -08 TO REV B	MRI	SMP	1-15-04
COLUMN "F" 6000PSI .305 WAS .285 .345 WAS .325 .375 WAS .355 .405 WAS .385 .495 WAS .475 (2) -10 THRU -14 TO REV B	MRI	JM	11/20/08
ADDED MATL DESCRIPTION COLUMN "H" -01 THRU -07, -15 TO REV B -08,-10 THRU -14, -XX TO REV C	BKB	MV	8/13/13
LETTER	———	———	———	C			
ECN NO.	RULE 2	04-0181	09-0155	500013063			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: SEE TAB

MATERIAL SIZE:

FINISH: BLACK OXIDE — MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
DKH		SMP	
DATE	DATE	DATE	DATE
12-5-96		11/77	

TITLE: PLUG-PORT,4 BOLT FLANGE

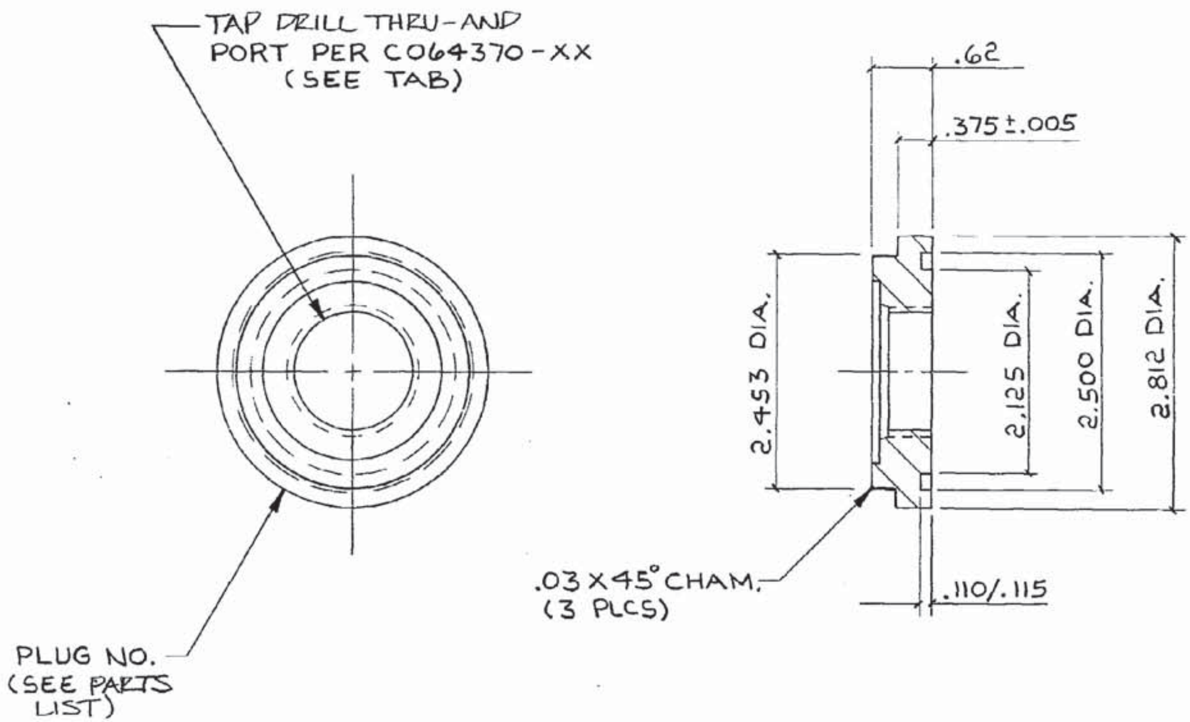
NEXT LEVEL:

PRODUCT CODE:

SIZE	NUMBER	REV
C	326985-XX	C

SHEET 1 OF 1

SOURCE/REF DRAWING:



PART NO.	PORT SIZE	REV	ENG/DATE
-08	PORT PER 064370-05	A	KKL 10/97
-07	PORT PER 064370-04	A	JWI 4-96
-06	PORT PER C064370-24	A	RAA 5/80
-05	PORT PER C064370-20	A	RAA 5/80
-04	PORT PER C064370-16	A	RAA 5/80
-03	PORT PER C064370-12	A	RAA 5/80
-02	PORT PER C064370-08	A	CPD 7/87
351958-01	PORT PER C064370-06	A	RSB 2/86

REVISIONS

LETTER	ECO NO.	DESCRIPTION	DFTSMN	APPVL	DATE
B	82-0767	REDRAWN & ADDED DIM'S	GFC	WER	9-13-82
—	—	REACTIVATED -02	T-K	CPD	7-29-87

REFERENCE DRAWINGS: C064370-XX

UNLESS OTHERWISE SPECIFIED

TOLERANCES: 2 PLACE INCHES ±.030; 3 PLACE INCHES ±.010; ANGLES ±1°
DO NOT SCALE DRAWING

CAP. IN MFD± % RES. IN OHMS± % ¼ W
DRILL DEPTHS ARE TO FULL DIAMETER
TAP DEPTHS ARE MINIMUM FULL THREADS
REMOVE ALL BURRS AND SHARP EDGES

APPROVAL: DFTSMN GFC, DATE 9-82; CHECK —; ENGR. DWH, DATE 9-82; MFG —

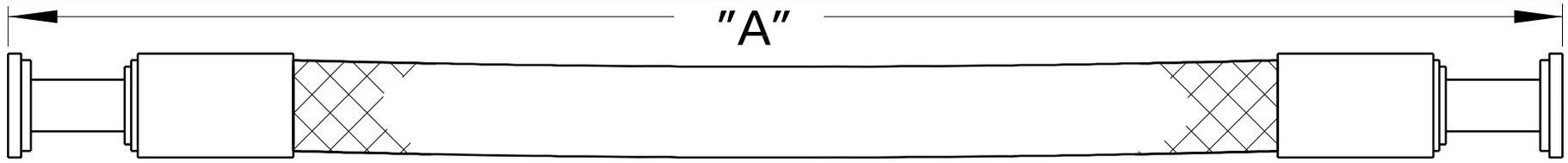
MATERIAL: 2" PORT PLUG # 326985-06 (MTS NO.)
SURFACE FINISH: 125 ✓
STOCK SIZE: —
QUANTITY:
SCALE: —
FINISH: —
THIRD ANGLE PROJ.

TITLE: ADAPTER - 4 BOLT TO BOSS

FIRST USED ON: —
MODEL/SYSTEM NO.: 290.XX
SIZE: C
NUMBER: 351958-XX
REV: SEE TAB
V CARD: — P/L: — SHEET 1 OF 1

MTS SYSTEMS CORPORATION
MINNEAPOLIS, MINNESOTA 55424 U.S.A.

Form 100734-56



PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439241-27	A	94.5	DJW 12-01
C439241-26	A	252.0	SMP 3-01
C439241-25	A	840.0	NSF 10-99
C439241-24	A	360.00	RJL 10-97
C439241-23	A	152.00	TRN 10-97
C439241-22	A	90.00	JWI 9-97
C439241-21	A	394.00	JWI 9-97
C439241-20	A	197.0	JWI 9-97
C439241-19	A	116.0	KKL 1-97
C439241-18	A	150.0	JHS 12-95
C439241-17	A	132.0	JHS 12-95
C439241-16	A	720.00	MMG 6-94
C439241-15	A	78.00	KKL 4-94
C439241-14	A	168.00	JJC 3-94
C439241-13	A	960.00	JJC 3-94
C439241-12	A	80.0	M-V 9-93
C439241-11	A	106.00	M-V 1-93
C439241-10	A	84.00	JWI 5-92
C439241-09	A	198.00	JWI 9-89
C439241-08	A	43.00	JWI 8-89
C439241-07	A	60.00	JWI 8-89
C439241-06	A	240.00	PER 4-89
C439241-05	A	65.50	PER 4-89
C439241-04	A	144.00	JWI 4-88
C439241-03	A	216.00	JWI 4-88
C439241-02	A	54.00	JWI 4-88
C439241-01	A	48.00	JWI 10-87

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439241-56	A	175.00	JDH 6-08
C439241-55	A	247.00	SGJ 2-08
C439241-54	A	113.00	RAA 2-07
C439241-53	A	99.00	RAA 11-06
C439241-52	A	41.00	RAA 8-06
C439241-51	A	101.00	RAA 3-06
C439241-50	A	109.00	RAA 1-06
C439241-49	A	104.00	RAA 1-12-06
C439241-48	A	386.00	JDH 11-05
C439241-47	A	141.00	RAA 8-05
C439241-46	A	67.00	RAA 4/05
C439241-45	A	62.00	RAA 9-7-04
C439241-44	A	300.00	RAA 10-5-04
C439241-43	A	420.00	BKB 8-04
C439241-42	A	110.00	RAA 10-03
C439241-41	A	334.00	RAA 9-03
C439241-40	A	64.00	DCP 7-03
C439241-39	A	284.00	JDH 6-03
C439241-38	A	282.00	JDH 6-03
C439241-37	A	74.00	RLT 4-03
C439241-36	A	68.00	TRN 2-03
C439241-35	A	122.00	DCP 11-02
C439241-34	A	400.00	DCP 11-02
C439241-33	A	380.00	DCP 11-02
C439241-32	A	429.00	DCP 11-02
C439241-31	A	407.00	DCP 11-02
C439241-30	A	59.0	RLT 3-02
C439241-29	A	63.0	RLT 3-02
C439241-28	A	70.0	RLT 3-02

NOTES:

1. SEE STD 7ES FOR ENGINEERING SPECIFICATIONS.
2. MINIMUM BEND RADIUS=25.00 IN.
3. WORKING PRESSURE= 2000 PSI; BURST= 8000 PSI. REF: SAE100R9, MEET OR EXCEED.
4. I.D. & O.D. TO BE COMPATIBLE WITH PETROLEUM BASED HYDRAULIC OIL- (MOBIL D.T.E. OR EQUIVALENT).
5. HOSE ENDS: "O"-RINGED FLANGED HEAD (SAE J518C), CODE 61, CRIMPED ONLY
6. HOSE TO BE MARKED OR TAGGED WITH THE FOLLOWING INFORMATION:
   (A). MTS P/N / 2000 W.P. / PRESS
   (B.) COMPANY / DATE [EXAMPLE: ACME / 6-10-82].
7. HOSE TO BE POWER FLUSHED WITH FLUID FILTERED TO 10 MICRONS.
8. HOSE TO BE CAPPED OR SEALED WITH A POSITIVE LOCKING ENCLOSURE: HOSES RECEIVED OPEN WILL BE RETURNED TO THE SUPPLIER.
9. REFERENCE SOURCES:*
   1) IMPERIAL EASTMAN L132
   2) STRATOFLEX 3270-32
   3) AEROQUIP FC 250A
   4) GATES 32C12
   *HOSES & COUPLINGS MUST BE FROM THE SAME MANUFACTURER!

SOURCE/REF DRAWING:

REVISIONS

DESCRIPTION / DRAWN / APPVL / DATE	LETTER	ECN NO.
ADDED -69 TO REV A -XX TO REV A — MCW — MCW — 6-20-12	—	500001599
ADDED TABS -70 & -71 -70 & -71 TO REV A -XX TO REV B — TRN — RAA — 1-31-13	B	500007369
ADDED TAB -72 -XX TO REV C — KKL — KKL — 4-11-13	C	500009153
ADDED TAB -73 -XX TO REV D — MCW — JAO — 11-20-13	D	500016031
ADDED TAB -74 -XX TO REV E — TRN — RAA — 8-6-14	E	500024019
ADDED TAB -75 -XX TO REV F — RWR — JAO — 8-25-14	F	500024403
ADDED TAB -76 -XX TO REV G — TRN — MV — 9-10-14	G	500025051
ADDED TAB -77 -XX TO REV H — TRN — MV — 4-17-15	H	500031689
ADDED TAB -78 -XX TO REV J — TRN — MV — 5-13-15	J	500035356

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION ----------

MATERIAL SIZE ----------

FINISH ---------- MASK M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

TITLE: HOSE ASSY-RETURN, 2" NOM STRAIGHT SPLIT FLANGE, XX

NEXT LEVEL | SIZE C | NUMBER 439241-XX | REV J

PRODUCT CODE ---------

PART NUMBER	REV.	LENGTH "A"	APV'D./DATE
C439241-57	A	24.00	GNS 2-25-09
C439241-58	A	44.00	GNS 3-12-09
C439241-59	A	42.00	GNS 3-12-09
C439241-60	A	96.00	LNH 7-19-10
C439241-61	A	194.00	NJG 10/1/10
C439241-62	A	86.00	RAA 12/21/10
C439241-63	A	102.00	DAK 5/3/11
C439241-64	A	120.00	RAA 2/28/12
C439241-65	A	56.00	RAA 2/28/12
C439241-66	A	37.00	RAA 2/28/12
C439241-67	A	46.00	RAA 2/28/12
C439241-68	A	172.00	RAA 3/12/12
C439241-69	A	600.00	MCW 6-20-12
C439241-70	A	106.00	RAA 1-31-13
C439241-71	A	126.00	RAA 1-31-13
C439241-72	A	984.00	KKL 4-11-13
C439241-73	A	180.00	JAO 11-20-13
C439241-74	A	30.00	RAA 8-6-14
C439241-75	A	31.00	JAO 8-25-14
C439241-76	A	87.00	MV 9-10-14
C439241-77	A	480.00	MV 4-17-15
C439241-78	A	648.00	MV 8-13-15

REVISIONS

	DESCRIPTION	APPVL	DATE
	DRAWN		
LETTER			
ECN NO.			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION

MATERIAL SIZE

FINISH

MASK M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180 ✓

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
WG		JWI	
DATE 9-87	DATE	DATE 10-87	DATE

SOURCE/REF DRAWING:

TITLE
HOSE ASSY-RETURN, 2" NOM
STRAIGHT SPLIT FLANGE,XX

NEXT LEVEL	SIZE	NUMBER	REV
	C	439241-XX	J

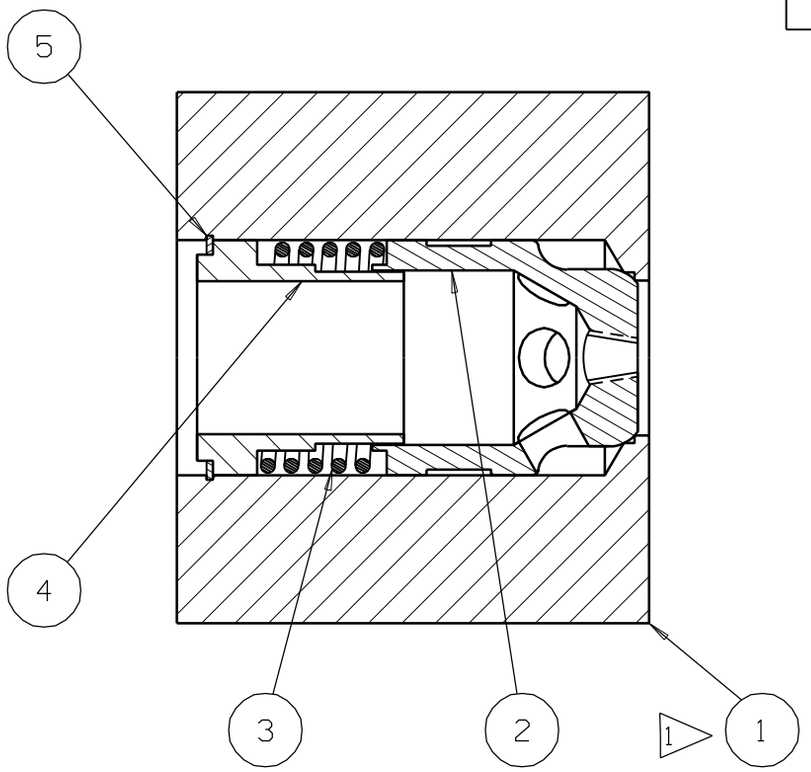
PRODUCT CODE

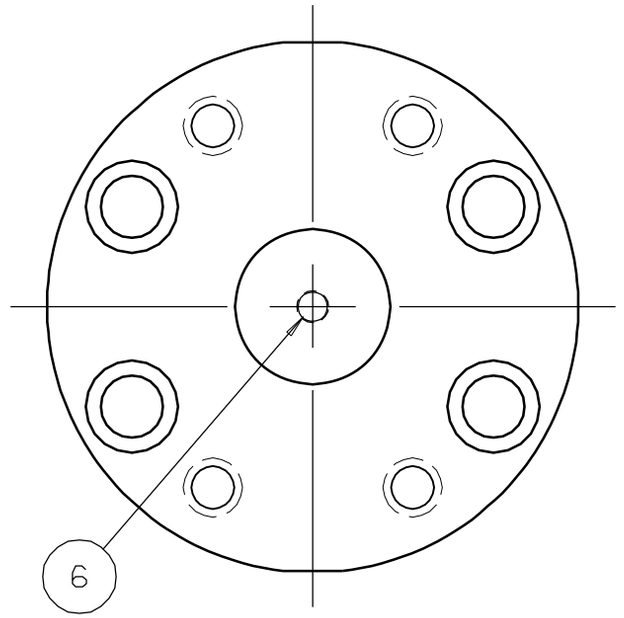
NOTES:

1. FINISH: TRIVALENT CLEAR ZINC PLATE PER ASTM B633-07-III, .0001/.0002 INCH THICK, WITH TOP COAT

2. EACH CHECK VALVE REQUIRES A SEAL PLATE (SEE TAB).

PART NUMBER	REV	ORF DIA	CRACKING PRESSURE	SEAL PLATE	NOTES	APPVL	DATE
475732-01	E	Ø	40 PSI	110085-26		MV	10-91
475732-02	D	.060	3 PSI	110085-26		MV	2-92
475732-03	D	.060	40 PSI	110085-26		MV	2-92
475732-04	D	Ø	3 PSI	110085-26		MV	2-92
475732-05	B	.030	75 PSI	110085-26		MV	10-93
475732-06	B	Ø	25 PSI	110085-26		KKL	10-93
475732-07	B	.060	3 PSI	110085-33	5000 PSI, 2" SAE CODE 62	JWI	9-96
475732-08	B	Ø	3 PSI	110085-33	5000 PSI, 2" SAE CODE 62	KKL	1-97
475732-09	B	.030	3 PSI	110085-26	2" SAE CODE 61	JJR	5-97
475732-10	B	.030	25 PSI	110085-26	2" SAE CODE 61	RAA	10-97
475732-11	B	.060	40 PSI	110085-33	5000 PSI, 2" SAE CODE 62	JDH	9-01
475732-12	C	.060	65 PSI	110085-26	2" SAE CODE 61	NSF	12-01
475732-13	B	.060	75 PSI	110085-26		ALR	1-02
475732-14	B	Ø	3 PSI	110085-26	2" SAE CODE 61	RLT	11-02
475732-15	C	Ø	75 PSI	110085-26	2" SAE CODE 61	JCG	5-04
475732-16	B	Ø	3 PSI	110085-26	2" SAE CODE 61, METRIC	SMP	6-07
475732-17	A	Ø	10 PSI	110085-26	2" SAE CODE 61, METRIC	JSW	8-10
475732-18	A	.030	3 PSI	110085-33	5000 PSI, 2" SAE CODE 62	RAA	1-24-12
475732-19	A	Ø	10 PSI	110085-26	2" SAE CODE 61	RAA	10-8-12
475732-20	A	.060	10 PSI	110085-26	2" SAE CODE 61	CSC	3-21-16





REVISIONS

DESCRIPTION	DFTSMN	APPVL	DATE
-01 REV.B PART LIST CHANGE ONLY, ITEM 1.	RRE	M-V	3-24-92
-01 REV.C. -02 THRU -04 REV.B. PART LIST CHANGES, ADDED NOTE. -05 DELETED.	RRE	M-V	6-4-92
CHG'D P/L'S ADDED ITEM #6. TAB -01, TO REV."D". TABS -02 THRU -04 TO REV."C".	DKB	MV	10-19-92
-15 WAS 100 PSI -15 TO REV B.	JCG	JCG	9-29-04
ADDED FINISH NOTE -01 TO REV E -02 THRU -04 TO REV D -05 THRU -14 TO REV B -15 TO REV C -16 TO REV B	MCW	RAA	11-12-07
ITEM 1 478914-01 VALVE BODY C61 QTY 1 WAS 100-065-675 VALVE BODY C62 QTY 1 -12 TO REV C	TRN	RAA	5-24-11
ADDED TAB-19 XX TO REV E -19 TO REV A	TRN	RAA	10-8-12
ADD TAB -20 @ REV A -XX TO REV F	KLQ	CSC	3-21-16
LETTER	—	B	C	-	—	—	E	F	
ECO NO.	92-0570	92-0801	93-0023	RULE 1	08-0106	11-0786	500004645	500044642	

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION

MATERIAL SIZE

FINISH 1 MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE FULL

MACHINED SURFACES 180 √

MTS® MTS SYSTEMS CORPORATION MINNEAPOLIS, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
MCW		MV	JK
DATE 10-21-91	DATE	DATE 10-21-91	DATE 10-91

TITLE

VALVE-CHECK 2 IN

NEXT LEVEL

PRODUCT CODE

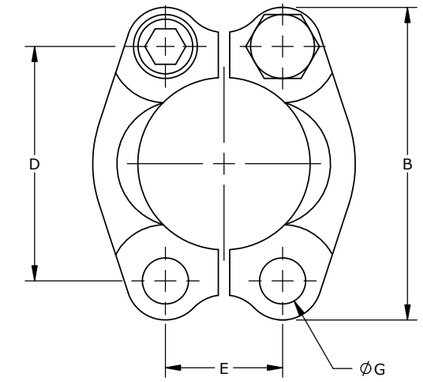
SIZE C

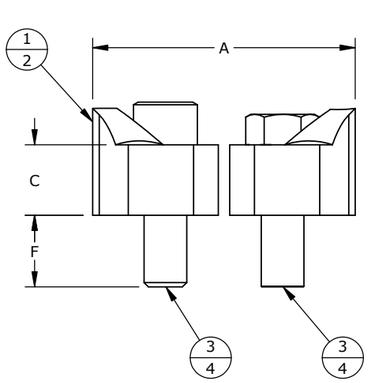
NUMBER 475732-XX REV F

SHEET 1 OF 1

SOURCE/REF. DRAWING: 453104-01

PART NUMBER	REV	PAD SIZE	CODE	THREAD TYPE	FASTENER TYPE	FASTENER SIZE	FASTENER LENGTH	FASTENER COATING	WRENCH SIZE	O-RING	O-RING MAT'L	"A"	"B"	"C"	"D"	"E"	"F"	"G"	APPLV/DATE
527984-01	B	∅1.25	61	ENGLISH	SOCKET HEAD	7/16-14	1.50	BLACK OXIDE	3/8	222	BUNA-A	2.88	3.12	.56	2.312	1.188	.94	.47	BKB/3-9-09
527984-02	B	∅1.50	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	BLACK OXIDE	3/8	225	BUNA-A	3.25	3.69	.62	2.750	1.406	.88	.53	BKB/3-9-09
527984-03	B	∅2.00	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	BLACK OXIDE	3/8	228	BUNA-A	3.81	4.00	.62	3.062	1.688	.88	.53	BKB/3-9-09
527984-04	B	∅1.25	61	ENGLISH	HEX HEAD	7/16-14	1.50	ZINC	5/8	222	BUNA-A	2.88	3.12	.56	2.312	1.188	.94	.47	BKB/3-9-09
527984-05	B	∅1.50	61	ENGLISH	HEX HEAD	1/2-13	1.50	ZINC	3/4	225	BUNA-A	3.25	3.69	.62	2.750	1.406	.88	.53	BKB/3-9-09
527984-06	B	∅2.00	61	ENGLISH	HEX HEAD	1/2-13	1.50	ZINC	3/4	228	BUNA-A	3.81	4.00	.62	3.062	1.688	.88	.53	BKB/3-9-09
527984-07	B	∅1.25	62	ENGLISH	SOCKET HEAD	1/2-13	1.75	BLACK OXIDE	3/8	222	BUNA-A	3.06	3.75	1.06	2.625	1.250	.69	.53	BKB/3-9-09
527984-08	C	∅1.50	62	ENGLISH	SOCKET HEAD	5/8-11	2.25	BLACK OXIDE	1/2	225	BUNA-A	3.75	4.44	1.19	3.125	1.437	1.06	.66	BKB/3-9-09
527984-09	B	∅2.00	62	ENGLISH	SOCKET HEAD	3/4-10	2.75	BLACK OXIDE	5/8	228	BUNA-A	4.50	5.25	1.44	3.812	1.750	1.31	.78	BKB/3-9-09
527984-10	B	∅1.25	62	ENGLISH	HEX HEAD	1/2-13	1.75	ZINC	3/4	222	BUNA-A	3.06	3.75	1.06	2.625	1.250	.69	.53	BKB/3-9-09
527984-11	B	∅1.50	62	ENGLISH	HEX HEAD	5/8-11	2.25	ZINC	15/16	225	BUNA-A	3.75	4.44	1.19	3.125	1.437	1.06	.66	BKB/3-9-09
527984-12	B	∅2.00	62	ENGLISH	HEX HEAD	3/4-10	2.75	ZINC	1 1/8	228	BUNA-A	4.50	5.25	1.44	3.812	1.750	1.31	.78	BKB/3-9-09
527984-13	B	∅2.00	61	ENGLISH	HEX HEAD	1/2-13	1.50	ZINC	3/4	228	VITON	3.81	4.00	.62	3.062	1.688	.88	.53	JC/3-9-09
527984-14	B	∅2.50	61	ENGLISH	HEX HEAD	1/2-13	1.50	ZINC	3/4	232	BUNA-A	4.28	4.50	.75	3.500	2.000	.75	.53	JC/3-9-09
527984-15	B	∅1.00	61	ENGLISH	SOCKET HEAD	3/8-16	1.25	BLACK OXIDE	5/16	219	BUNA-A	2.31	2.75	.62	2.062	1.031	.63	.41	BKB/3-9-09
527984-16	B	∅1.00	61	ENGLISH	HEX HEAD	3/8-16	1.25	ZINC	9/16	219	BUNA-A	2.31	2.75	.62	2.062	1.031	.63	.41	BKB/3-9-09
527984-17	B	∅1.00	62	ENGLISH	SOCKET HEAD	7/16-14	1.75	BLACK OXIDE	3/8	219	BUNA-A	2.75	3.19	.94	2.250	1.093	.81	.47	BKB/3-9-09
527984-18	B	∅1.00	62	ENGLISH	HEX HEAD	7/16-14	1.75		5/8	219	BUNA-A	2.75	3.19	.94	2.250	1.093	.81	.47	BKB/3-9-09
527984-19	B	∅.75	61	ENGLISH	SOCKET HEAD	3/8-16	1.25	BLACK OXIDE	5/16	214	BUNA-A	2.05	2.56	.56	1.875	.875	.69	.41	BKB/3-9-09
527984-20	B	∅.75	61	ENGLISH	HEX HEAD	3/8-16	1.25	ZINC	9/16	214	BUNA-A	2.05	2.56	.56	1.875	.875	.69	.41	BKB/3-9-09
527984-21	B	∅.75	62	ENGLISH	SOCKET HEAD	3/8-16	1.50	BLACK OXIDE	5/16	214	BUNA-A	2.38	2.81	.75	2.000	.937	.75	.41	BKB/3-9-09
527984-22	B	∅.75	62	ENGLISH	HEX HEAD	3/8-16	1.50	ZINC	9/16	214	BUNA-A	2.38	2.81	.75	2.000	.937	.75	.41	BKB/3-9-09
527984-23	B	∅2.00	62	METRIC	SOCKET HEAD	M20 X 2.5mm	70mm	BLACK OXIDE	17mm	228	BUNA-A	4.50	5.25	1.44	3.812	1.750	1.32	21.0mm	BKB/3-9-09
527984-24	B	∅3.00	61	ENGLISH	HEX HEAD	5/8-11	1.75	ZINC	15/16	237	BUNA-A	5.16	5.31	.88	4.188	2.438	.87	.66	BKB/3-9-09
527984-25	B	∅3.00	61	ENGLISH	SOCKET HEAD	5/8-11	1.75	BLACK OXIDE	1/2	237	BUNA-A	5.16	5.31	.88	4.188	2.438	.87	.66	BKB/3-9-09
527984-26	B	∅2.00	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	BLACK OXIDE	3/8	228	VITON	3.81	4.00	.62	3.062	1.688	.88	.53	BKB/3-9-09
527984-27	B	∅1.25	62	ENGLISH	SOCKET HEAD	1/2-13	1.75	BLACK OXIDE	3/8	222	VITON	3.06	3.75	1.06	2.625	1.250	.69	.53	BKB/3-9-09
527984-28	B	∅2.00	62	ENGLISH	SOCKET HEAD	3/4-10	2.75	BLACK OXIDE	5/8	228	VITON	4.50	5.25	1.44	3.812	1.750	1.31	.78	BKB/3-9-09
527984-29	B	∅2.00	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	ULTRACOAT	3/8	228	VITON	3.81	4.00	.62	3.062	1.688	.88	.53	BKB/3-9-09
527984-30	B	∅1.25	62	ENGLISH	SOCKET HEAD	1/2-13	1.75	ULTRACOAT	3/8	222	VITON	3.06	3.75	1.06	2.625	1.250	.69	.53	BKB/3-9-09
527984-31	B	∅2.00	62	ENGLISH	HEX HEAD	3/4-10	2.50	ULTRACOAT	1 1/8	228	VITON	4.50	5.25	1.44	3.812	1.750	1.06	.78	BKB/3-9-09
527984-32	B	∅2.50	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	ULTRACOAT	3/8	232	VITON	4.28	4.50	.75	3.500	2.000	.75	.53	BKB/3-9-09
527984-33	B	∅1.50	61	ENGLISH	SOCKET HEAD	1/2-13	1.50	ULTRACOAT	3/8	225	VITON	3.25	3.69	.62	2.750	1.406	.88	.53	BKB/3-9-09
527984-34	B	∅1.00	61	ENGLISH	SOCKET HEAD	3/8-16	1.25	ULTRACOAT	5/16	219	VITON	2.31	2.75	.62	2.062	1.031	.63	.41	BKB/3-9-09
527984-35	B	∅1.50	62	METRIC	SOCKET HEAD	M16 X 2.0mm	55mm	BLACK OXIDE	14mm	225	BUNA-A	3.75	4.44	1.19	3.125	1.437	.98	16.5mm	JM/3-9-09
527984-36	B	∅2.00	61	METRIC	SOCKET HEAD	M12 X 1.75mm	35mm	BLACK OXIDE	10mm	228	BUNA-A	3.81	4.00	.62	3.062	1.688	.76	12.5mm	JAA/3-9-09
527984-37	B	∅3.00	61	ENGLISH	HEX HEAD	5/8-11	1.75	ULTRACOAT	15/16	237	BUNA-A	5.16	5.31	.88	4.188	2.438	.87	.66	JPL/3-9-09
527984-38	B	∅.50	61	ENGLISH	SOCKET HEAD	5/16-18	1.25	BLACK OXIDE	1/4	210	BUNA-A	1.81	2.12	.50	1.500	.688	.75	.34	JM/3-9-09
527984-39	B	∅.50	61	ENGLISH	HEX HEAD	5/16-18	1.25	ZINC	1/2	210	BUNA-A	1.81	2.12	.50	1.500	.688	.75	.34	JM/3-9-09
527984-40	B	∅.50	62	ENGLISH	SOCKET HEAD	5/16-18	1.25	BLACK OXIDE	1/4	210	BUNA-A	1.88	2.22	.62	1.594	.718	.63	.34	JM/3-9-09
527984-41	B	∅.50	62	ENGLISH	HEX HEAD	5/16-18	1.25	ZINC	1/2	210	BUNA-A	1.88	2.22	.62	1.594	.718	.63	.34	JM/3-9-09
527984-42	B	∅.50	61	METRIC	SOCKET HEAD	M8 X 1.25mm	25mm	BLACK OXIDE	6mm	210	BUNA-A	1.81	2.12	.50	1.500	.688	.48	8.5mm	JM/3-9-09
527984-43	B	∅.50	61	METRIC	HEX HEAD	M8 X 1.25mm	25mm	FACTORY	13mm	210	BUNA-A	1.81	2.12	.50	1.500	.688	.48	8.5mm	JM/3-9-09
527984-44	B	∅.50	62	METRIC	SOCKET HEAD	M8 X 1.25mm	30mm	BLACK OXIDE	6mm	210	BUNA-A	1.88	2.22	.62	1.594	.718	.56	8.5mm	JM/3-9-09
527984-45	B	∅.50	62	METRIC	HEX HEAD	M8 X 1.25mm	30mm	BLACK OXIDE	13mm	210	BUNA-A	1.88	2.22	.62	1.594	.718	.56	8.5mm	JM/3-9-09
527984-46	B	∅.75	61	METRIC	SOCKET HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	8mm	214	BUNA-A	2.05	2.56	.56	1.875	.875	.62	10.5mm	JM/3-9-09
527984-47	B	∅.75	61	METRIC	HEX HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	17mm	214	BUNA-A	2.05	2.56	.56	1.875	.875	.62	10.5mm	JM/3-9-09
527984-48	B	∅.75	62	METRIC	SOCKET HEAD	M10 X 1.50mm	35mm	BLACK OXIDE	8mm	214	BUNA-A	2.38	2.81	.75	2.000	.937	.63	10.5mm	JM/3-9-09
527984-49	B	∅.75	62	METRIC	HEX HEAD	M10 X 1.50mm	35mm	BLACK OXIDE	17mm	214	BUNA-A	2.38	2.81	.75	2.000	.937	.63	10.5mm	JM/3-9-09
527984-50	B	∅1.00	61	METRIC	SOCKET HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	8mm	219	BUNA-A	2.31	2.75	.62	2.062	1.031	.56	10.5mm	JM/3-9-09
527984-51	B	∅1.00	61	METRIC	HEX HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	17mm	219	BUNA-A	2.31	2.75	.62	2.062	1.031	.56	10.5mm	JM/3-9-09
527984-52	B	∅1.00	62	METRIC	SOCKET HEAD	M12 X 1.75mm	45mm	BLACK OXIDE	10mm	219	BUNA-A	3.06	3.75	1.06	2.625	1.250	.71	12.5mm	JM/3-9-09
527984-53	B	∅1.00	62	METRIC	HEX HEAD	M12 X 1.75mm	45mm	BLACK OXIDE	19mm	219	BUNA-A	3.06	3.75	1.06	2.625	1.250	.71	12.5mm	JM/3-9-09
527984-54	B	∅1.25	61	METRIC	SOCKET HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	8mm	222	BUNA-A	2.88	3.12	.56	2.312	1.188	.62	10.5mm	JM/3-9-09
527984-55	B	∅1.25	61	METRIC	HEX HEAD	M10 X 1.50mm	30mm	BLACK OXIDE	17mm	222	BUNA-A	2.88	3.12	.56	2.312	1.188	.62	10.5mm	JM/3-9-09
527984-56	B	∅1.25	62	METRIC	SOCKET HEAD	M12 X 1.75mm	45mm	BLACK OXIDE	10mm	222	BUNA-A	3.06	3.75	1.06	2.625	1.250	.71	12.5mm	JM/3-9-09
527984-57	B	∅1.25	62	METRIC	HEX HEAD	M12 X 1.75mm	45mm	BLACK OXIDE	19mm	222	BUNA-A	3.06	3.75	1.06	2.625	1.250	.71	12.5mm	JM/3-9-09
527984-58	B	∅1.50	61	METRIC	SOCKET HEAD	M12 X 1.75mm	35mm	BLACK OXIDE	10mm	225	BUNA-A	3.25	3.69	.62	2.750	1.406	.76	12.5mm	JM/3-9-09
527984-59	B	∅1.50	61	METRIC	HEX HEAD	M12 X 1.75mm	35mm	ZINC	19mm	225	BUNA-A	3.25	3.69	.62	2.750	1.406	.76	12.5mm	JM/3-9-09
527984-60	B	∅1.50	62	METRIC	HEX HEAD	M16 X 2.0mm	55mm	BLACK OXIDE	24mm	225	BUNA-A	3.75	4.44	1.19	3.125	1.437	.98	16.5mm	JM/3-9-09
527984-61	B	∅2.00	61	METRIC	HEX HEAD	M12 X 1.75mm	35mm	ZINC	19mm	228	BUNA-A	3.81	4.00	.62	3.062	1.688	.76	12.5mm	JM/3-9-09
527984-62	B	∅2.00	62	METRIC	HEX HEAD	M20 X 2.50mm	70mm	BLACK OXIDE	30mm	228	BUNA-A	4.50	5.25	1.44	3.812	1.750	1.32	21.0mm	JM/3-9-09
527984-63	C	∅2.50	61	METRIC	SOCKET HEAD	M12 X 1.75mm	40mm	BLACK OXIDE	10mm	232	BUNA-A	4.28	4.50	.75	3.500	2.000	.82	12.5mm	JM/3-9-09
527984-64	C	∅2.50	61	METRIC	HEX HEAD	M12 X 1.75mm	40mm	ZINC	19mm	232	BUNA-A	4.28	4.50	.75	3.500	2.000	.82	12.5mm	JM/3-9-09
527984-65	B	∅3.00	61	METRIC	SOCKET HEAD	M16 X 2.0mm	50mm	BLACK OXIDE	14mm	237	BUNA-A	5.16	5.31	.88	4.188	2.438	1.09	16.5mm	JM/3-9-09
527984-66	B	∅3.00	61	METRIC	HEX HEAD	M16 X 2.0mm	50mm	ZINC	24mm	237	BUNA-A	5.16	5.31	.88	4.188	2.438	1.09	16.5mm	JM/3-9-09





(2) O-RING (NOT SHOWN)

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO
ADDED "WRENCH SIZE" COLUMN ADDED PART BALLOONS TABS -01 THRU -07 TO REV. B, -08 TO REV. C, -09 & -10, -13 THRU -15, -19 & -23, -29 THRU -34 TO REV. B RULE 1: -11 & -12, -16 THRU -18, -20 THRU -22, -24 THRU -28, -35 THRU -66 TO REV. B	JMH	JM	4-20-09		09-0567
ITEM 1 100-170-112 FLG HALF WAS 100-107-112 ACTUATOR -63 & -64 TO REV C -XX FROM SEE TAB TO REV C	TRN	JM	9-27-12	C	500004368

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH NONE MASK M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

GENERAL TOLERANCES

.XXX HOLE SIZE TOLERANCE	
0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

ANGLE ±2°	
X/X	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
JMH	-	JM	-
DATE	DATE	DATE	DATE
3-9-09	-	3-2009	-

TITLE: FLANGE KIT-SAE, WITH O-RING

NEXT LEVEL -

SIZE D

NUMBER 527984-XX

REV C

PRODUCT CODE -

SHEET 1 OF 1

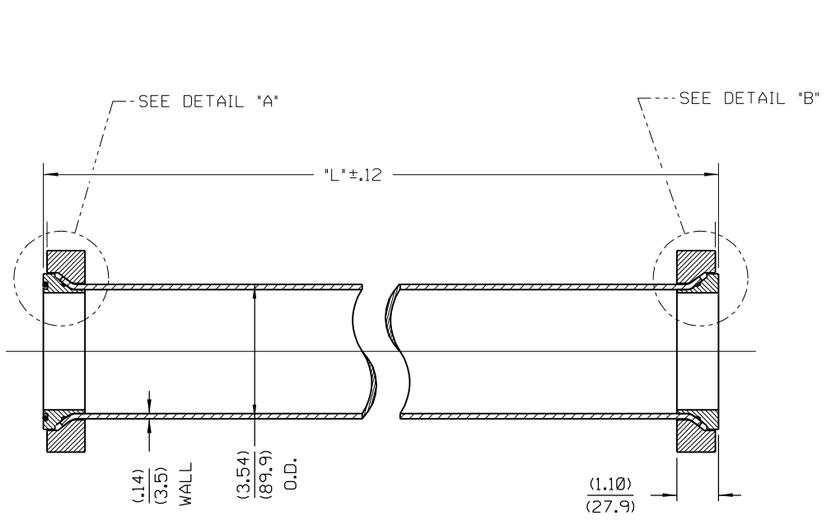
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

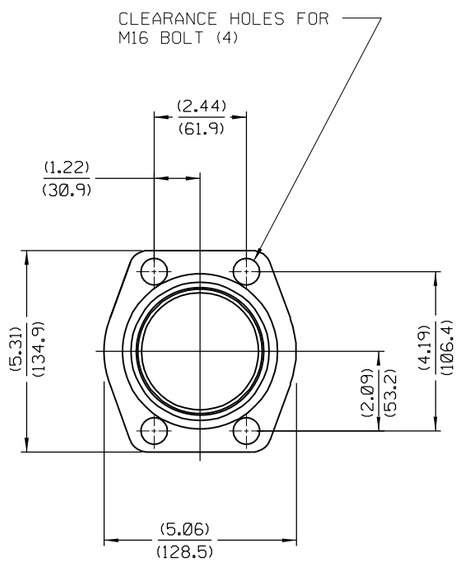
PART NO.	REV	"L" IN	PIPE O.D. X WALL	FLANGE: ONE END	FLANGE: OTHER END	MTS TO PAINT PER	APPVL	DATE
571371-01	A	22.00	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	11-1-06
-02	A	23.18	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	11-1-06
-03	A	107.21	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	11-1-06
-04	A	107.21	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	SMP	11-1-06
-05	A	30.00	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	11-1-06
-06	A	13.27	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	3-5-08
-07	A	39.35	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	3-5-08
-08	A	80.15	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	3-5-08
-09	A	83.91	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	3-5-08
-10	A	21.62	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	10-15-08
-11	A	158.81	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	10-15-08
-12	A	216.50	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	10-15-08
-13	A	108.02	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	1-9-09
-14	A	103.70	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	1-9-09
-15	A	146.62	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	SMP	1-9-09
-16	A	146.62	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	SMP	1-9-09
-17	A	38.45	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	MJS	9/21/12

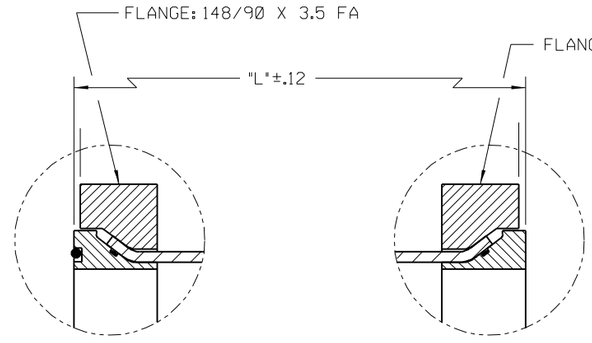
PART NO.	REV	"L" IN	PIPE O.D. X WALL	FLANGE: ONE END	FLANGE: OTHER END	MTS TO PAINT PER	APPVL	DATE
571371-18	A	80.00	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-19	A	36.15	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-20	A	83.65	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-21	A	197.65	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	JPG	10-6-16
-22	A	157.50	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-23	A	179.82	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-24	A	179.82	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	JPG	10-6-16
-25	A	63.00	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-26	A	51.00	90MM X 3.5MM	DETAIL A	DETAIL A	372889-28 (BLUE)	JPG	10-6-16
-27	A	124.50	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	JPG	10-6-16
-28	A	100.00	90MM X 3.5MM	DETAIL A	DETAIL B	372889-28 (BLUE)	JPG	10-6-16

REVISIONS

DESCRIPTION	LETTER	ECO NO.
-17 TAB ADDED, -XX TO REV B JAV | MJS | 9/12	B	500004183
ADDED -18 THRU -28 TO REV A -XX TO REV C RWR | JPG | 10-6-16	C	500051874







DETAIL "A"

SCALE: FULL

DETAIL "B"

SCALE: FULL

NOTES:

1. MATERIAL: ST 52.4 NBK PHOSPHATED COLD DRAWN SEAMLESS CARBON STEEL PIPE.
2. BOLTS NOT INCLUDED.
3. PIPE TO BE CAPPED OR SEALED BY A METHOD APPROVED BY MTS ENGINEERING.
4. ZERUST PIPE STRIPS OR SIMILAR CORROSION INHIBITERS INSTALLED PER MANUFACTURER INSTRUCTIONS.
5. DIMENSIONS INCHES / MILLIMETERS
6. DIMENSIONS IN PARENTHESIS ARE REFERENCE.

VENDOR REFERENCE INFORMATION:

RECOMMENDED MOUNTING BOLTS:
SIZE- M16 X 2.00MM
LENGTH- FLANGE TO COMPONENT: 50 MM
FLANGE TO FLANGE: 80 MM
TORQUE- 165 NM (122 LB-FT)

SOURCE/REF. DRAWING: 546855-XX

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION 1

MATERIAL SIZE

FINISH: SEE TAB — MASK M

- THREAD DEPTHS ARE TO MIN. FULL THDS
- DRILL DEPTHS ARE TO FULL DIA.
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE 1:2

MACHINED SURFACES 180 √

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

	DRAWN	CHECK	ENGR	MFG
	MCW		SMP	
DATE	11-1-06	DATE	11-1-06	DATE

THIRD ANGLE PROJ.

PRODUCT CODE: HMPG

MTS® MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A. ©

TITLE: PIPE ASSY-RETURN, STRAIGHT, 90 MM O.D.

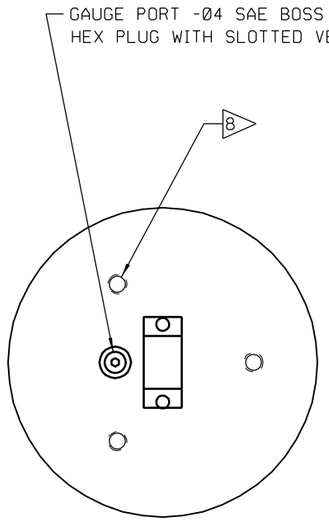
NEXT LEVEL

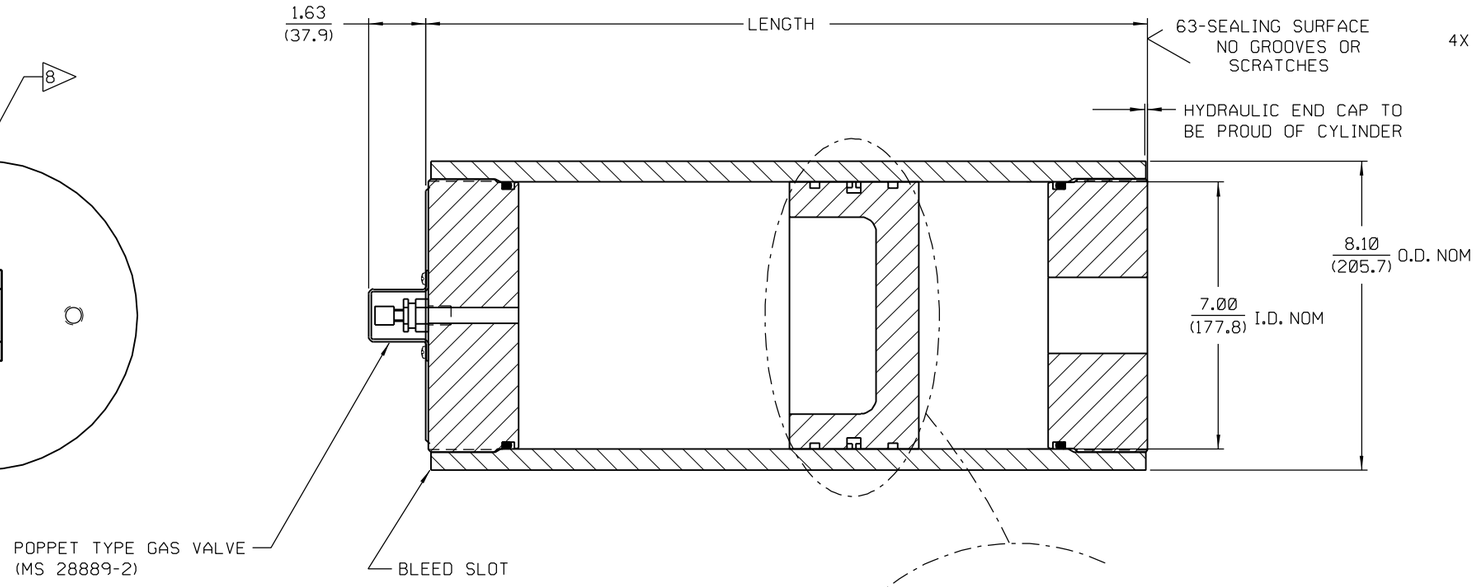
SIZE: D

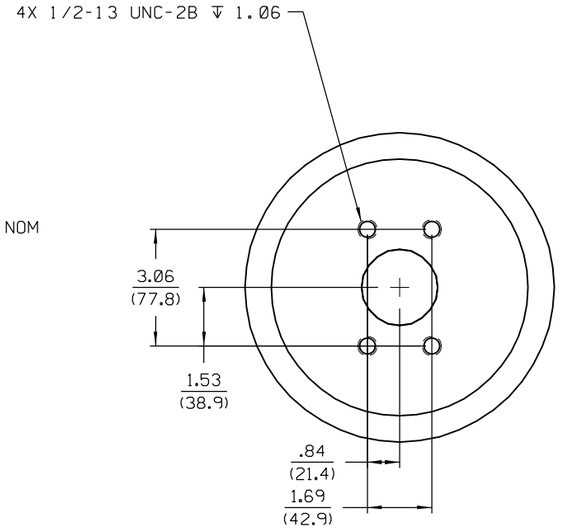
NUMBER: 571371-XX

REV: C

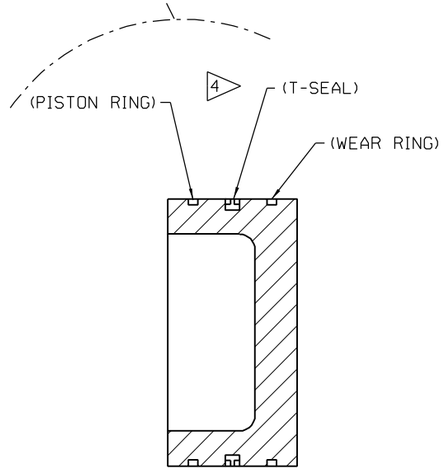
SHEET 1 OF 1

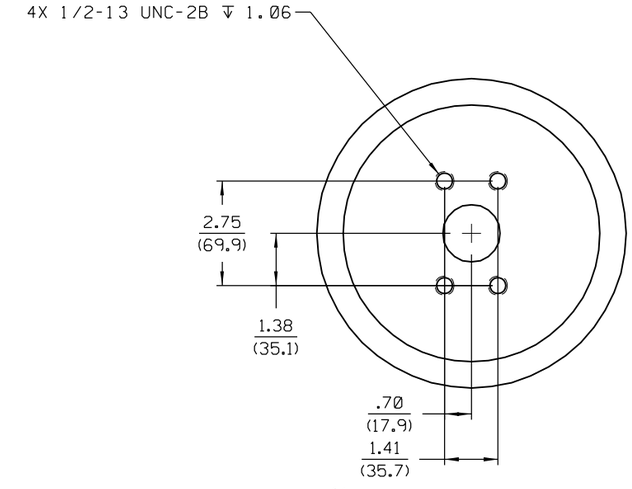






2" CODE 61 MOUNTING PORT





1½" CODE 61 MOUNTING PORT

NOTES:

1. ACCUMULATORS TO BE PROVIDED WITH A CRN (CANADIAN REGISTRATION NUMBER) AND ALL DOCUMENTS AND LABELS REQUIRED FOR USE WITHIN THE PROVINCE WHERE THE ACCUMULATOR WILL BE OPERATED.
2. MAX OPERATING PRESSURE: 3000 PSI

4 PISTON SEAL TO BE QTY (1) T-SEAL AND QTY (1) PISTON RING.

5. ACCUMULATOR TO BE PROVIDED WITH A LABEL INCLUDING THE FOLLOWING:
   - MTS LOGO
   - MTS PART NUMBER
   - MANUFACTURER NAME
   - MANUFACTURER PART NUMBER
   - MANUFACTURER SERIAL NUMBER
   - MAX OPERATING PRESSURE
   - TEMPERATURE OPERATING RANGE
   - NOMINAL VOLUME
   - MANUFACTURER SEAL KIT PART NUMBER
   - MTS SEAL KIT PART NUMBER
   E - ANY ADDITIONAL INFORMATION REQUIRED FOR USE IN CANADA
6. ACCUMULATOR LABEL TO CONTAIN HAZARD AND/OR INFORMATIONAL SYMBOLS FOR THE FOLLOWING:
   A. SKIN INJECTION HAZARD SYMBOL
   B. ACCUMULATOR SYMBOL
   C. CONSULT MANUAL SYMBOL
7. MTS TO PROVIDE AND INSTALL CHARGE PRESSURE RECORD LABEL (REF Ø3-659-201)

8 BLIND HOLES ON TOP OF GAS END CAP MAY BE USED FOR ASSEMBLY/DISASSEMBLY.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO.
NOTE 2 WAS 250 BAR -01 TO REV B	MCW	BJA	4-20-11	—	11-0677
ADDED MISSING INFO LENGTH,TEMP, -01 TO REV C	MCW	BJA	9-27-11	—	11-1417
ADDED -02 & -03 TO REV A -XX FROM SEE TAB TO REV C	MCW	BJA	8-28-13	C	500013552
ADDED -04THRU-10 TO REV A -XX TO REV D	MCW	BJA	12-17-13	D	500016736
E CHGD INFO ON NOTE 5 -05 WAS 7½GAL & 2"C61 -XX TO REV E -01 TO REV D -02 THRU -10 TO REV B	MCW	BJA	1-17-14	E	500017228
ADDED MISSING DIMENSIONS -XX TO REV F -01 TO REV E -02 THRU -10 TO REV C	MCW	BJA	3-1-14	F	500018548

565416-XX

SOURCE/REF DRAWING: 572149-XX

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ----------

MATERIAL SIZE: ----------

FINISH: SEE TAB — MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180 √

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

THIRD ANGLE PROJ.

	DRAWN	CHECK	ENGR	MFG
	MCW		BJA	
DATE	4-19-11	DATE	4-19-11	DATE

TITLE: ACCUMULATOR-PISTON, T SEAL CRN, 7" DIA

NEXT LEVEL: ----------

PRODUCT CODE: ---------

SIZE: D

NUMBER: 575811-XX

REV: F

SHEET 1 OF 2

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

PART NO.	REV.	MODEL	TYPE	OIL VOLUME NOM	OIL VOLUME ACTUAL CU. IN.	LENGTH MM	DRY WEIGHT LBS	MOUNTING (OIL) PORT	ACCUM OPERATING TEMP RANGE	SEALS MATERIAL	SEALS OPERATING TEMP RANGE	SHELL MIN DESIGN METAL TEMP	FINISH	APPVL	DATE	NOTES
575811-01	E	111.14	ACCUM	7½GAL	1732.5	1411.5	283.5	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	4-19-11	
575811-02	C	111.14	ACCUM	2½GAL	577.5	649.5	169.6	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	8-28-13	
575811-03	C	111.14	ACCUM	5 GAL	1155	1030.5	226.5	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	8-28-13	
575811-04	C	111.14	ACCUM	1 GAL	231	420.9	135.3	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-05	C	111.14	ACCUM	2½GAL	577.5	649.5	169.6	1½" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-06	C	111.14	ACCUM	10 GAL	1789	1792.5	340.4	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-07	C	111.14	ACCUM	15 GAL	3465	2554.5	454.3	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-08	C	111.14	ACCUM	20 GAL	4620	3318.3	568.2	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-09	C	111.14	ACCUM	25 GAL	5775	4080.3	682.1	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	
575811-10	C	111.14	ACCUM	30 GAL	6930	4842.3	796.0	2" CODE 61	+20°F/+165°F	BUNA N	-20°F/+165°F	————	372889-16 BLK	BJA	12-17-13	

REVISIONS

DESCRIPTION			LETTER	ECN NO.
DRAWN	ENGR	DATE		

SOURCE/REF DRAWING: 565416-XX

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ----------

MATERIAL SIZE: ----------

FINISH: SEE TAB — MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180 √

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
MCW		BJA	
DATE 4-19-11	DATE	DATE 4-19-11	DATE

TITLE: ACCUMULATOR-PISTON, T SEAL CRN, 7" DIA

NEXT LEVEL: ----------

PRODUCT CODE: ---------

SIZE: D

NUMBER: 575811-XX

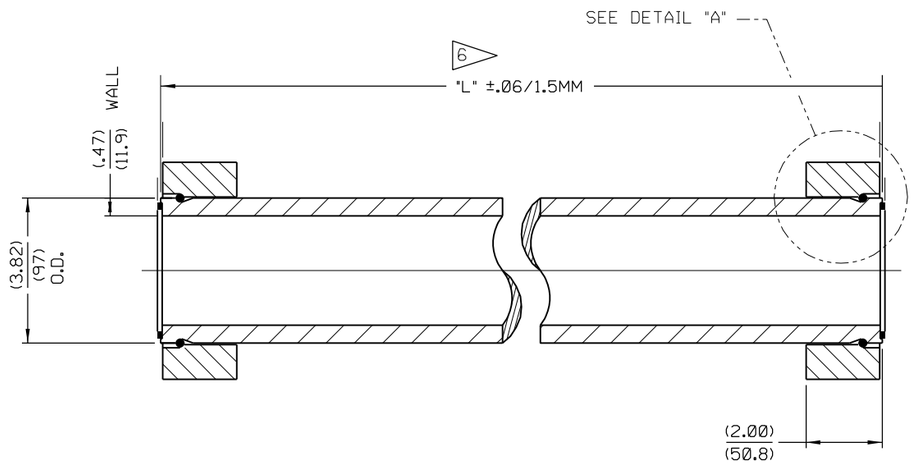
REV: F

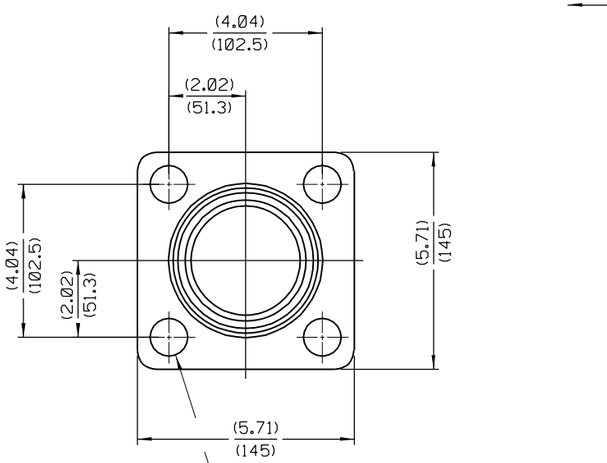
PART NO.	REV	"L" IN / (MM)	PIPE O.D. X WALL	MTS TO PAINT PER	APPROVAL	DATE
579820-01	A	205.61 / (5222.4)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-02	A	212.56 / (5398.9)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-03	A	138.35 / (3514.0)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-04	A	134.02 / (3404.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-05	A	233.85 / (5939.8)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-06	A	29.69 / (754.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-07	A	43.69 / (1109.7)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-08	A	39.53 / (1004.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-09	B	106.46 / (2704.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-10	A	94.36 / (2396.8)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14

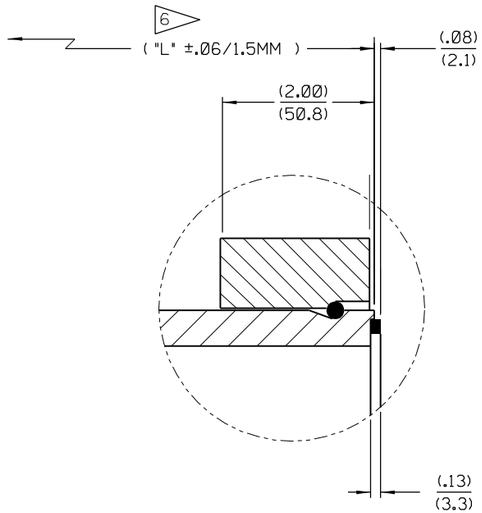
PART NO.	REV	"L" IN / (MM)	PIPE O.D. X WALL	MTS TO PAINT PER	APPROVAL	DATE
579820-11	A	92.68 / (2354.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-12	A	118.27 / (3004.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-13	A	128.11 / (3254.1)	97MM X 12MM	372889-29 (RED)	JAO	4-8-14
579820-14	A	133.74 / (3397.0)	97MM X 12MM	372889-29 (RED)	CSC	2-8-16
579820-15	A	120.48 / (3060.2)	97MM X 12MM	372889-29 (RED)	CSC	2-8-16
579820-16	A	90.33 / (2294.4)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-17	A	33.78 / (858.0)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-18	A	69.14 / (1756.2)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-19	A	104.00 / (2641.6)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-20	A	180.00 / (4572.0)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-21	A	60.63 / (1540.0)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-22	A	49.40 / (1254.8)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16
579820-23	A	236.00 / (5994.4)	97MM X 12MM	372889-29 (RED)	JPG	10-6-16

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO.
TAB -09: 106.46" WAS 108.16" -XX AND -09 TO REV B	KKL	JAO	4-16-14	B	500022012
ADDED -14,-15 REV A -XX TO REV C	RWR	CSC	2-8-16	C	500042528
ADDED -16 THRU -23 REV A -XX TO REV D	RWR	JPG	10-6-16	D	500051874







DETAIL "A"

SCALE: FULL

NOTES:

1. MATERIAL: ST 52.4 NBK PHOSPHATED COLD DRAWN SEAMLESS CARBON STEEL PIPE.
2. BOLTS NOT INCLUDED.
3. PIPE TO BE CAPPED OR SEALED BY A METHOD APPROVED BY MTS ENGINEERING.
4. ZERUST PIPE STRIPS OR SIMILAR CORROSION INHIBITERS INSTALLED PER MANUFACTURER INSTRUCTIONS.
5. DIMENSIONS $\frac{\text{INCHES}}{\text{MILLIMETERS}}$ DIMENSIONS IN PARENTHESIS ARE REFERENCE.
6. DIMENSION "L" INCLUDES SEALS.

571370-XX

SOURCE/REF DRAWING: 493697-XX

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: 1

MATERIAL SIZE:

FINISH: SEE TAB — MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180 √

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

THIRD ANGLE PROJ.

	DRAWN	CHECK	ENGR	MFG
	KKL		JAO	
DATE	4-7-14	DATE	4-8-14	DATE

TITLE: PIPE ASSY-PRESS, 97MM X 12MM

NEXT LEVEL:

SIZE: D

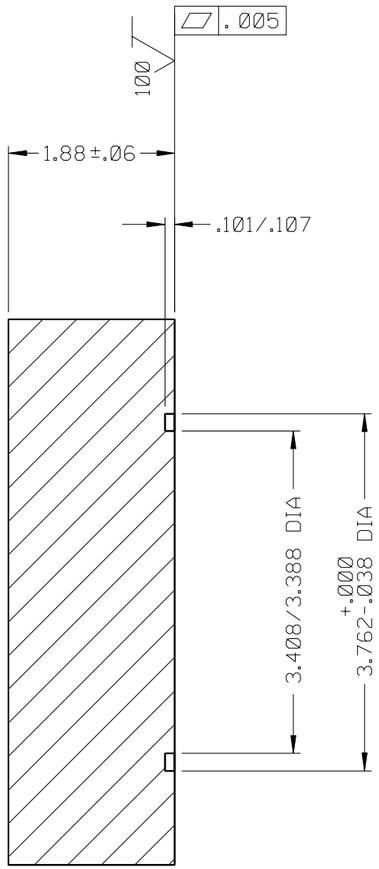
NUMBER: 579820-XX

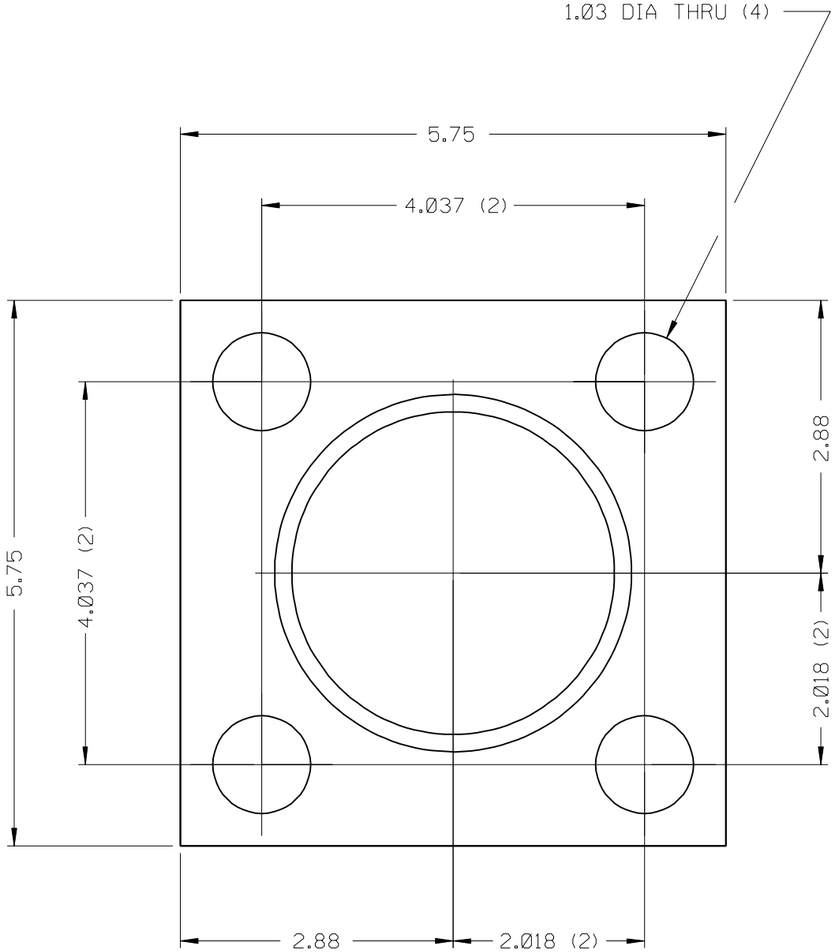
REV: D

PRODUCT CODE: -----

SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©





NOTES:

1. FINISH: YELLOW ZINC PLATE PER ASTM B633-85, TYPE II, .0003"/.0005" THICK. ALL DIMENSIONS APPLY BEFORE PLATING.

APPROXIMATE WEIGHT: 17 LBS

SOURCE/REF DRAWING:

REVISIONS

	DESCRIPTION	APPVL	DATE
DRAWN			
LETTER			
ECN NO.			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: STL HR/CR LOW CARBON

MATERIAL SIZE: 2.00 THK

FINISH: 1 MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE 1:1

MACHINED SURFACES 180 √

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

THIRD ANGLE PROJ.

DRAWN	CHECK	ENGR	MFG
KKL		CLC	
DATE 3-9-98	DATE	DATE 3-10-98	DATE

TITLE: PLATE-BLOCKING,PRESSURE 97MM FLANGE

NEXT LEVEL: 539596-01

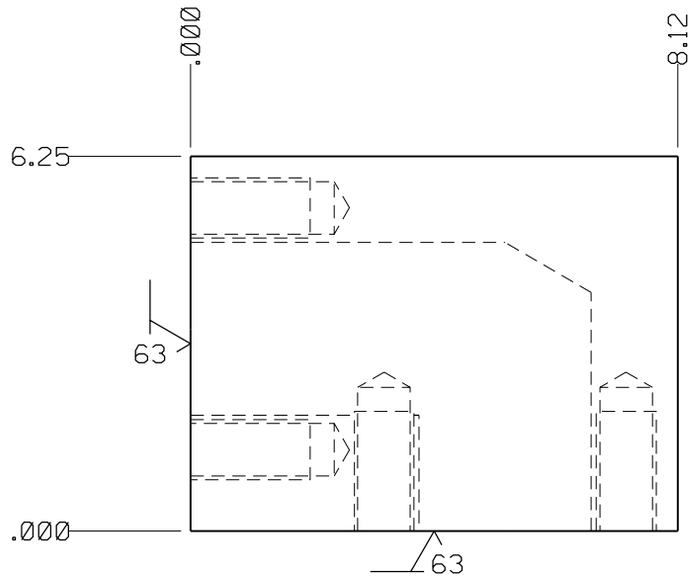
SIZE: C

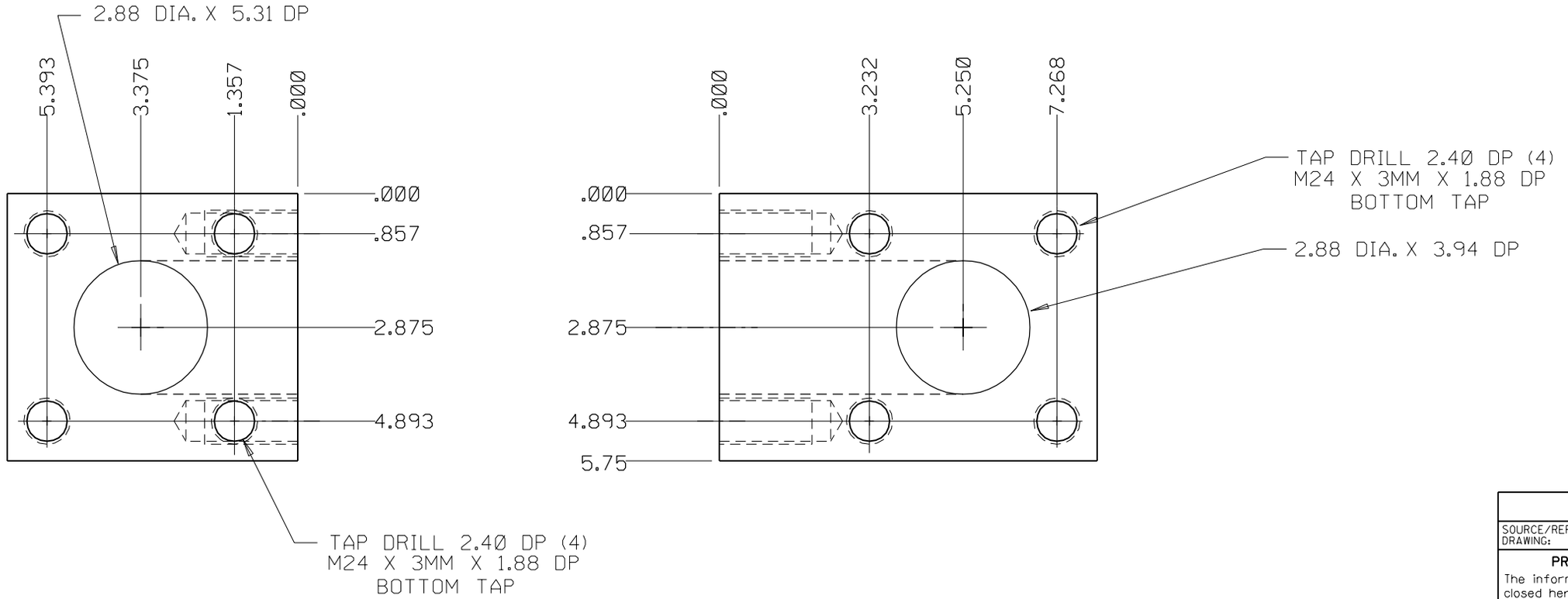
NUMBER: 545520-01

REV: A

PRODUCT CODE: 320.21-51

SHEET 1 OF 1





554233-01

SOURCE/REF DRAWING: 100-036-077

REVISIONS

	DESCRIPTION	DRAWN	APPVL	DATE
LETTER				
ECN NO.				

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE:

FINISH: BLACK ANODIZE — MASK M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE 1/2

MACHINED SURFACES 180 √

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

	DRAWN	CHECK	ENGR	MFG
	MCW		SMP	
DATE	6-15-06		6-15-06	

TITLE: MANIFOLD-ELBOW 97MM ALUM

NEXT LEVEL

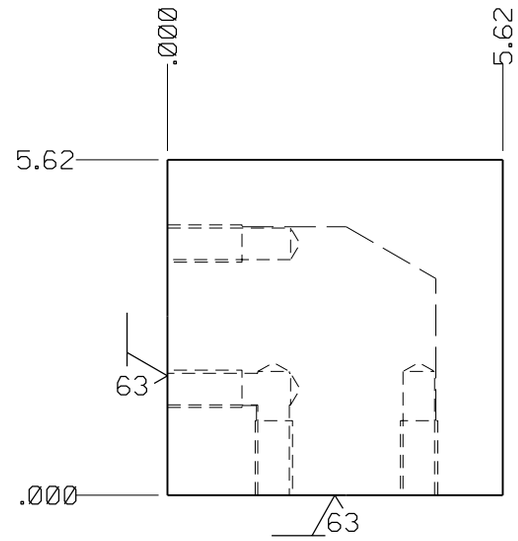
SIZE: C

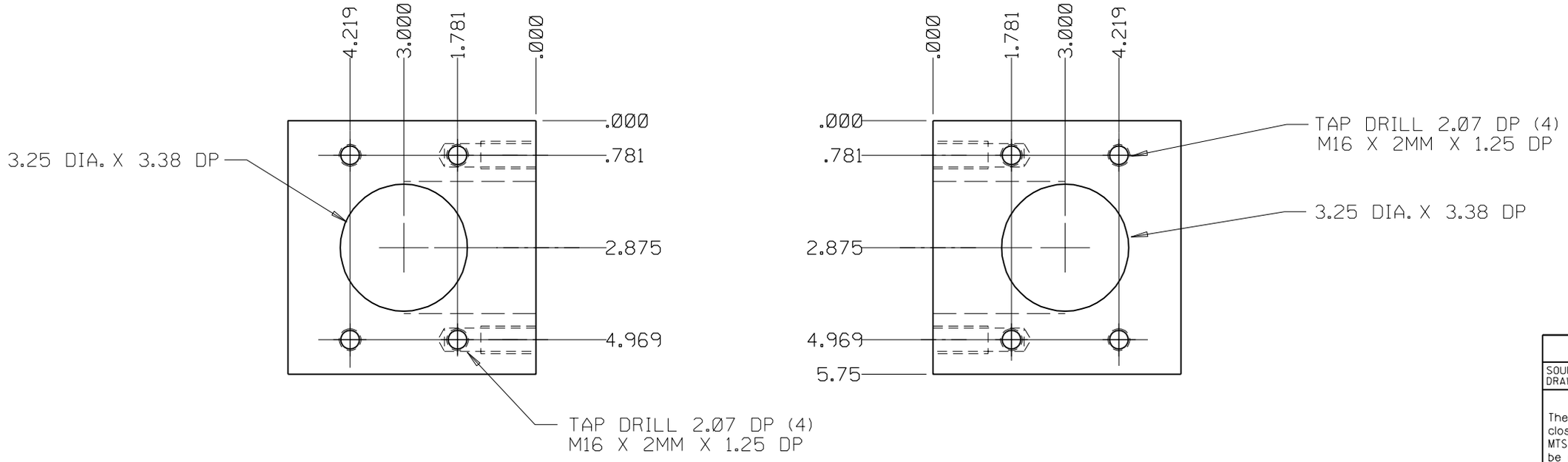
PRODUCT CODE: HMPG

NUMBER: 100-166-276

REV: A

SHEET 1 OF 1





554232-01

SOURCE/REF DRAWING: 100-036-078

PROPRIETARY DATA

REVISIONS

DESCRIPTION	DRAWN	APPVL	DATE
LETTER			
ECN NO.			

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE:

FINISH: BLACK ANODIZE

MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE 1/2

MACHINED SURFACES 180 √

.XXX HOLE SIZE TOLERANCE

0.000 TO .750	OVER .750 TO 1.500
+.010/-.002	+.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ.

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A. ©

	DRAWN	CHECK	ENGR	MFG
	MCW		SMP	
DATE	6-15-06		6-15-06	

TITLE: MANIFOLD-ELBOW 90MM ALUM

NEXT LEVEL:

SIZE: C

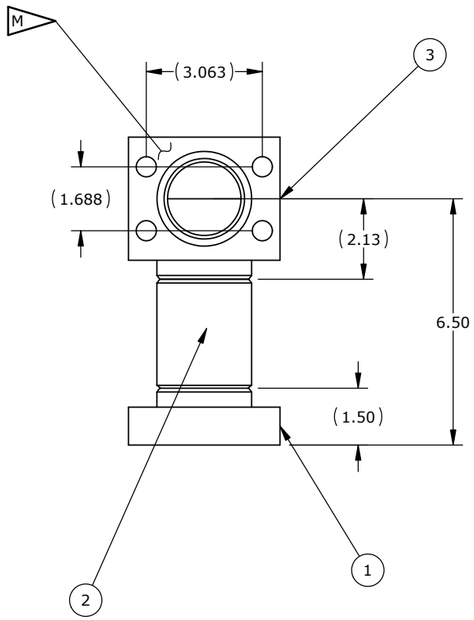
NUMBER: 100-166-277

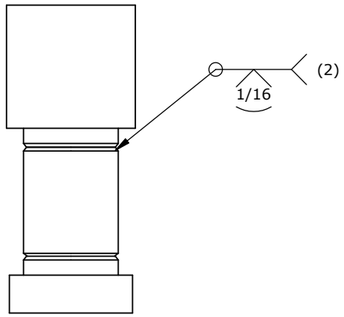
REV: A

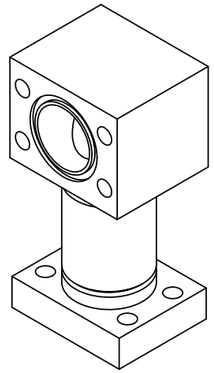
PRODUCT CODE: HMPG

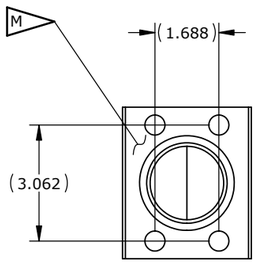
SHEET 1 OF 1

ITEM NO.	DESCRIPTION	VENDOR	VENDOR P/N	QTY.
1	FLANGE-WELDMENT, O-RING	MAIN MFG	1109-32-32	1
2	PIPE 2 IN NOM SCH 80 X 2.75 LG	————	————	1
3	FLANGE ELBOW BUTT WELD	MAIN MFG	1137-32-32	1









REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

SOURCE/REF DRAWING

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: SEE DRAWING
MATERIAL SIZE: ————

FINISH: 372889-16 BLACK
MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE
MACHINED SURFACES: 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
MCW		SMP	
DATE	DATE	DATE	DATE
1-9-09		1-9-09	

TITLE: ELBOW-PIPE WELDMENT,2" C61 SCHED 80

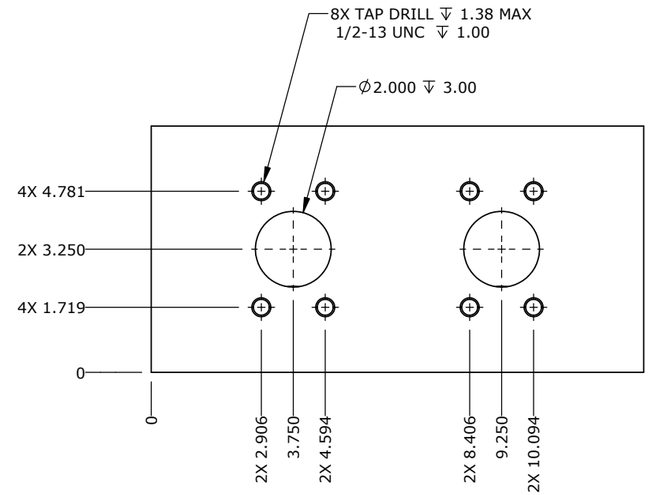
NEXT LEVEL: ————
PRODUCT CODE: ----------

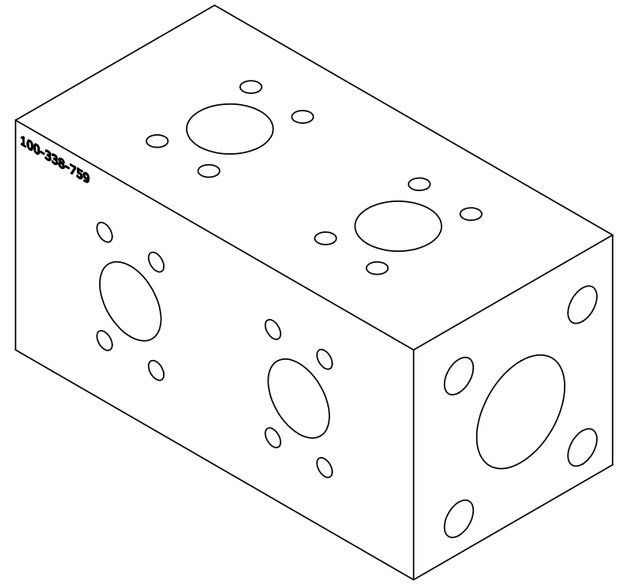
SIZE: D

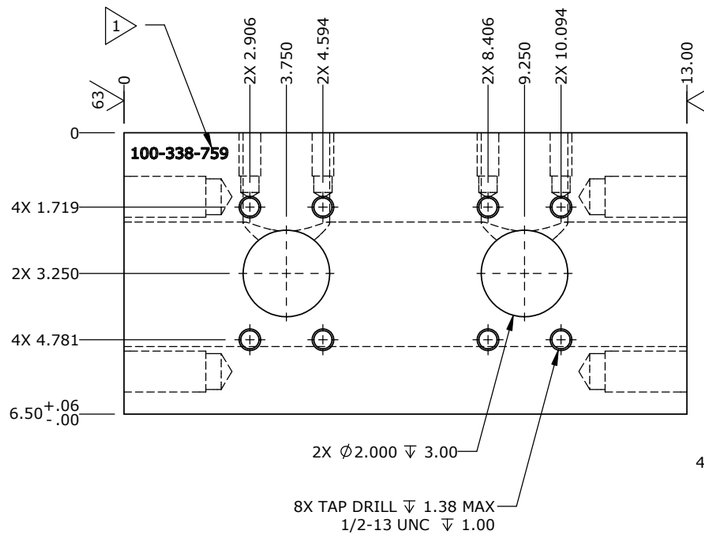
NUMBER: 100-207-308
REV: A

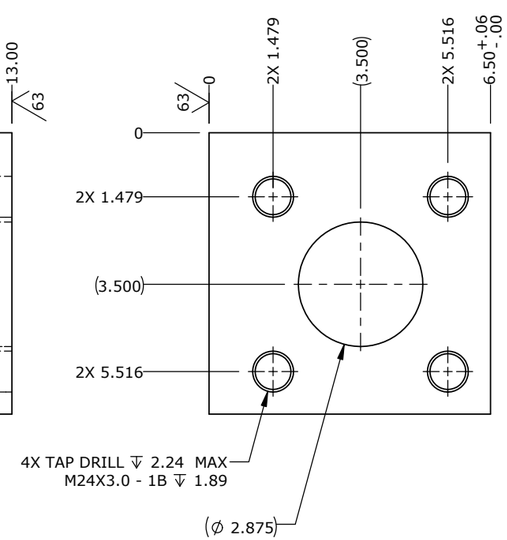
SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.









NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING 100-207-449

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351
MATERIAL SIZE: -----
FINISH: 2
MASK
- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE
MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

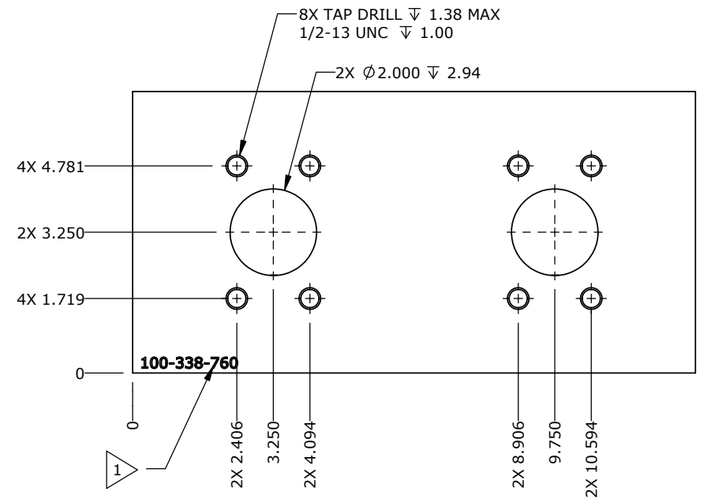
THIRD ANGLE PROJ

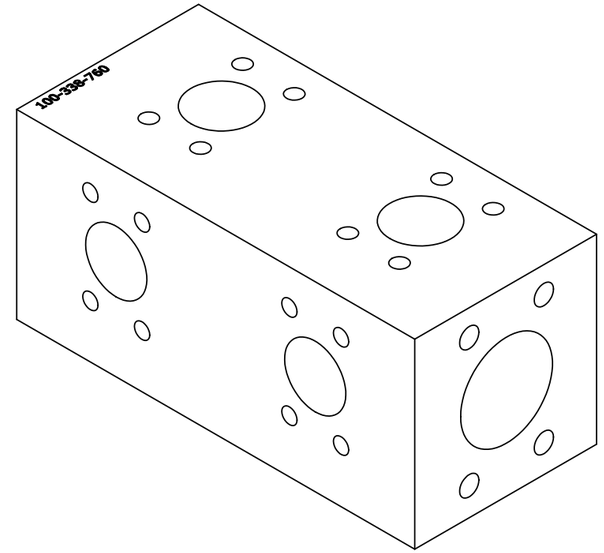
DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 7/11/16	DATE -	DATE 7/11/16	DATE -

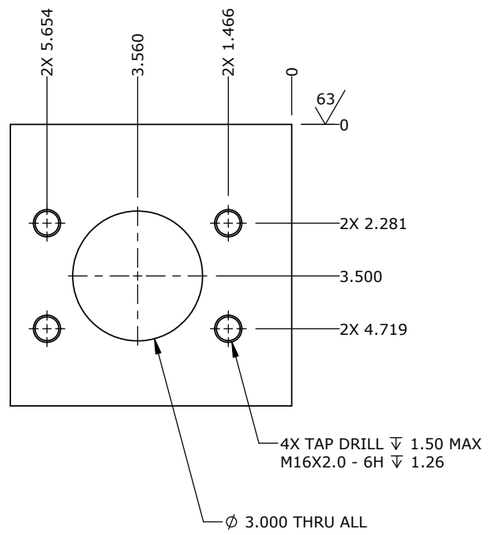
TITLE: MANIFOLD-97MM W/(4) 2" C61 OUTLETS

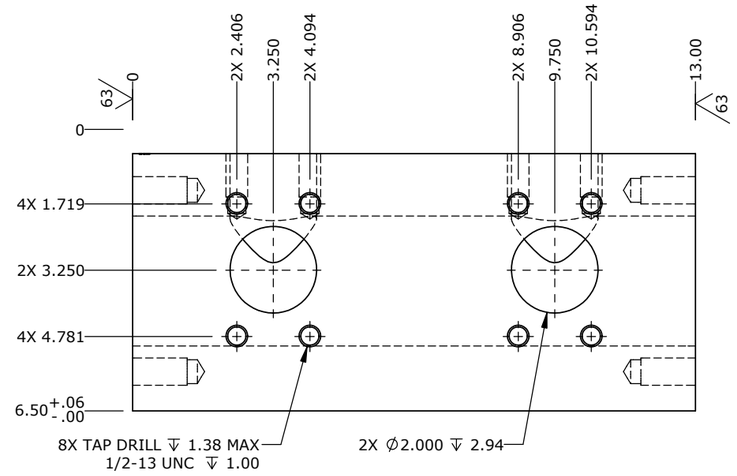
NEXT LEVEL: -----
PRODUCT CODE: -----
SIZE: D
NUMBER: 100-338-759
REV: A
SHEET 1 OF 1

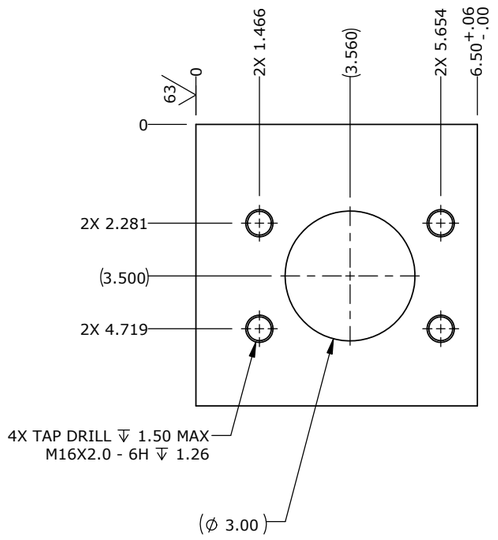
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.











NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

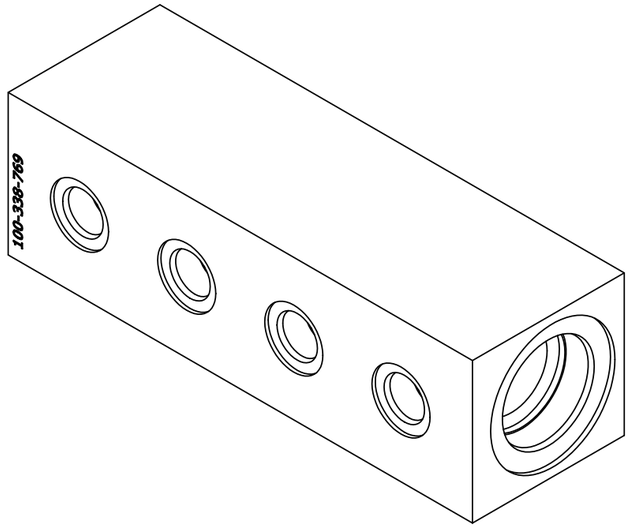
DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

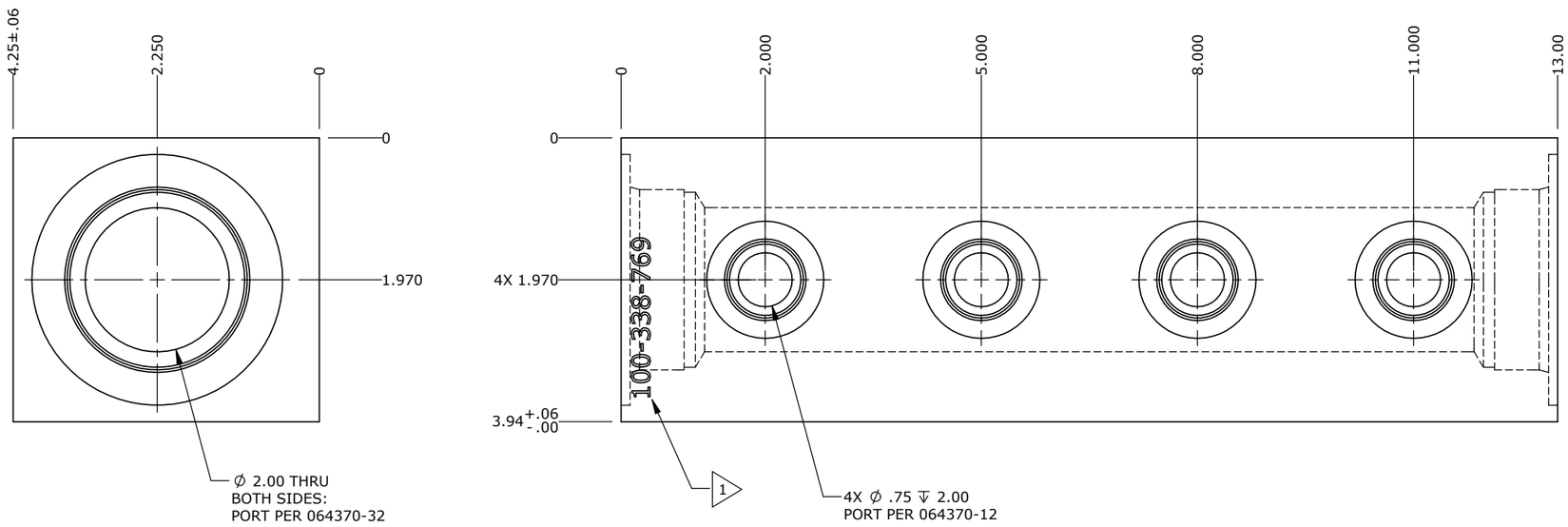
-

SOURCE/REF DRAWING 100-207-451

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351	.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003	DRAWN: RAP	CHECK: -	ENGR: JPG	MFG: -
MATERIAL SIZE: -----			DATE: 7/11/16	DATE: -	DATE: 7/11/16	DATE: -
FINISH: 2	MASK	ANGLE ±2°	TITLE: MANIFOLD-90MM W/(4) 2" C61 OUTLETS			
• THREAD DEPTHS ARE TO MIN FULL THDS • DRILL DEPTHS ARE TO FULL DIA • REMOVE BURRS AND SHARP EDGES • DO NOT SCALE PRINT	SCALE: NONE	GENERAL TOLERANCES: X ±1/4, .X ±.1, .XX ±.03, .XXX ±.010				
	MACHINED SURFACES 180√		NEXT LEVEL: -----	SIZE: D	NUMBER: 100-338-760	REV: A
MTS MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A.	THIRD ANGLE PROJ		PRODUCT CODE: -----		SHEET 1 OF 1	





NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE: -----

FINISH: 2

MASK: M

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES: 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2°; X/Y ±1/4; .X ±.1; .XX ±.03; .XXX ±.010

THIRD ANGLE PROJ

	DRAWN	CHECK	ENGR	MFG
	RAP	-	JPG	-
DATE	7/11/16	-	7/11/16	-

TITLE: MANIFOLD, -32(2) WITH -12(4) OUTLETS

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

NEXT LEVEL: -----

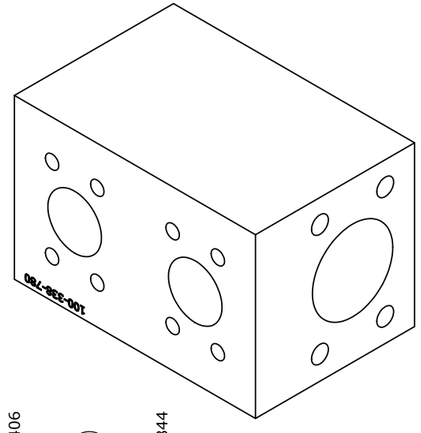
PRODUCT CODE: -----

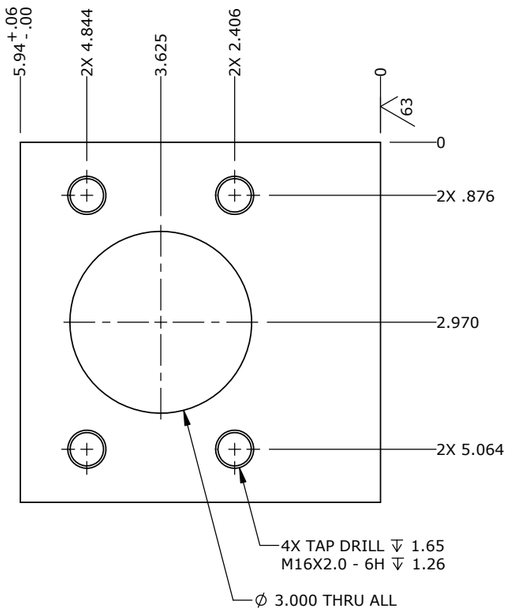
SIZE: D

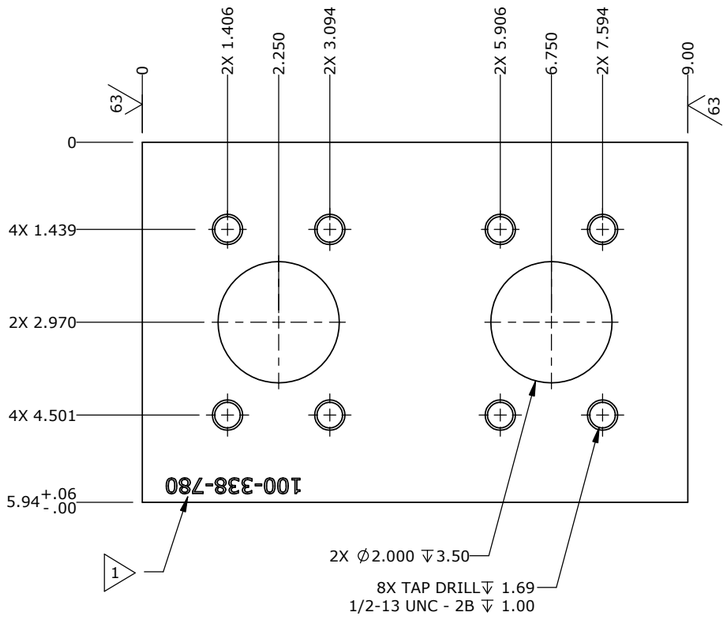
NUMBER: 100-338-769

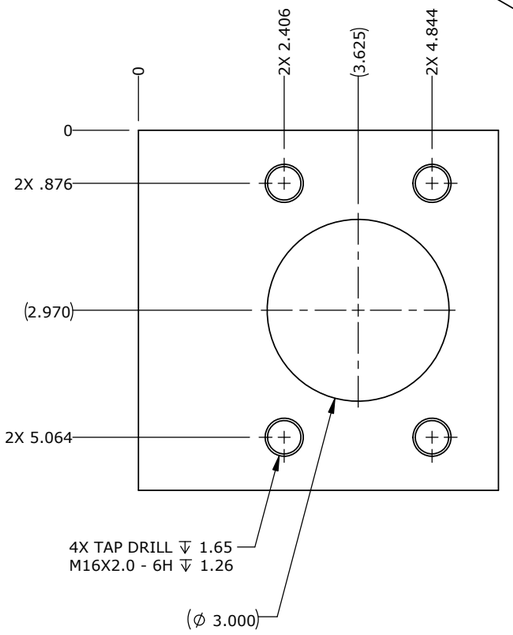
REV: A

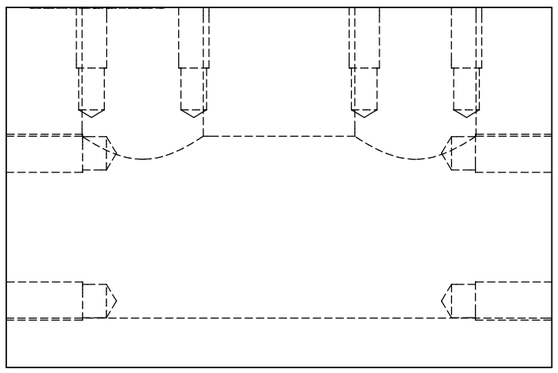
SHEET 1 OF 1











NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

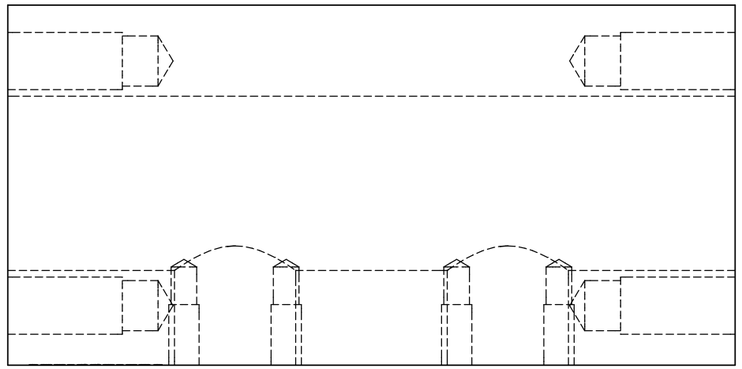
DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

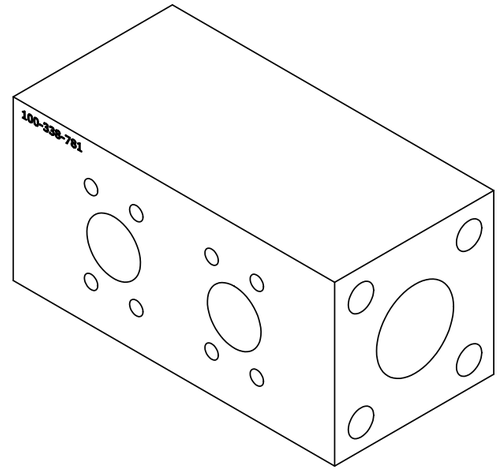
-

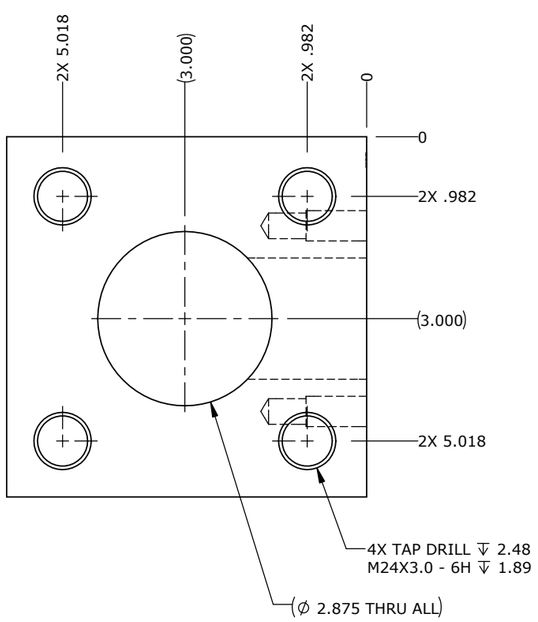
SOURCE/REF DRAWING 100-233-710

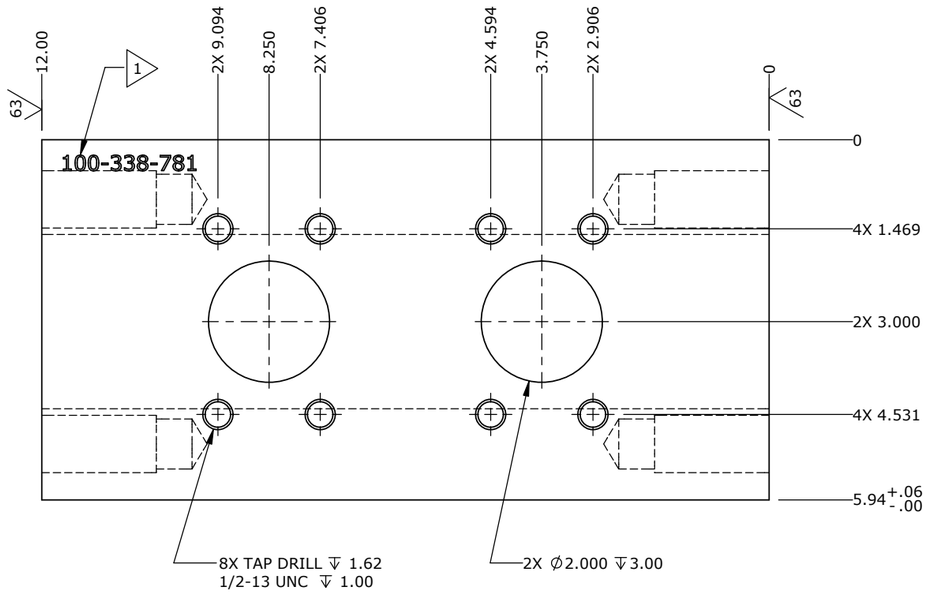
UNLESS OTHERWISE SPECIFIED

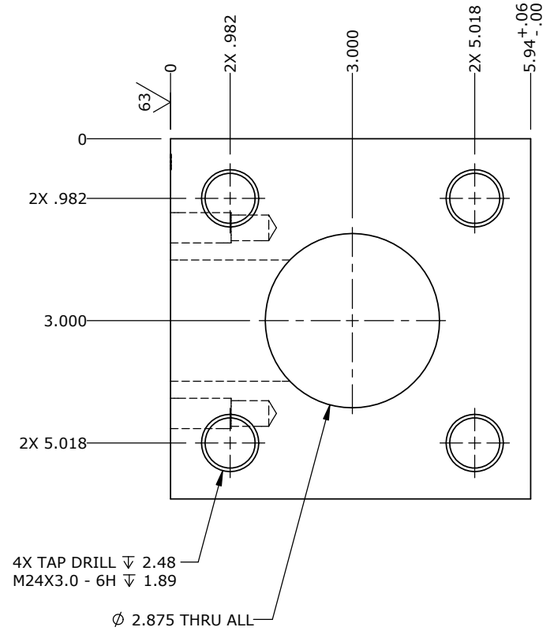
MATERIAL DESCRIPTION: ALUM 2024-T351	.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003	DRAWN: RAP DATE 7/11/16	CHECK: - DATE -
MATERIAL SIZE: -----		ENGR: JPG DATE 7/11/16	MFG: - DATE -
FINISH: 2 MASK	GENERAL TOLERANCES: ANGLE ±2° ; X/Y ±1/4 ; .X ±.1 ; .XX ±.03 ; .XXX ±.010	TITLE: MANIFOLD,90MM X 2"C61(2)	
• THREAD DEPTHS ARE TO MIN FULL THDS • DRILL DEPTHS ARE TO FULL DIA • REMOVE BURRS AND SHARP EDGES • DO NOT SCALE PRINT	SCALE: NONE; MACHINED SURFACES: 180√	NEXT LEVEL: -----	SIZE: D
MTS MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A.	THIRD ANGLE PROJ	PRODUCT CODE: -----	NUMBER: 100-338-780 REV: A
			SHEET 1 OF 1











NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING 100-289-907

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE: -----

FINISH: 2 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

	DRAWN	CHECK	ENGR	MFG
	RAP	-	JPG	-
DATE	7/11/16	-	7/11/16	-

TITLE: MANIFOLD-LINE END,97MM/2X 2"C61 OUTLETS

NEXT LEVEL: -----

PRODUCT CODE: -----

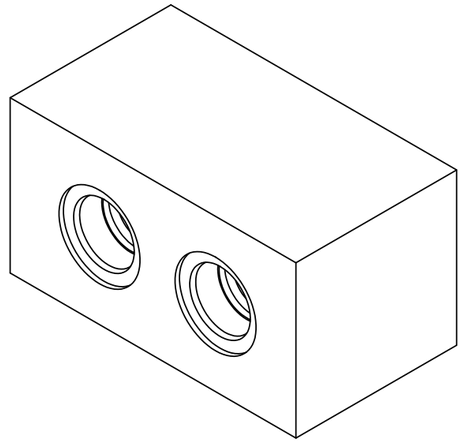
SIZE: D

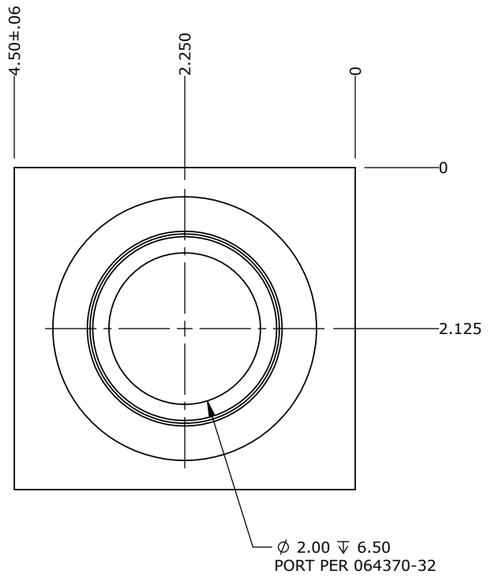
NUMBER: 100-338-781

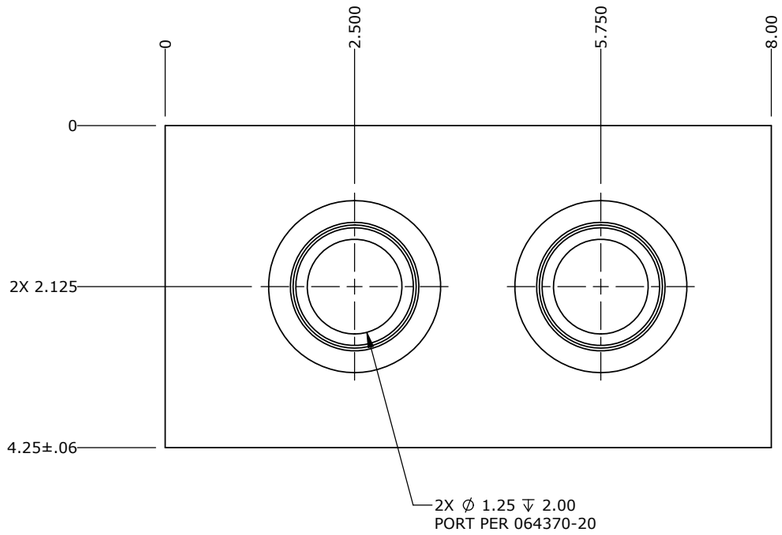
REV: A

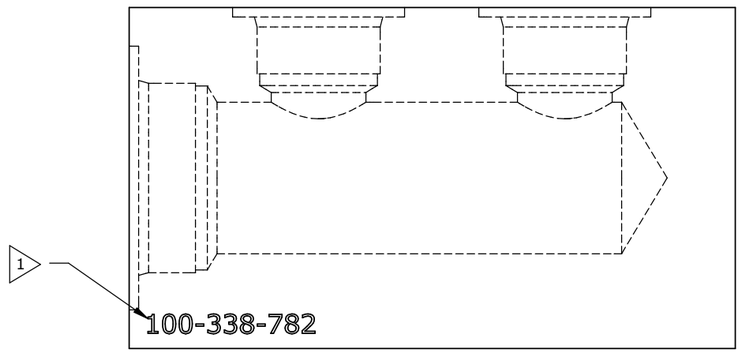
SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.









NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351
MATERIAL SIZE: -----
FINISH: 2
MASK
- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE
MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 7/11/16	DATE -	DATE 7/11/16	DATE -

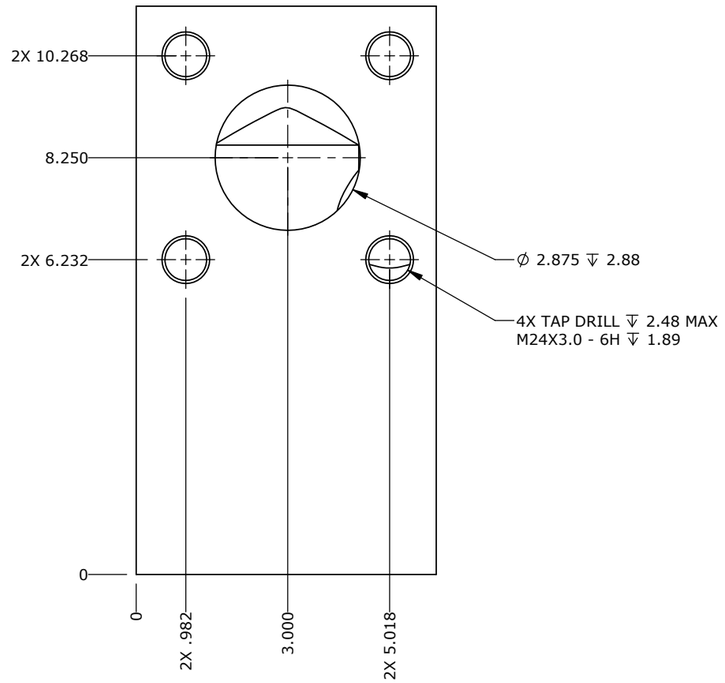
TITLE: MANIFOLD-DRAIN -20 (2), -32

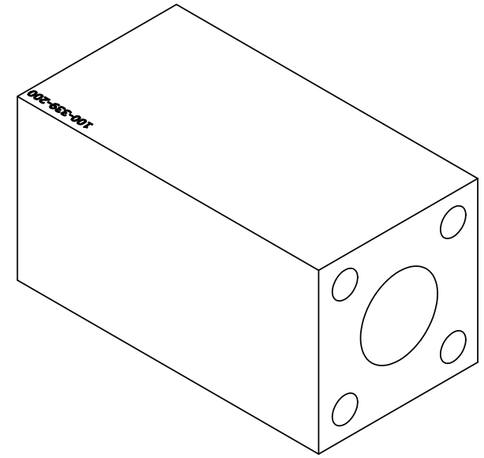
NEXT LEVEL: -----
PRODUCT CODE: -----

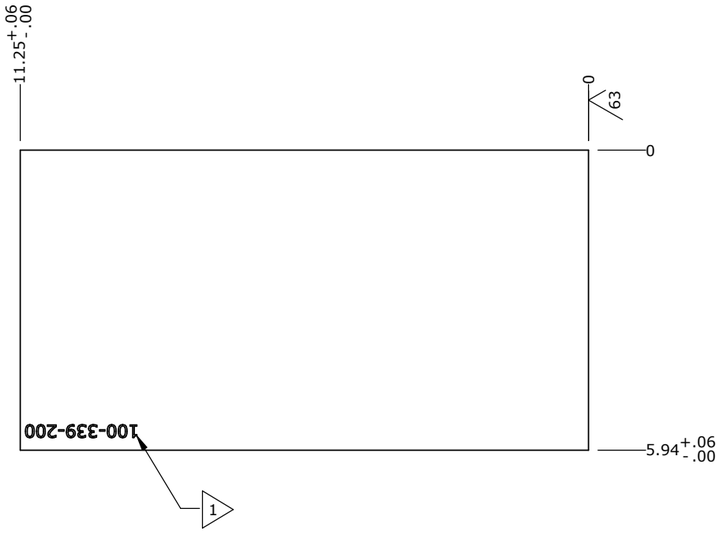
SIZE	NUMBER	REV
D	100-338-782	A

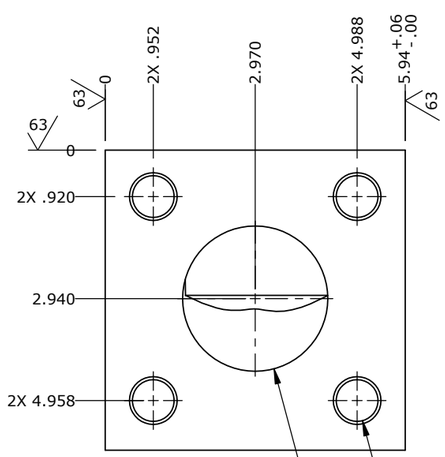
SHEET 1 OF 1

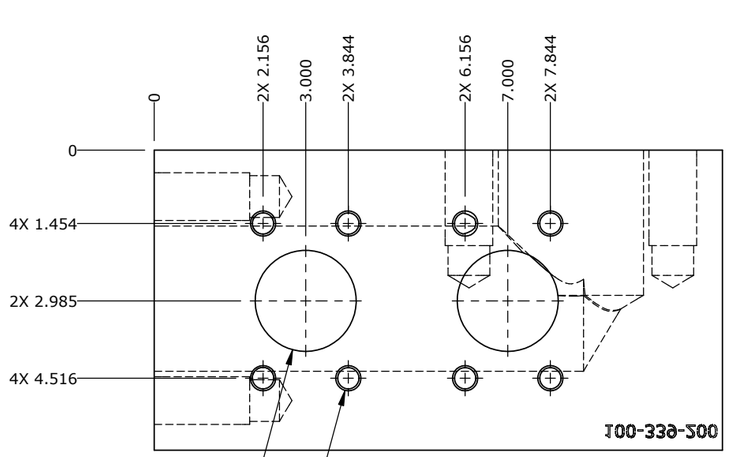
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.











NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING 100-338-781

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE: -----

FINISH: 2 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

	DRAWN	CHECK	ENGR	MFG
	RAP	-	JPG	-
DATE	7/19/16	-	7/19/16	-

TITLE: MANIFOLD-LINE END,97MM/2X 2"C61 OUTLETS

NEXT LEVEL: -----

PRODUCT CODE: -----

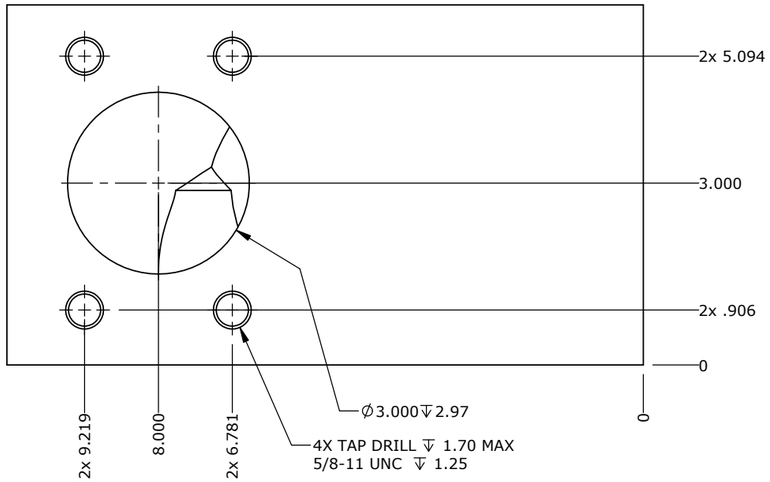
SIZE: D

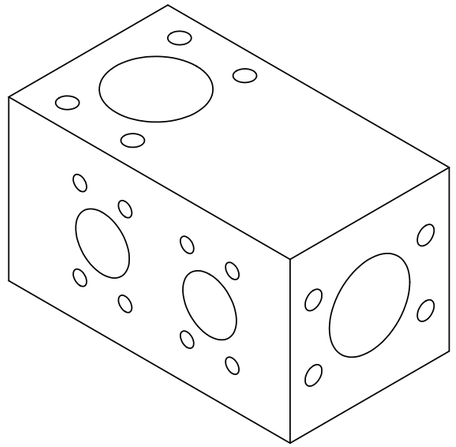
NUMBER: 100-339-200

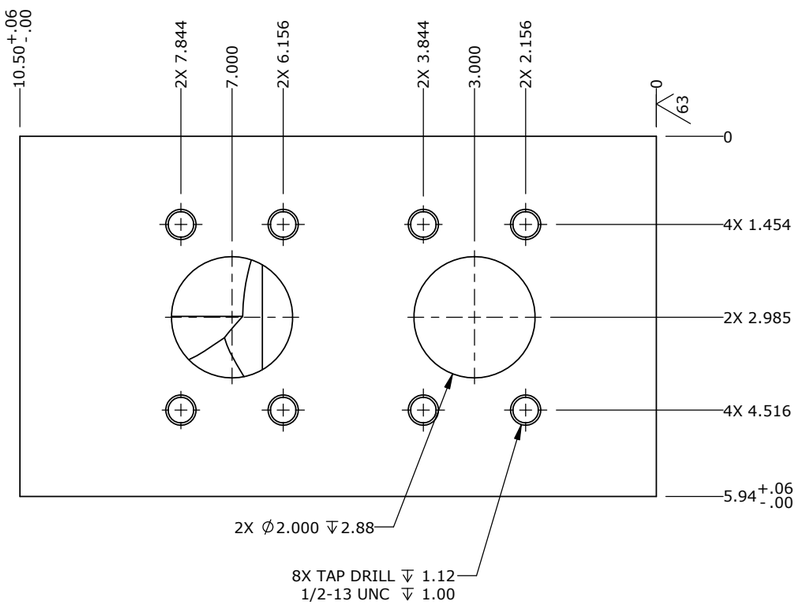
REV: A

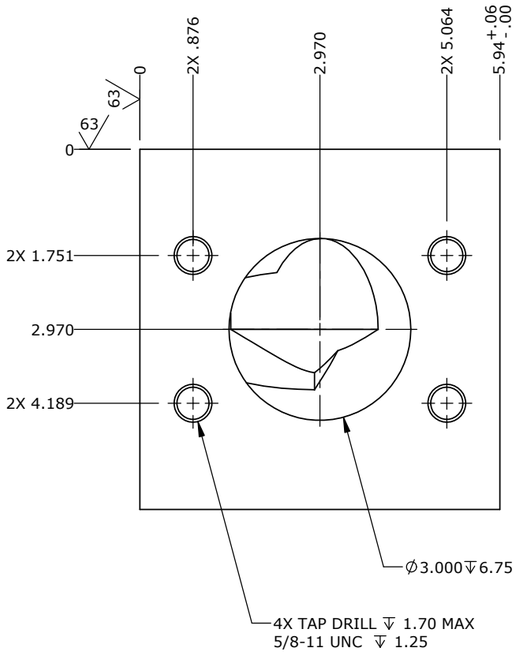
SHEET 1 OF 1

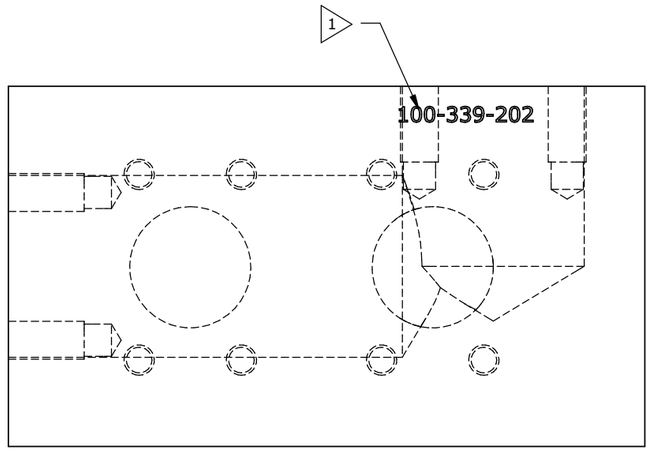
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.











NOTES:

1. PREFERRED: LASER ETCH TEXT 1/4" HIGH IN APPROX. LOCATION.
   ACCEPTABEL ALTERNATE: MACHINE TEXT 1/4" HIGH IN APPROX. LOCATION.

2. FINISH: BLACK ANODIZE PER MIL-A-8625, TYPE II. ANY DIES, COLORANTS AND/OR SEALANTS MUST BE RoHS COMPLIANT.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING 100-338-760

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: ALUM 2024-T351

MATERIAL SIZE: -----

FINISH: 2 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 7/19/16	DATE -	DATE 7/19/16	DATE -

TITLE: MANIFOLD-OFFSET,90MM(2) X 2"C61(2)

NEXT LEVEL: -----

PRODUCT CODE: -----

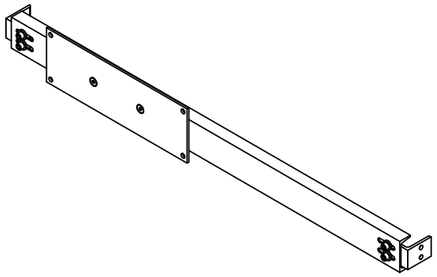
SIZE: D

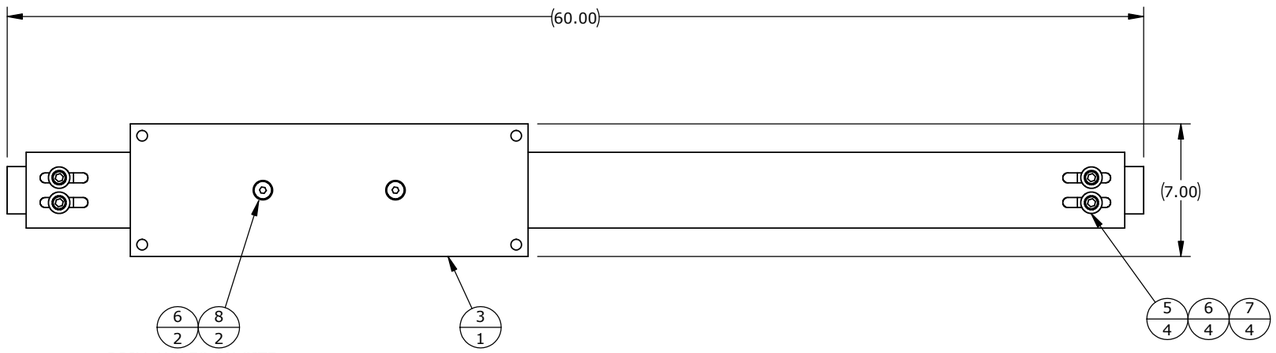
NUMBER: 100-339-202

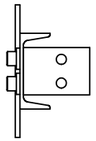
REV: A

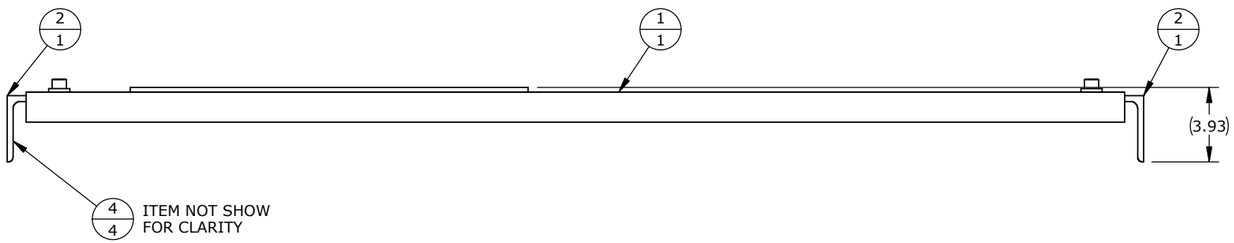
SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.









REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: -----

MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-23-16	DATE -	DATE 9-23-16	DATE -

TITLE: BRACKET-ASSY, HARDLINE SUPPORT 55867

NEXT LEVEL: -----

PRODUCT CODE: -----

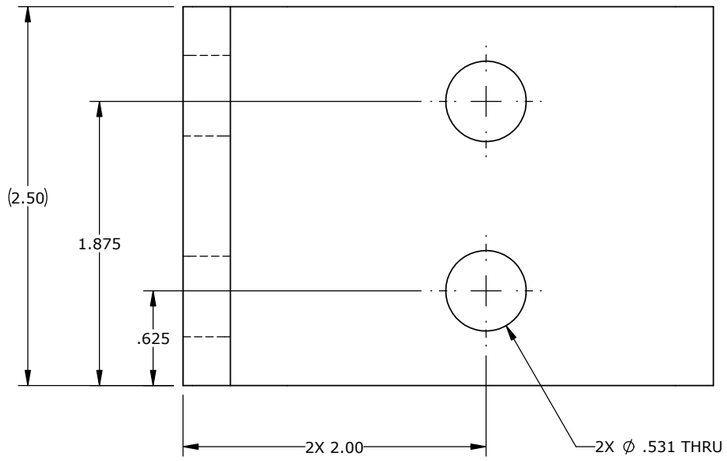
SIZE: D

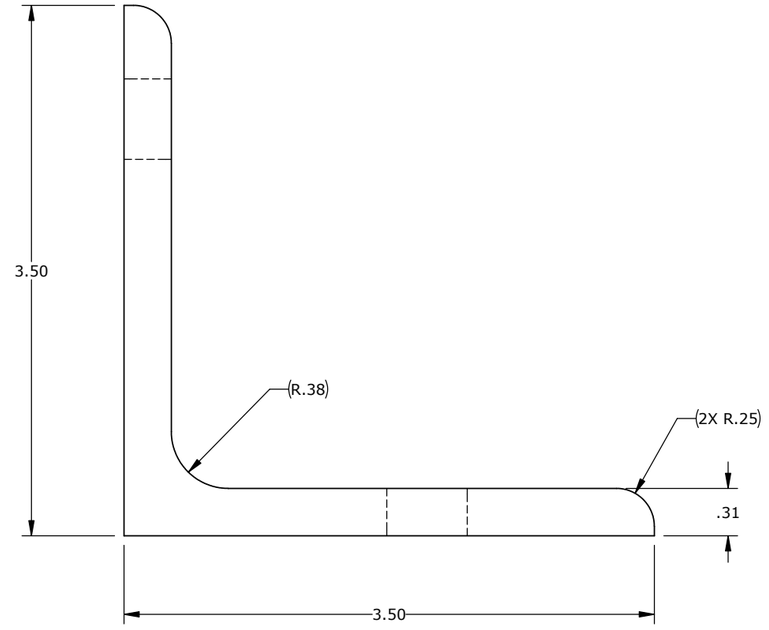
NUMBER: 100-342-776

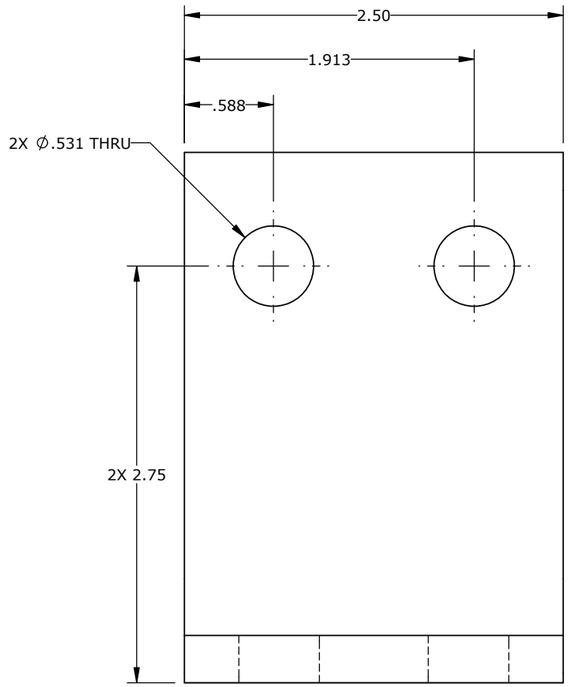
REV: A

SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.







REVISIONS					
DESCRIPTION				LETTER	ECN NO
DRAWN	ENGR	DATE			

-

SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: 3.50 X 3.50 STL ANGLE

MATERIAL SIZE: SEE DWG

FINISH: 372889-16 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-22-16	DATE -	DATE 9-22-16	DATE -

TITLE: BRACKET-ANGLE, HARDLINE SUPPORT 55867

NEXT LEVEL: -----

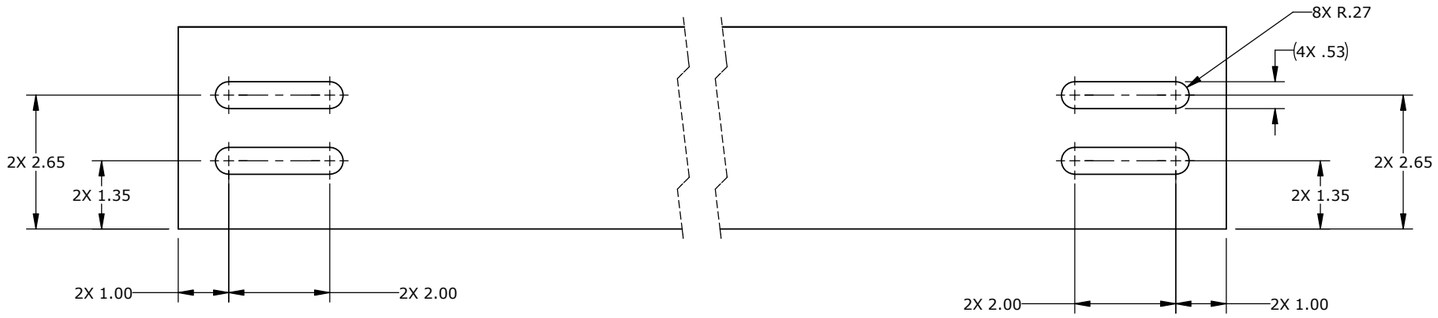
PRODUCT CODE: -----

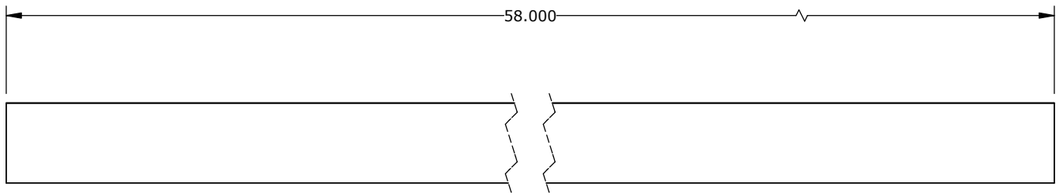
SIZE: D

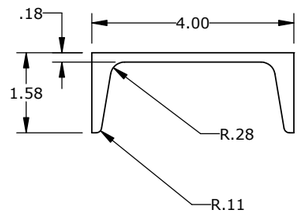
NUMBER: 100-342-778 REV: A

SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.







REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: 4.0 X 1.5 STL AISI 1015-1025

MATERIAL SIZE: -----

FINISH: 372889-16 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE	
0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-22-16	DATE -	DATE 9-22-16	DATE -

TITLE
CHANNEL-SUPPORT, "C"
CHANNEL 55867

NEXT LEVEL: -----

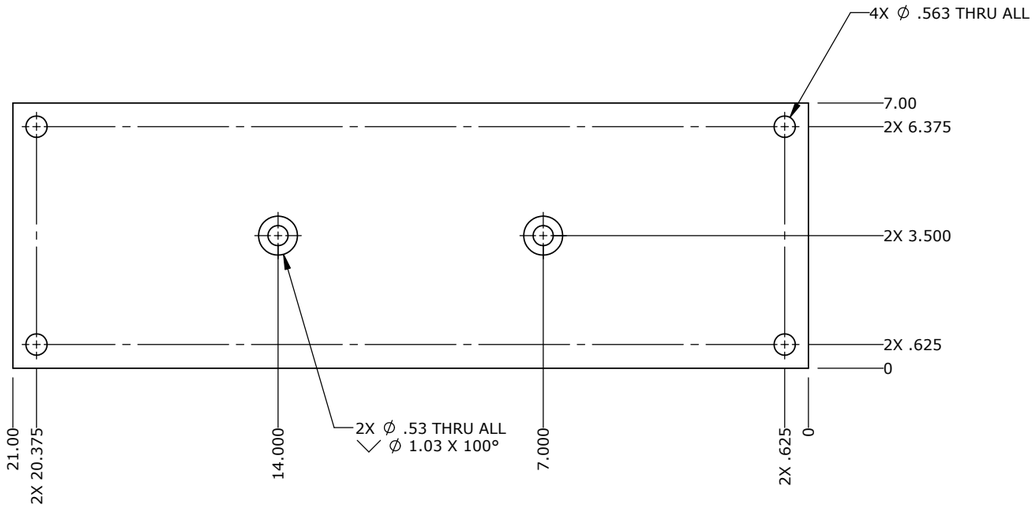
PRODUCT CODE: -----

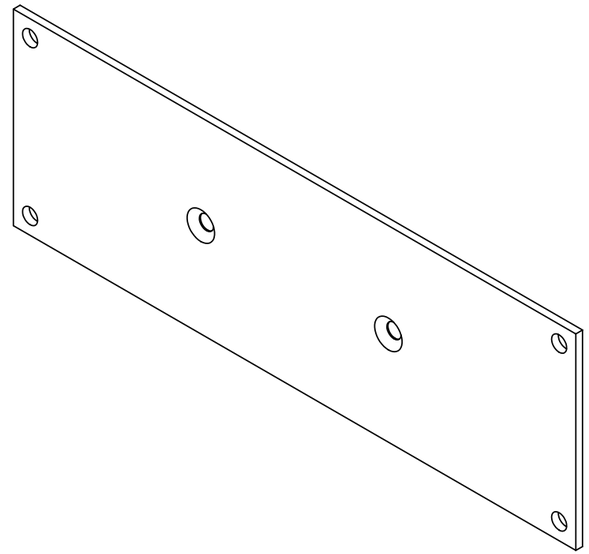
SIZE: D

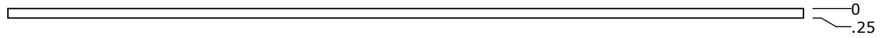
NUMBER: 100-342-779

REV: A

SHEET 1 OF 1







REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: STL PLATE AISI 1015-1025

MATERIAL SIZE: SEE DWG

FINISH: 372889-16 MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
RAP	-	JPG	-
DATE 9-22-16	DATE -	DATE 9-22-16	DATE -

TITLE: PLATE-BRACKET, HARDLINE SUPPORT 55867

NEXT LEVEL: -----

PRODUCT CODE: -----

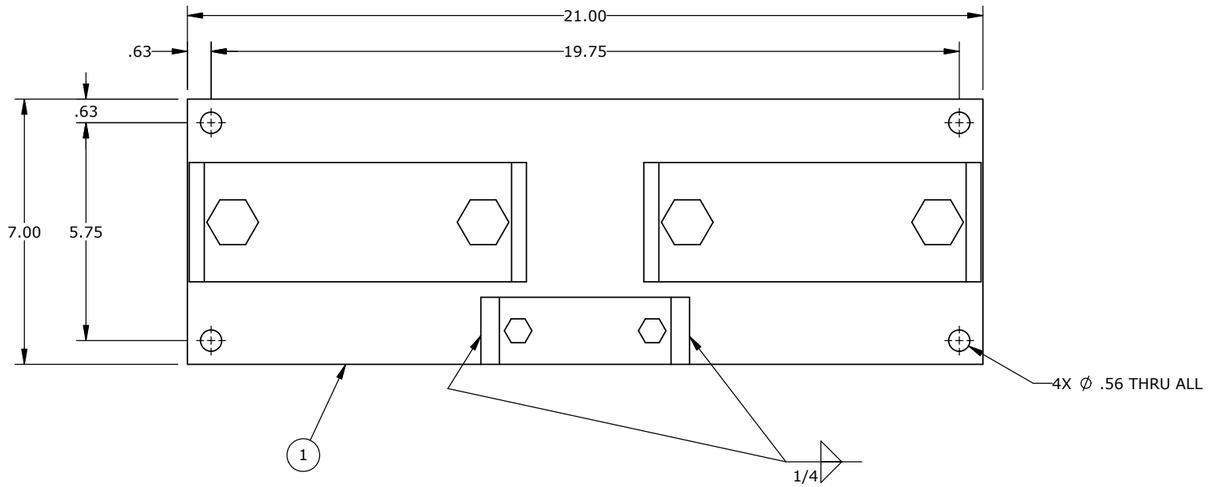
SIZE: D

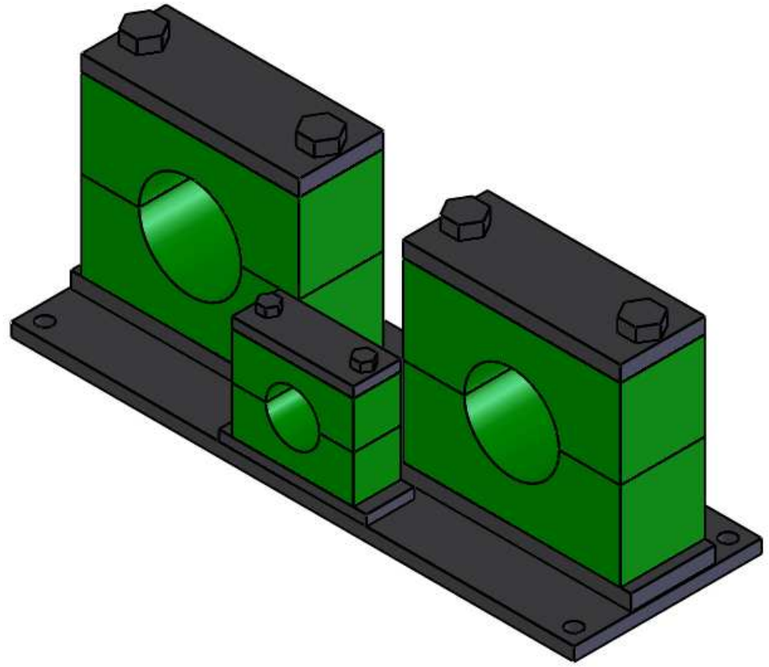
NUMBER: 100-342-780

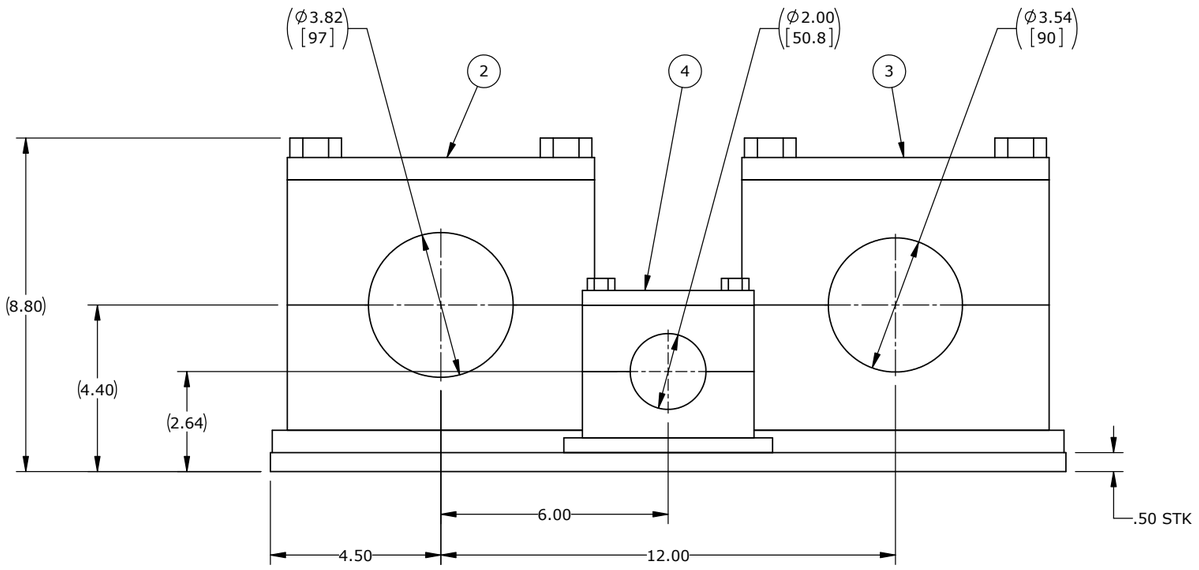
REV: A

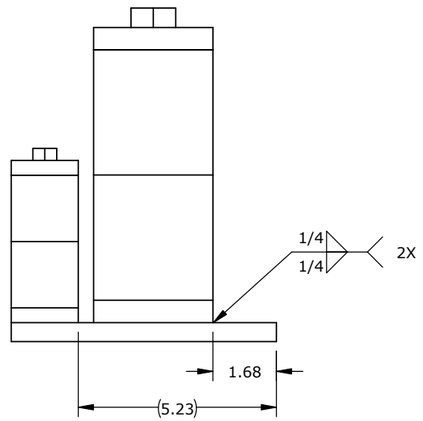
SHEET 1 OF 1

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.









ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	STL PLT 7.0 X 20.0 X .50 THK	----------
2	1	CLAMP STAUFF (OR EQUIV) HVY DTY 97MM	SPAL-8970S-PP-DPAL-AS
3	1	CLAMP STAUFF (OR EQUIV) HVY DTY 90MM	SPAL-8900S-PP-DPAL-AS
4	1	CLAMP STAUFF (OR EQUIV) HVY DTY 2.00"	SPAL-6508S-PP-DPAL-AS

NOTES:

1. FINISH: PAINT PER MTS SPEC 372889-16 BLACK.
   REMOVE CLAMPS BEFORE PAINTING.

PART NUMBER	REV	DESCRIPTION	APPVL	DATE
579774-02	A	UNPAINTED PART	MJH	3-26-14
579774-01	A	PAINTED PART	MJH	3-26-14

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING 577009-XX A

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: SEE BOM

MATERIAL SIZE: -----

FINISH: SEE TAB

MASK

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

THIRD ANGLE PROJ

MTS MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A.

DRAWN	CHECK	ENGR	MFG
TLN	-	MJH	-
DATE 3-26-14	DATE -	DATE 3-26-14	DATE -

TITLE: CLAMP ASSY-WELD,97/90/2.00"

NEXT LEVEL: -----

PRODUCT CODE: -----

SIZE: D

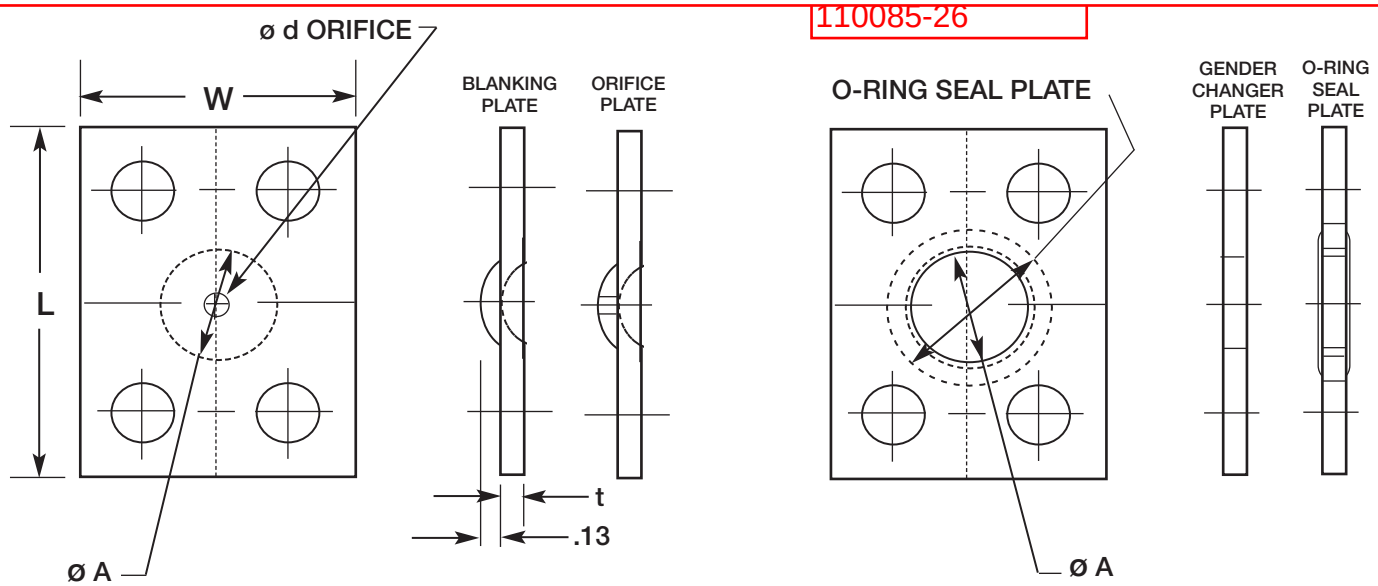
NUMBER: 579774-XX

REV: A

SHEET 1 OF 1

MTS CONTROLLED VENDOR DATA SHEET REVISION B 08/17/2015 ECN# 500035541
MTS MATERIAL NUMBER 11-008-526 C/C 47289 ENGINEER RICK ARTHUR

110085-26



PATTERN SIZE	A DIA.	L	W	t	d* DIA.	O-RING SIZE NO.
U46102	1/8	1.00	.62	.06	CUSTOMER SPECIFIED	010
U46104	1/4	1.25	.75	.06		011
U46106	3/8	1.50	.88	.06		014
6108	1/2	2.12	1.38	.11		210
6112	3/4	2.50	1.75			214
6116	1	2.75	2.00			219
6120	1 1/4	3.00	2.25			222
6124	1 1/2	3.75	2.75			225
6132(1)	2	4.00	3.25	.24		228
6140(2)	2 1/2	4.50	3.50	.11	N/A	232
6148(2)	3	5.25	4.25	.11	N/A	237

PATTERN SIZE	A DIA.	L	W	t	d* DIA.	O-RING SIZE NO.
6208	1/2	2.25	1.50	.11	CUSTOMER SPECIFIED	210
6212	3/4	2.75	1.88			214
6216	1	3.00	2.25			219
6220	1 1/4	3.25	2.50			222
6224	1 1/2	4.25	3.00			225
6232(1)	2	5.00	4.00	.24		228
6240(2)	2 1/2	6.75	4.25	.11	N/A	232
6248(2)	3	8.50	5.25	.11	N/A	237

*MIN. Ø = .016

(1) t = .11 for seal plate and gender changer.
(2) Sizes 6*40 & 6*48 are not available in blanking or orifice plates.

FLANGE PLATES

ORDERING INFORMATION

ISP — A — 61 12 — S — N — IS

INSERTA®

PLATE TYPE
BP = BLANKING PLATE
OP = ORIFICE PLATE
GC = GENDER CHANGER
SP = SEAL PLATE

DESIGN CODE

MOUNTING PATTERN
~~U461 = UNIFIED CODE U61 4-BOLT~~
61 = SAE CODE 61
62 = SAE CODE 62

NOMINAL SIZE
02 = 1/8 08 = 1/2 20 = 1 1/4 40 = 2 1/2
04 = 1/4 12 = 3/4 24 = 1 1/2 48 = 3
06 = 3/8 16 = 1 32 = 2

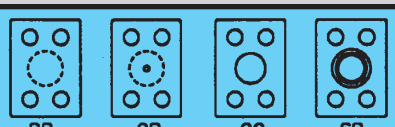
OPTIONS
IS = INTEGRITY SUPPORT RING
O*** = ORIFICE SIZE
FIRST DIGIT - INCHES
2 & 3 DIGIT ADDS DECIMAL INCREMENTS, I.E. 0.25

SEAL MATERIAL
N = BUNA N
V = VITON

SEAL PLATE MATERIAL
S = STEEL

Inserta Products, Inc.
Blue Bell, Pa. 19422

SPECIALTY FLANGE PLATES



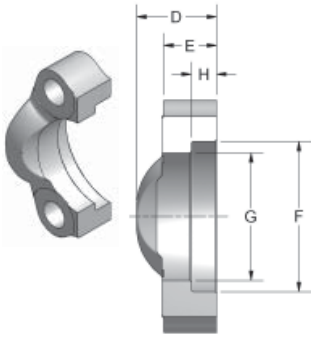
 www.adaconn.com / www.inserta.com

SAE J518 Split & Captive Flange

ANCHOR FLUID POWER

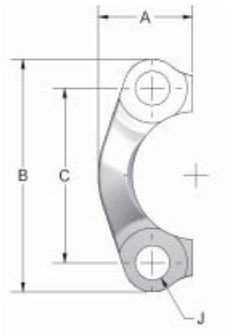
CODE 61 SPLIT FLANGE

*PART NO.	**KIT PART NO.	FLANGE SIZE	A	B	C	D	E	F	G	H	J	MOUNTING HARDWARE	
												O-RING	HHCS
8SF-2	8SFO	.50	.86	2.12	1.500	.75	.50	1.219	.955	.245	.344	210	5/16-18X1.25
12SF-2	12SFO	.75	.98	2.56	1.875	.88	.56	1.531	1.265	.245	.406	214	3/8-16X1.25
16SF-2	16SFO	1.00	1.11	2.75	2.062	.94	.62	1.781	1.515	.295	.406	219	3/8-16X1.25
20SF-2	20SFO	1.25	1.39	3.12	2.312	.88	.56	2.031	1.720	.295	.469	222	7/16-14X1.50
24SF-2	24SFO	1.50	1.58	3.69	2.750	1.00	.62	2.406	2.000	.295	.531	225	1/2-13X1.50
32SF-2	32SFO	2.00	1.86	4.00	3.062	1.03	.62	2.844	2.470	.355	.531	228	1/2-13X1.50
40SF-2	40SFO	2.50	2.09	4.50	3.500	1.50	.75	3.344	2.950	.355	.531	232	1/2-13X1.75
48SF-2	48SFO	3.00	2.53	5.31	4.188	1.62	.88	4.031	3.580	.355	.656	237	5/8-11X1.75
56SF-2	56SFO	3.50	2.70	6.00	4.750	1.12	.88	4.531	4.030	.422	.656	241	5/8-11X2.00
64SF-2	64SFO	4.00	2.95	6.38	5.125	1.38	1.00	5.031	4.530	.422	.656	245	5/8-11X2.00

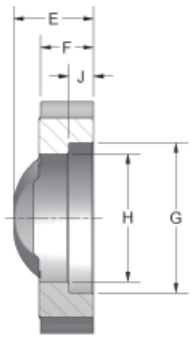


CODE 62 SPLIT FLANGE

*PART NO.	**KIT PART NO.	FLANGE SIZE	A	B	C	D	E	F	G	H	J	MOUNTING HARDWARE	
												O-RING	HHCS
8SFX-2	8SFXO	.50	.89	2.22	1.594	.88	.62	1.281	.970	.285	.344	210	5/16-18X1.25
12SFX-2	12SFXO	.75	1.14	2.81	2.000	1.12	.75	1.656	1.280	.325	.406	214	3/8-16X1.50
16SFX-2	16SFXO	1.00	1.33	3.19	2.250	1.31	.94	1.906	1.530	.355	.469	219	7/16-14X1.75
20SFX-2	20SFXO	1.25	1.48	3.75	2.625	1.50	1.06	2.156	1.750	.385	.531	222	1/2-13X1.75
24SFX-2	24SFXO	1.50	1.83	4.44	3.125	1.69	1.19	2.531	2.030	.475	.656	225	5/8-11X2.25
32SFX-2	32SFXO	2.00	2.20	5.25	3.812	2.06	1.44	3.156	2.660	.475	.781	228	3/4-10X2.75

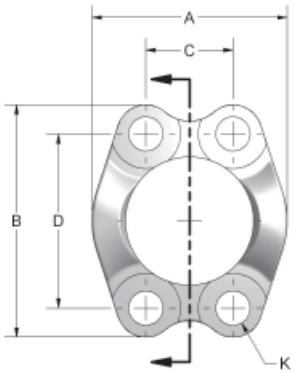


*ANCHOR PART # INCLUDES: (1) SPLIT FLANGE HALF ONLY
**KIT PART # INCLUDES: (2) SPLIT FLANGE HALVES, (4) HEX HEAD SCREWS WITH LOCKWASHERS, AND (1) BUNA N O-RING
NOTE: SPLIT FLANGE HALVES ARE SILVER TRIVALENT PLATED



CODE 61 CAPTIVE FLANGE

DRILLED PART NO.	TAPPED PART NO.	FLANGE SIZE	A	B	C	D	E	F	G	H	J	K	K UNC-2B
8SFW	8SFTW	.50	1.81	2.12	.688	1.500	.75	.50	1.219	.955	.245	.344	5/16-18
12SFW	12SFTW	.75	2.06	2.56	.875	1.875	.88	.56	1.531	1.265	.245	.406	3/8-16
16SFW	16SFTW	1.00	2.31	2.75	1.031	2.062	.94	.62	1.781	1.515	.295	.406	3/8-16
20SFW	20SFTW	1.25	2.88	3.12	1.188	2.312	.88	.56	2.031	1.720	.295	.469	7/16-14
24SFW	24SFTW	1.50	3.25	3.69	1.406	2.750	1.00	.62	2.406	2.000	.295	.531	1/2-13
32SFW	32SFTW	2.00	3.81	4.00	1.688	3.062	1.03	.62	2.844	2.470	.355	.531	1/2-13
40SFW	40SFTW	2.50	4.28	4.50	2.000	3.500	1.50	.75	3.344	2.950	.355	.531	1/2-13
48SFW	48SFTW	3.00	5.16	5.31	2.438	4.188	1.62	.88	4.031	3.580	.355	.656	5/8-11
56SFW	56SFTW	3.50	5.50	6.00	2.750	4.750	1.12	.88	4.531	4.030	.422	.656	5/8-11
64SFW	64SFTW	4.00	6.00	6.38	3.062	5.125	1.38	1.00	5.031	4.530	.422	.656	5/8-11



CODE 62 CAPTIVE FLANGE

DRILLED PART NO.	TAPPED PART NO.	FLANGE SIZE	A	B	C	D	E	F	G	H	J	K	K UNC-2B
8SFXW	8SFXTW	.50	1.86	2.22	.718	1.594	.88	.62	1.281	.970	.285	.344	5/16-18
12SFXW	12SFXTW	.75	2.38	2.81	.937	2.000	1.12	.75	1.656	1.280	.325	.406	3/8-16
16SFXW	16SFXTW	1.00	2.75	3.19	1.093	2.250	1.31	.94	1.906	1.530	.355	.469	7/16-14
20SFXW	20SFXTW	1.25	3.06	3.75	1.250	2.625	1.50	1.06	2.156	1.750	.385	.531	1/2-13
24SFXW	24SFXTW	1.50	3.75	4.44	1.437	3.125	1.69	1.19	2.531	2.030	.475	.656	5/8-11
32SFXW	32SFXTW	2.00	4.50	5.25	1.750	3.812	2.06	1.44	3.156	2.660	.475	.781	3/4-10

NOTE: CAPTIVE FLANGES HAVE NATURAL FINISH

Anchor Fluid Power • 5555 Fair Lane, Cincinnati, OH 45227 • (Office)1-866-FLANGES (Fax) 513-527-4449
www.anchorfluidpower.com • sales@anchorfluidpower.com

MTS CONTROLLED VENDOR DATA SHEET REVISION B
MTS MATERIAL NUMBER 11-950-362 C/C 45702
ENGINER RICK ARTHUR ECN# 500018431

KHB & KHM Series

2-way Ball Valves with Split Flange Connections

KHB Series
Block Housing

KHM Series
Forged Housing

Specifications

- 1/2" - 2" Full Port Design
- SAE Code 61 and 62 Split Flange Connections
- Carbon Steel Housing
- Block Housing - Sizes 16 - 25
- Forged Housing - Sizes 32 - 50
- Polyacetal Ball Seals *(standard)*
- FPM *(Fluoroelastomer)* O-Rings *(standard)*
- Operating Pressure to 5800 psi Depending on
- Valve Size and Seal Materials Selected
- Temp Range: 14°F to 176°F with Standard materials (1114) up to max. pressure rating. Extended Temperature range -40°F to 392°F on request with special materials and reduced pressure rating *(see page 24)*.

Model Code

KHB - 20 F3 - 1 1 1 4 X - 12X - L

Housing Type
- KHB = Block Housing, Carbon Steel - Sizes 16-25
- KHM = Forged Housing, Carbon Steel - Sizes 32-50
- KHM = Forged Housing, Stainless Steel - Sizes 06 - 50 *(see page 12 for details)*

Nominal Sizes

Valve Size	Nominal Flange Size	Flange Dash Size
16	1/2"	-8
20	3/4"	-12
25	1"	-16
32	1-1/4"	-20
40	1-1/2"	-24
50	2"	-32

Connection Type

SAE J518 Four bolt split flange type:
- F3 = Standard Pressure Series, Code 61
- F6 = High Pressure Series, Code 62

Body Material
- 1 = Carbon Steel *(phosphate coated)*
- 3 = Stainless Steel *(see page 12 for ordering details)*

Spindle and Ball Material
- 1 = Carbon Steel *(ball is chrome plated, spindle is zinc plated)*
- 3 = Stainless Steel

Ball Seal Material
- 1 = Polyacetal *(standard)*
- 3 = PTFE *(1500 psi max)*
- 8 = PEEK

O-Ring Material
- 2 = NBR *(Buna N)*
- 3 = PTFE Spindle Seals and FPM *(fluoroelastomer)* O-Rings *(1500 psi max)*
- 4 = FPM *(fluoroelastomer) (standard)*
- 5 = EPR

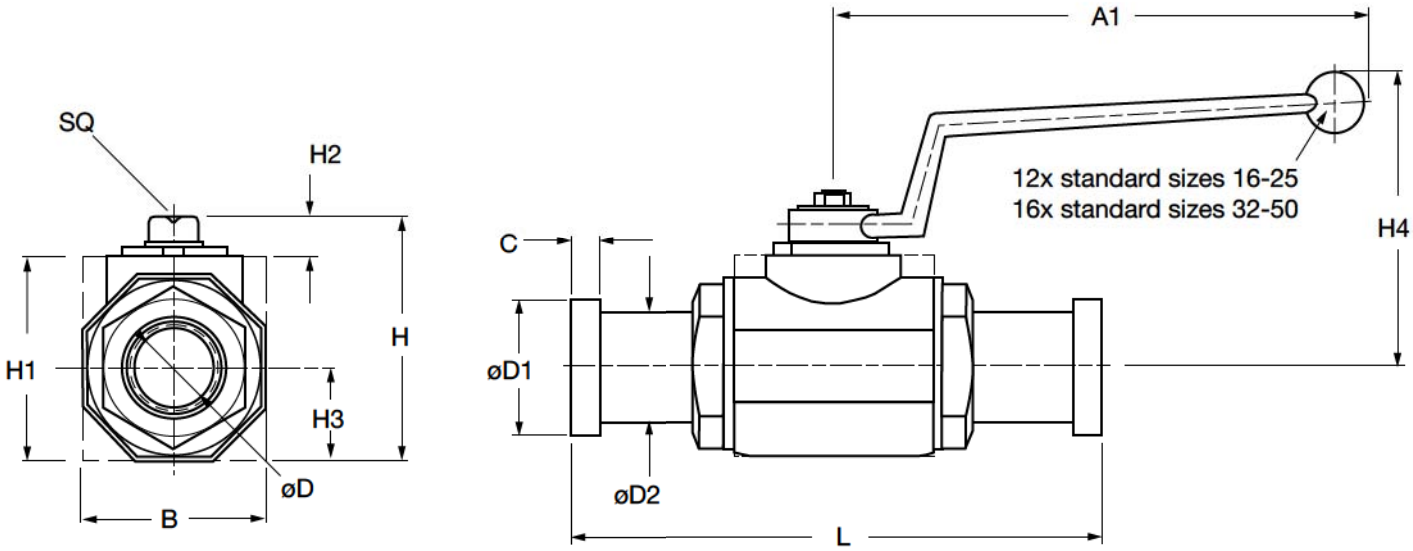
Split Flange Material
- X = Without Split Flanges *(order split flanges separately see page 151)*

Handle Codes
- 09X = Without Handle, Sizes 16-50
- 12X = Offset Aluminum, Sizes 16-25
- 16X = Offset Steel, Sizes 32-50

Locking Device Option
- L = Locking Device *(see page 21 to order locking device separately)*
- LS = Locking Device with 5 amp Limit Switch, Available for Sizes 20-50 *(Not available with PTFE Spindle Seals)*

Model Codes containing selections listed in RED are non-standard items – Minimum quantities will apply – Contact HYDAC for information and availability
Not all combinations are available

Dimensions



For dimensional information on flanges, see page 151

SAE Code 61 [...F3]

Model	max. psi*	Size	A1	B	C	øD	øD1	øD2	H	H1	H2	H3	H4	L	SQ	Weight
KHB-16 F3	5000	1/2"	6.42 (163)	1.50 (38)	0.27 (6.8)	0.51 (13)	1.19 (30.2)	0.94 (24)	2.44 (62)	1.77 (45)	0.43 (11)	0.75 (19)	3.27 (83)	5.94 (151)	0.47 (12)	2.4 (1.1)
KHB-20 F3	5000	3/4"	7.20 (183)	1.89 (48)	0.27 (6.8)	0.75 (19)	1.50 (38.1)	1.24 (31.5)	2.95 (75)	2.24 (57)	0.43 (11)	0.96 (24.5)	3.62 (92)	6.69 (170)	0.55 (14)	4.0 (1.8)
KHB-25 F3	5000	1"	7.20 (183)	2.24 (57)	0.31 (8)	0.98 (25)	1.75 (44.45)	1.50 (38)	3.23 (82)	2.52 (64)	0.43 (11)	1.12 (28.5)	3.74 (95)	6.95 (176.5)	0.55 (14)	5.1 (2.3)
KHM-32 F3	4000	1-1/4"	12.01 (305)	2.95 (75)	0.31 (8)	1.18 (30)	2.00 (50.8)	1.69 (43)	4.06 (103)	3.35 (85)	0.47 (12)	1.48 (37.5)	5.94 (151)	7.54 (191.4)	0.67 (17)	9.0 (4.1)
KHM-40 F3	3000	1-1/2"	12.01 (305)	3.35 (85)	0.31 (8)	1.50 (38)	2.38 (60.35)	1.97 (50)	4.49 (114)	3.78 (96)	0.47 (12)	1.67 (42.5)	6.18 (157)	9.09 (231)	0.67 (17)	13.1 (5.9)
KHM-50 F3	3000	2"	12.01 (305)	4.13 (105)	0.38 (9.6)	1.89 (48)	2.81 (71.4)	2.44 (62)	5.18 (131.5)	4.43 (112.5)	0.47 (12)	2.07 (52.5)	6.46 (164)	9.21 (234)	0.67 (17)	19.2 (8.7)

SAE Code 62 [...F6]

Model	max. psi*	Size	A1	B	C	øD	øD1	øD2	H	H1	H2	H3	H4	L	SQ	Weight
KHB-16 F6	5800	1/2"	6.41 (163)	1.50 (38)	0.31 (7.8)	0.51 (13)	1.25 (31.8)	0.94 (24)	2.44 (62)	1.77 (45)	0.43 (11)	0.75 (19)	3.27 (83)	5.94 (151)	0.47 (12)	2.4 (1.1)
KHB-20 F6	5000	3/4"	7.20 (183)	1.89 (48)	0.35 (8.8)	0.75 (19)	1.63 (41.3)	1.26 (32)	2.95 (75)	2.24 (57)	0.43 (11)	0.96 (24.5)	3.62 (92)	6.69 (170)	0.55 (14)	4.0 (1.8)
KHB-25 F6	5000	1"	7.20 (183)	2.24 (57)	0.37 (9.5)	0.98 (25)	1.87 (47.6)	1.50 (38)	3.23 (82)	2.52 (64)	0.43 (11)	1.12 (28.5)	3.72 (95)	7.81 (198.5)	0.55 (14)	5.4 (2.4)
KHM-32 F6	5000	1-1/4"	12.01 (305)	2.95 (75)	0.41 (10.3)	1.18 (30)	2.13 (54)	1.73 (44)	4.06 (103)	3.35 (85)	0.47 (12)	1.48 (37.5)	5.94 (151)	8.80 (223.4)	0.67 (17)	10.6 (4.8)
KHM-40 F6	5000	1-1/2"	12.01 (305)	3.35 (85)	0.50 (12.6)	1.50 (38)	2.50 (63.5)	2.01 (51)	4.49 (114)	3.78 (96)	0.47 (12)	1.67 (42.5)	6.18 (157)	11.06 (281)	0.67 (17)	15.4 (7.0)
KHM-50 F6	5000	2"	12.01 (305)	4.13 (105)	0.50 (12.6)	1.89 (48)	3.13 (79.4)	2.64 (67)	5.18 (131.5)	4.43 (112.5)	0.47 (12)	2.07 (52.5)	6.46 (164)	12.40 (315)	0.67 (17)	22.5 (10.2)

*** END OF SECTION ***

Section E: MTC 515 Product Information Catalogue

Series 515 SilentFlo™ Hydraulic Power Unit - Product Information

Models 515.60, 515.90, 515.120, 515.150, 515.180, 515.90S-1, 515.180S-1, 515.180S-2, 515.180S-3

Original Instructions (English)

MTS Trademarks

Proprietary Software

Software Verification and Validation

MTS software is developed using established quality practices in accordance with the requirements detailed in the ISO 9001 standards. Because MTS-authored software is delivered in binary format, it is not user accessible. This software will not change over time. Many releases are written to be backwards compatible, creating another form of verification. The status and validity of MTS' operating software is also checked during system verification and routine calibration of MTS hardware. These controlled calibration processes compare the final test results after statistical analysis against the predicted response of the calibration standards. With these established methods, MTS assures its customers that MTS products meet MTS' exacting quality standards when initially installed and will continue to perform as intended over time.

Manual Part Number	Publication Date
100-312-919 B Original Instructions (English)	February 2017
100-312-919 A	September 2015

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Know relevant software information 10

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Technical Support

How to Get Technical Support

Start with your manuals

The manuals supplied by MTS provide most of the information you need to use and maintain your equipment. If your equipment includes software, look for online help and README files that contain additional product information.

Technical support methods

MTS provides a full range of support services after your system is installed. If you have any questions about a system or product, contact Technical Support in one of the following ways.

Type of Support	Details
Web site	www.mts.com > Contact Us > In the **Subject** field, choose **To escalate a problem**; **Problem Submittal Form**
E-mail	Worldwide: tech.support@mts.com Europe: techsupport.europe@mts.com
Telephone	Worldwide: 1 800 328 2255 - toll free in U.S.; +1 952 937 4000 - outside U.S. Europe: +800 81002 222, International toll free in Europe

Outside the U.S.

For technical support outside the United States, contact your local sales and service office. For a list of worldwide sales and service locations and contact information, use the Global MTS link at the MTS web site:

www.mts.com > **About MTS Systems** > **Global Presence** > **Choose a Region**

Before You Contact MTS

MTS can help you more efficiently if you have the following information available when you contact us for support.

Know your site number and system number

The site number contains your company number and identifies your equipment type (such as material testing or simulation). The number is typically written on a label on your equipment before the system leaves MTS. If you do not know your MTS site number, contact your sales engineer.

Example site number: 571167

When you have more than one MTS system, the system job number identifies your system. You can find your job number in your order paperwork.

Example system number: US1.42460

Know information from prior technical assistance

If you have contacted MTS about this problem before, we can recall your file based on the:

- MTS case number
- Name of the person who helped you

Identify the problem

Describe the problem and know the answers to the following questions:

- How long and how often has the problem occurred?
- Can you reproduce the problem?
- Were any hardware or software changes made to the system before the problem started?
- What are the equipment model numbers?
- What is the controller model (if applicable)?
- What is the system configuration?

Know relevant computer information

For a computer problem, have the following information available:

- Manufacturer's name and model number
- Operating software type and service patch information
- Amount of system memory
- Amount of free space on the hard drive where the application resides
- Current status of hard-drive fragmentation
- Connection status to a corporate network

Know relevant software information

For software application problems, have the following information available:

- The software application's name, version number, build number, and (if available) software patch number. This information can typically be found in the About selection in the Help menu.
- The names of other applications on your computer, such as:
    - Anti-virus software
    - Screen savers
    - Keyboard enhancers
    - Print spoolers
    - Messaging applications

If You Contact MTS by Phone

A Call Center agent registers your call before connecting you with a technical support specialist. The agent asks you for your:

- Site number
- Email address
- Name
- Company name
- Company address
- Phone number where you can be reached

If your issue has a case number, please provide that number. A new issue will be assigned a unique case number.

Identify system type

To enable the Call Center agent to connect you with the most qualified technical support specialist available, identify your system as one of the following types:

- Electrodynamic material test system
- Electromechanical material test system
- Hydromechanical material test system
- Vehicle test system
- Vehicle component test system
- Aero test system

Be prepared to troubleshoot

Prepare to perform troubleshooting while on the phone:

- Call from a telephone close to the system so that you can implement suggestions made over the phone.
- Have the original operating and application software media available.
- If you are not familiar with all aspects of the equipment operation, have an experienced user nearby to assist you.

Write down relevant information

In case Technical Support must call you:

- Verify the case number.
- Record the name of the person who helped you.
- Write down any specific instructions.

After you call

MTS logs and tracks all calls to ensure that you receive assistance for your problem or request. If you have questions about the status of your problem or have additional information to report, please contact Technical Support again and provide your original case number.

Problem Submittal Form

Use the Problem Submittal Form to communicate problems with your software, hardware, manuals, or service that are not resolved to your satisfaction through the technical support process. The form includes check boxes that allow you to indicate the urgency of your problem and your expectation of an acceptable response time. We guarantee a timely response—your feedback is important to us.

You can access the Problem Submittal Form at www.mts.com > Contact Us (upper-right corner) > In the **Subject** field, choose **To escalate a problem; Problem Submittal Form**

Preface

Before You Begin

Safety first!

Before you use your MTS product or system, read and understand the safety information provided with your system. Improper installation, operation, or maintenance can result in hazardous conditions that can cause severe personal injury or death, or damage to your equipment and specimen. Again, read and understand the safety information provided with your system before you continue. It is very important that you remain aware of hazards that apply to your system.

Documentation Conventions

The following paragraphs describe some of the conventions that are used in your MTS manuals.

Hazard conventions

Hazard notices may be embedded in this manual. These notices contain safety information that is specific to the activity to be performed. Hazard notices immediately precede the step or procedure that may lead to an associated hazard. Read all hazard notices carefully and follow all directions and recommendations. Three different levels of hazard notices may appear in your manuals. Following are examples of all three levels. (for general safety information, see the safety information provided with your system.)

Danger: Danger notices indicate the presence of a hazard with a high level of risk which, if ignored, will result in death, severe personal injury, or substantial property damage.

Warning: Warning notices indicate the presence of a hazard with a medium level of risk which, if ignored, can result in death, severe personal injury, or substantial property damage.

Caution: Caution notices indicate the presence of a hazard with a low level of risk which, if ignored, could cause moderate or minor personal injury or equipment damage, or could endanger test integrity.

Other special text conventions

Important:

Important notices provide information about your system that is essential to its proper function. While not safety-related, if the important information is ignored, test results may not be reliable, or your system may not operate properly.

Note:

Notes provide additional information about operating your system or highlight easily overlooked information.

Recommended:

Recommended notes provide a suggested way to accomplish a task based on what MTS has found to be most effective.

Tip:

Tips provide helpful information or a hint about how to most efficiently accomplish a task.

Access:

Access provides the route you should follow to a referenced item in the software.

Example: Examples show specific scenarios relating to your product and appear with a shaded background.

Special terms

The first occurrence of special terms is shown in italics.

Illustrations

Illustrations appear in this manual to clarify text. They are examples only and do not necessarily represent your actual system configuration, test application, or software.

Electronic manual conventions

This manual is available as an electronic document in the Portable Document File (PDF) format. It can be viewed on any computer that has Adobe Acrobat Reader installed.

Hypertext links

The electronic document has many hypertext links displayed in a blue font. All blue words in the body text, along with all contents entries and index page numbers, are hypertext links. When you click a hypertext link, the application jumps to the corresponding topic.

Safety

General Safety Practices: Hydraulic Power Units and Hydraulic Service Manifolds 16

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General Safety Practices: Hydraulic Power Units and Hydraulic Service Manifolds

The hydraulic power unit (HPU) provides high pressure hydraulic fluid to system components for system operation. The hydraulic service manifold (HSM) controls distribution of that hydraulic fluid pressure. This section provides general information about safety issues that pertain to system hydraulic supply and distribution components. These issues include statements to the intended use and foreseeable misuse of the system and definition for the graphical hazard labeling that is affixed to your product, and other (more general) safety information that relates to the high-pressure and high-performance characteristics of MTS servohydraulic and electromechanical systems.

When you prepare to operate a system that includes hydraulic components, ensure the following:

- Do not use or allow personnel to operate the system who are not experienced, trained, or educated in the inherent dangers associated with high-performance servo hydraulics and who are not experienced, trained, or educated with regard to the intended operation as it applies to this test system.
- Do not disable safety components or features (including limit detectors, light curtains, or proximity switches/detectors).
- Do not attempt to operate the system without appropriate personal safety gear (for example, hearing, hand, and eye protection).
- Do not modify the system or replace system components using parts that are not MTS component parts or effect repairs using parts or components that are not manufactured to MTS specifications.
- Do not use the system in a test area where uncontrolled access to the test system is allowed when the system is in operation.
- For servohydraulic systems, do not operate the system unless an interlock is installed to monitor supply pressure into the HSM and initiate a system interlock if a low or no pressure event occurs.
- Mists of DTE 25 are combustible. Refer to MSDS. Customer is responsible for fire prevention measures as per facility or building or other local regulations and codes

If you have system related responsibilities (that is, if you are an operator, service engineer, or maintenance person), you should study safety information carefully before you attempt to perform any test system procedure.

You should receive training on this system or a similar system to ensure a thorough knowledge of your equipment and the safety issues that are associated with its use. In addition, you should gain an understanding of system functions by studying the other manuals supplied with your test system. Contact MTS for information about the content and dates of training classes that are offered.

It is very important that you study the following safety information to ensure that your facility procedures and the system's operating environment do not contribute to or result in a hazardous situation. Remember, you cannot eliminate all the hazards associated with this system, so you must learn and remain aware of the hazards that apply to your system at all times. Use these safety guidelines to help

learn and identify hazards so that you can establish appropriate training and operating procedures and acquire appropriate safety equipment (such as gloves, goggles, and hearing protection).

Each test system operates within a unique environment which includes the following known variables:

- Facility variables (facility variables include the structure, atmosphere, and utilities)
- Unauthorized customer modifications to the equipment
- Operator experience and specialization
- Test specimens

Because of these variables (and the possibility of others), your system can operate under unforeseen circumstances that can result in an operating environment with unknown hazards.

Improper installation, operation, or maintenance of your system can result in hazardous conditions that can cause death, personal injury, or damage to the equipment or to the specimen. Common sense and a thorough knowledge of the system's operating capabilities can help to determine an appropriate and safe approach to its operation.

Read all manuals

Study the contents of this manual and the other manuals provided with your system before attempting to perform any system function for the first time. Procedures that seem relatively simple or intuitively obvious may require a complete understanding of system operation to avoid unsafe or dangerous situations.

Locate and read hazard placards/labels

Find, read, and follow the hazard placard instructions located on the equipment. These placards are placed strategically on the equipment to call attention to areas such as known crush points, electrical voltage, and high pressure hazards.

Specimen temperature changes

During environmental testing, the specimen temperature can become hot enough to cause burns. Wear personal protection equipment (gloves) when handling specimens.

Know facility safe procedures

Most facilities have internal procedures and rules regarding safe practices within the facility. Be aware of these safe practices and incorporate them into your daily operation of the system.

Know controls

Before you operate the system for the first time, make a trial run through the operating procedures with the power off. Locate all hardware and software controls and know what their functions are and what adjustments they require. If any control function or operating adjustment is not clear, review the applicable information until you understand it thoroughly.

Have first aid available

Accidents can happen even when you are careful. Arrange your operator schedules so that a properly trained person is always close by to render first aid. In addition, ensure that local emergency contact information is posted clearly and in sight of the system operator.

Know potential crush and pinch points

Be aware of potential crush and pinch points on your system and keep personnel and equipment clear of these areas.

Remember, when hydraulic power is interrupted on a servohydraulic system, it is likely that stored accumulator pressure will persist for some time within the system. In addition, it is likely that as stored energy dissipates, gravity will cause portions of the system to move.

Be aware of component movement with hydraulics off

The actuator rod can also drift down when hydraulics are turned off hitting anything in its path. This uncommanded movement is because of oil movement between the pressure/return ports and oil blow by across the piston hub. Be aware that this can happen and clear the area around the actuator rod when hydraulics are turned off.

Know electrical hazards

When the system electrical power is turned on, minimize the potential for electrical shock hazards. Wear clothing and use tools that are properly insulated for electrical work. Avoid contact with exposed wiring or switch contacts.

Whenever possible, turn off electrical power when you work on or in proximity to any electrical system component. Observe the same precautions as those given for any other high-voltage machinery.

Make sure that all electrical components are adequately grounded. Grounds must remain connected and undisturbed at all times.

Keep bystanders safely away

Keep bystanders at a safe distance from all equipment. Never allow bystanders to touch specimens or equipment while the test is running.

Wear proper clothing

Do not wear neckties, shop aprons, loose clothing or jewelry, or long hair that could get caught in equipment and result in an injury. Remove loose clothing or jewelry and restrain long hair.

Remove flammable fluids

Remove flammable fluids from their containers or from components before you install the container or component. If desired, you can replace the flammable fluid with a non-flammable fluid to maintain the

proper proportion of weight and balance.

Check bolt ratings and torques

To ensure a reliable product, fasteners (such as bolts and tie rods) used in MTS-manufactured systems are torqued to specific requirements. If a fastener is loosened or the configuration of a component within the system is modified, refer to information in this product manual to determine the correct fastener, fastener rating, and torque. Over torquing or under torquing a fastener can create a hazardous situation due to the high forces and pressures present in MTS test systems.

On rare occasions, a fastener can fail even when it is correctly installed. Failure usually occurs during torquing, but it can occur several days later. Failure of a fastener can result in a high velocity projectile. Therefore, it is a good practice to avoid stationing personnel in line with or below assemblies that contain large or long fasteners.

Practice good housekeeping

Keep the floors in the work area clean. Any fluids that are spilled on any type of floor can result in a dangerous, slippery surface. Do not leave tools, fixtures, or other items not specific to the test, lying about on the floor, system, or decking.

Protect hoses and cables

Protect electrical cables from spilled hydraulic fluid and from excessive temperatures that can cause the cables to harden and eventually fail. Ensure that all cables have appropriate strain relief devices installed at the cable and near the connector plug. Do not use the connector plug as a strain relief.

Protect all system hoses and cables from sharp or abrasive objects that can cause the hose or cable to fail. Never walk on hoses or cables or move heavy objects over them. Consider hydraulic distribution system layout and route hoses and cables away from areas that expose them to possible damage.

Provide proper hydraulic fluid filtration

If the system is equipped with a non-MTS hydraulic power unit, ensure proper filtration to the hydraulic distribution system and testing components. Particles present in hydraulic fluid and cause erratic or poor system response.

Protect accumulators from moving objects

Protect accumulators with supports or guards. Do not strike accumulators with moving objects. This could cause the accumulator(s) to separate from the manifold resulting in equipment damage and personal injury.

Do not exceed the Maximum Supply Pressure

For hydraulic grips and fixtures. make sure that the hydraulic supply pressure is limited to the maximum pressure defined by the grip or fixture identification (ID) tag.

Do not disable safety devices

Your system may have active or passive safety devices installed to prevent system operation if the device indicates an unsafe condition. Do not disable such devices as it may result in unexpected system motion.

Use appropriately sized fuses

Whenever you replace fuses for the system or supply, ensure that you use a fuse that is appropriately sized and correctly installed. Undersized or oversized fuses can result in cables that overheat and fuses that explode. Either instance creates a fire hazard.

Provide adequate lighting

Ensure adequate lighting to minimize the chance of operation errors, equipment damage, and personal injury. You need to see what you are doing.

Provide means to access out-of-reach components

Make sure you can access system components that might be out of reach while standing on the floor. For example, ladders or scaffolding might be required to reach load cell connectors on tall load units.

Wear appropriate personal protection

Wear eye protection when you work with high-pressure hydraulic fluid, breakable specimens, or when anything characteristic to the specimen could break apart.

Wear ear protection when you work near electric motors, pumps, or other devices that generate high noise levels. Some systems can create sound pressure levels that exceed 70 dbA during operation.

Wear appropriate personal protection equipment (gloves, boots, suits, respirators) whenever you work with fluids, chemicals, or powders that can irritate or harm the skin, respiratory system, or eyes.

Handle chemicals safely

Whenever you use or handle chemicals (for example, cleaning fluids, hydraulic fluid, batteries, contaminated parts, electrical fluids, and maintenance waste), refer to the appropriate MSDS documentation for that material and determine the appropriate measures and equipment required to handle and use the chemical safely. Ensure that the chemical is disposed of appropriately.

Know system interlocks

Interlock devices should always be used and properly adjusted. Interlock devices are designed to minimize the chance of accidental damage to the test specimen or the equipment. Test all interlock devices for proper operation immediately before a test. Do not disable or bypass any interlock devices as doing so could allow hydraulic pressure to be applied regardless of the true interlock condition. The Reset/Override button is a software function that can be used to temporarily override an interlock while

attempting to gain control of the system.

Know system limits

Never rely on system limits such as mechanical limits or software limits to protect you or any personnel. System limits are designed to minimize the chance of accidental damage to test specimens or to equipment. Test all limits for proper operation immediately before a test. Always use these limits and adjust them properly.

Do not disturb sensors

Do not bump, wiggle, adjust, disconnect, or otherwise disturb a sensor (such as an accelerometer or extensometer) or its connecting cable when system power is applied.

Ensure secure cables

Do not change any cable connections when electrical power or hydraulic pressure is applied. If you attempt to change a cable connection while the system is in operation, an open control loop condition can result. An open control loop condition can cause a rapid, unexpected system response which can result in severe personal injury, death, or damage to equipment. Also, ensure that all cables are connected after you make any changes in the system configuration.

Stay alert

Avoid long periods of work without adequate rest. In addition, avoid long periods of repetitious, unvarying, or monotonous work because these conditions can contribute to accidents and hazardous situations. If you are too familiar with the work environment, it is easy to overlook potential hazards that exist in that environment.

Contain small leaks

Do not use your fingers or hands to stop small leaks in hydraulic or pneumatic hoses. Substantial pressures can build up, especially if the hole is small. These high pressures can cause the oil or gas to penetrate your skin, causing painful and dangerously infected wounds. Turn off the hydraulic supply and allow the hydraulic pressure to dissipate before you remove and replace the hose or any pressurized component.

Stay clear of moving equipment/avoid crush points

Stay clear of mechanical linkages, connecting cables, and hoses that move because you can get pinched, crushed, tangled, or dragged along with the equipment. High forces generated by the system can pinch, cut, or crush anything in the path of the equipment and cause serious injury. Stay clear of any potential crush points. Most test systems can produce sudden, high-force motion. Never assume that your reactions are fast enough to allow you to escape injury when a system fails.

Know the causes of unexpected actuator motions

The high force and velocity capabilities of MTS actuators can be destructive and dangerous (especially

if actuator motion is unexpected). The most likely causes of unexpected actuator response are operator error and equipment failure due to damage or abuse (such as broken, cut, or crushed cables and hoses; shorted wires; overstressed feedback devices; and damaged components within the servocontrol loop). Eliminate any condition that could cause unexpected actuator motion.

Do not use RF transmitters

Keep radio frequency (RF) transmitters away from the workstation computers, remote terminals, and electronics consoles. Intense RF fields can cause erratic operation of the more sensitive circuits in the system.

Know compressed gas hazards

Some environmental chambers use liquid nitrogen or some inert gas to achieve a required test atmosphere. Typically these gasses are supplied in pressurized tanks.

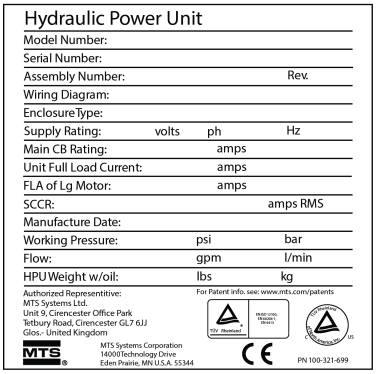
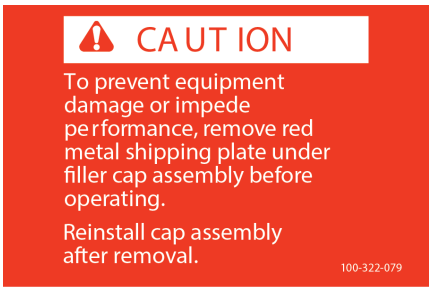
Observe the following safety practices when you work with high-pressure air or gases:

- When you charge an accumulator, follow all the charging instructions provided in the appropriate product information manuals. When precharging accumulators, properly identify the type of gas to be used and the type of accumulator to be precharged.
- Use only dry-pumped nitrogen to precharge nitrogen-charged accumulators. (Dry-pumped nitrogen can also be labeled “oil pumped” or “dry water pumped.”) Do not use compressed air or oxygen for precharging: the temperature increase caused by rapid gas compression can result in highly explosive conditions when hydraulic fluid is in the presence of oxygen or compressed air.
- Always follow the recommended bleeding procedures before you remove or disassemble components that contain pressurized gas. When you bleed a gas or remove a fitting, hose, or component that contains a gas, remember that many gases cannot support life. Therefore, as the ratio of released gas to oxygen increases, so does the potential for suffocation.
- Wear appropriate safety devices to protect your hearing. Escaping air or gas can create a noise level that can damage your hearing.
- Ensure that all pressurized air or gas is bled out of a pneumatic or gas-charged device before you start to disassemble it. A thorough understanding of the assembly and its pressurized areas is necessary before you undertake any maintenance. Refer to the appropriate product information for the correct bleeding procedure.

  It may not be obvious or intuitive which bolts or fittings are used to restrain a pressurized area. On some assemblies, you must remove a cover plate to gain access to the structural bolts. Sometimes, to protect you from a rapid release of trapped gases, a small port is exposed when you remove this cover plate. Exposing this port ensures that the gas precharge is fully bled before disassembly. However, this is not the recommended procedure for bleeding a pneumatic or gas-charged device, because it can expose you to the dangers of escaping compressed gas and particulates that are expelled from the chamber or around the seals. Do not assume that cover plates and ports are installed in all the critical locations.

Consult MTS when in doubt about the safety or reliability of any system-related procedure or modification that involves devices that contain any type of compressed gas.

Labels

Label	Description
 **Part # 100-321-699**	**Hydraulic Power Unit** information label.
 **Part # 100-322-079**	**Caution:** To prevent equipment damage or impede performance, remove red metal shipping plate under filler cap assembly before operating. Reinstall cap assembly after removal.
 **Part # 058-068-402**	See the next five rows for descriptions of each individual label in this composite.
	**Voltage hazard:** High voltage exists in the vicinity where this icon is located. Be aware of possible electrocution when working in areas noted with this icon.

Label	Description
	**Explosion hazard:** Release of pressure. High pressure fluid or gasses. Do not tamper with fittings or hoses. Wear appropriate protection such as safety goggles and hearing protection. Maintain safe pressure levels.
	**Arc Flash Hazard:** Follow requirements in NFPA 70 E for safe work practices and appropriate PPE. Failure to comply can result in death or injury.
	Disconnect from electrical power before servicing.
	Read the manuals.
 **Part # 572302-44**	**Burn hazard:** Hot surface. Do not touch.
 Part # 100-320-037	**System Contains Accumulators:** High pressure oil can cause severe injury. Disconnect power and drain accumulator before servicing hydraulic system.

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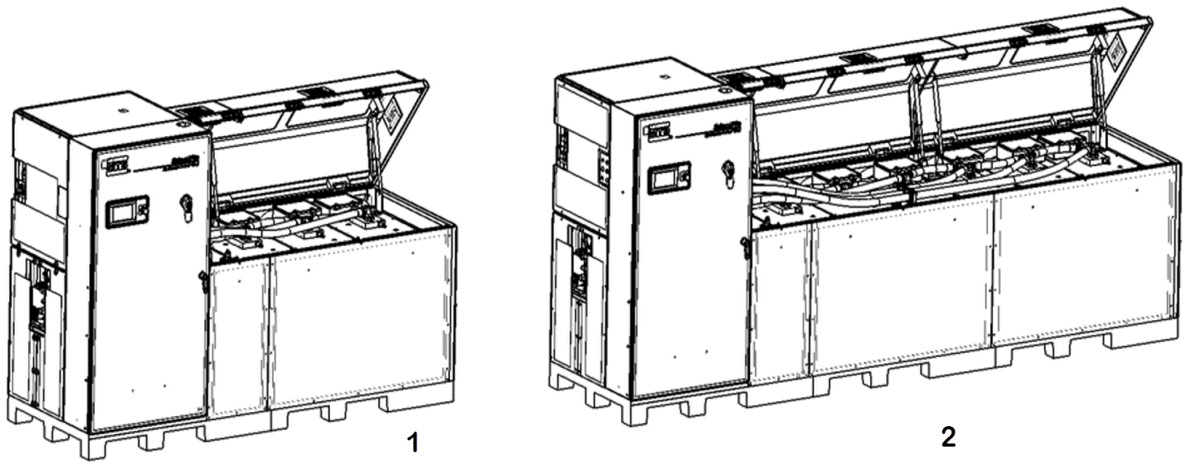
HPU Models



Item	Description
1†*	Models 515.60, 515.90, and 515.90S-1
2††*	Models 515.120, 515.150, 515.180, 515.180S-1, 515.180S-2, and 515.180S-3

† 3 bay HPU
†† 6 bay HPU
* Standard right hand orientation shown.

EU Declarations

EC Declaration of Conformity (Machinery Directive 2006/42/EC Annex II 1A)

If applicable, a Declaration of Conformity is supplied with the machinery; an example of the Declaration of Conformity is provided at the end of this manual.

Intended Use

The intended use of the Hydraulic Power Unit (HPU) is:

- Hydraulic supply for servohydraulic testing systems.
- Power supply for other hydraulically operated machinery, presses, or test systems.

Product Information CD

A Product Information CD is supplied with the HPU. The Product Information CD includes the electrical and hydraulic schematics along with the configuration drawings. The Product Information CD also contains the product specifications and other reference documents to aid MTS qualified service personnel. These documents include:

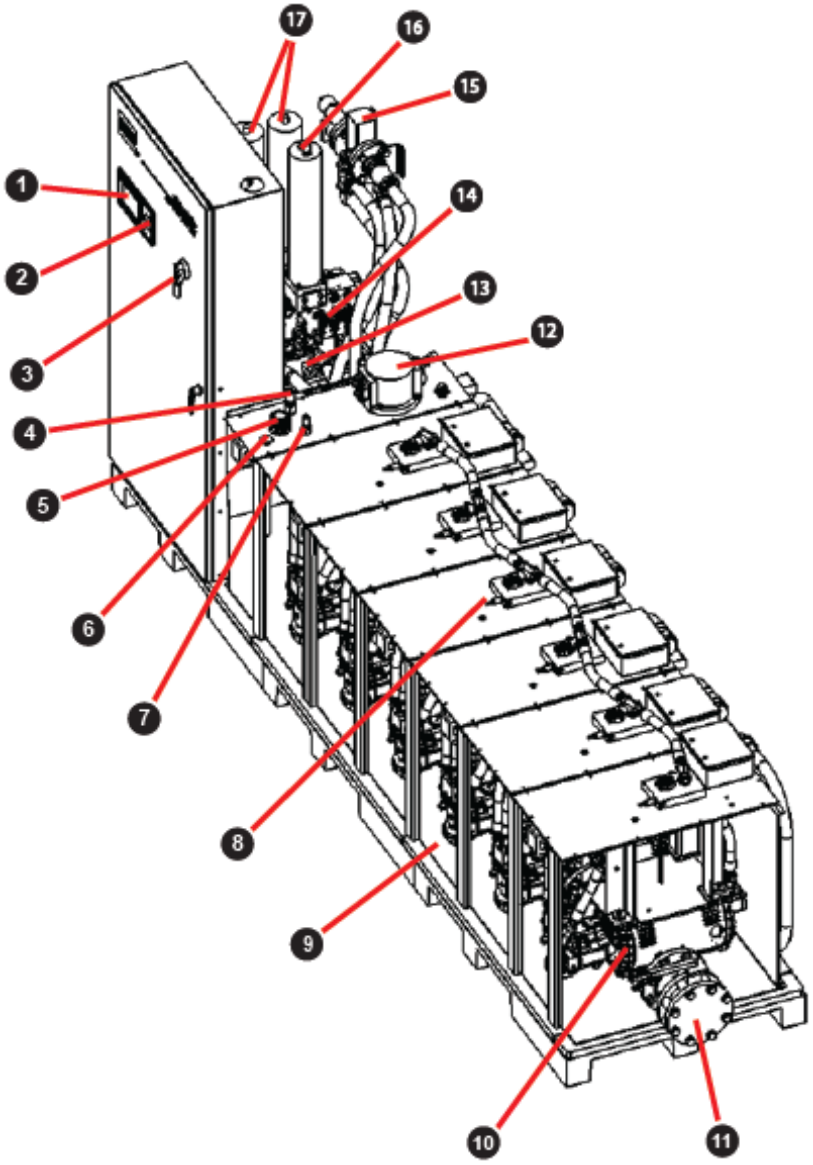
HPU Models	Electrical Schematic	Hydraulic Schematic	Spec Sheet	Configuration Drawing LH (option)	Configuration Drawing RH (option)
515.90S-1, 515.60, 515.90	700-008-259	700-007-767	700-007-695	700-007-772	700-007-771
515.180S-1, 515.180S-2, 515.180S-3, 515.120, 515.150, 515.180	700-008-259	700-007-768	700-007-695	700-007-774	700-007-773

Environmental Specifications

Item	Specification
Operating Temperature	5-40° C (41-104°F)
Operating Humidity	50-85% Noncondensing
Storage Temperature	-18-49°C (0-120°F)
Maximum Storage Humidity	90% Noncondensing
Maximum altitude	2000 m (6562 ft)

HPU Component Identification and Functional Description

Component Locations (515.180 shown)



Component Descriptions

Item	Component	Description
1	HMI (Human Machine Interface)	The HMI indicates the current status of the pressure, temperature, level, and optional flow sensors as well as configures and controls the operation of the hydraulic power unit (HPU).
2	Emergency Stop (E-Stop)	Press to immediately shut down the HPU.
3	Power Disconnect Switch	Disconnects the incoming power from the HPU. The switch has a lockable, mechanical latch. The switch will not allow the HPU door to be opened when in the ON position. Incoming power lines to the switch are live unless power is removed externally.
4	Level Transducer	Senses the hydraulic fluid level. The PLC uses this value to shut down the HPU if the level falls outside a set range.
5	Filler Cap	This is where you add hydraulic fluid. Also vents the hydraulic fluid reservoir.
6	Fluid Level Gage	Indicates the reservoir hydraulic fluid level.
7	TemperatureTransducer	Senses the hydraulic fluid temperature. The PLC uses this value to shut down the HPU in the event temperature exceeds a set value.
8	Output Pressure Control	Sets the output pressure of each pump module.
9	Reservoir	Holds the hydraulic fluid and houses the pump modules.
10	Pump Modules	Produces the pressurized hydraulic fluid for system use. Each pump module includes a main pump, cooling pump, motor, and interface manifold. Main pumps draw hydraulic fluid from the reservoir and pressurize it to a maximum preset pressure. Each pump module has a flow capacity that contributes to the total hydraulic flow capacity of the HPU.
11	Commoning Assembly (optional)	Allows the HPU to be commoned with another HPU.
12	Return Filter	Filters particles out of the hydraulic fluid. As hydraulic fluid returns to the reservoir, it is filtered by a full flow element. This ensures that all hydraulic fluid is filtered, whether it travels out through the high pressure circuit or returns by way of the unit's manifold under low pressure. Filter cleanliness is automatically monitored. An alarm registered on the HMI signals when the filter needs to be changed.

Component Descriptions (continued)

Item	Component	Description
13	Heat Exchanger (water cooled models only)	Removes the heat generated by the HPU. The heat exchanger cools the hydraulic fluid using an oil-to-water heat exchanger. A regulating valve monitors the temperature of the hydraulic fluid and adjusts the flow of water through the heat exchanger. If the hydraulic fluid temperature in the reservoir exceeds the maximum preset temperature, the PLC shuts down the HPU. An optional solenoid shutoff valve can shut off the flow of water when the HPU is off.
14	Manifold	Combines the output of the individual pump modules to deliver the full output of the HPU through a single port. The manifold provides solenoid control of the high/low pressure output from the individual pump modules. It also contains relief valves for each pump circuit and valves to help relieve pressure when the system is shut down. Check valves are located within the manifol to prevent pressurized hydraulic fluid from being forced back through the pump modules.
15	Cooling Control Valve	Often called the PENN valve. On water cooled models, it controls the flow of cooling water for the HPU based on the reservoir temperature. On air cooled models it controls the flow of oil through the air/oil heat exchanger.
16	Accumulator (optional)	Enable the HPU to cope with demand extremes and smooth out pulsations.
17	High Pressure Filter(s) (optional)	Ensures that the output flow from the HPU is clean. Actual location may vary depending on the model and other options.

Options Available for the HPU

Accumulator Option

An accumulator can be added to the HPU hydraulic output lines to damp pressure line fluctuations.

ROD and Flow Meter Options

The Flow Meter option is required for the ROD (Run On Demand) option. ROD enables the HPU to automatically turn individual pump modules on and off as needed to accommodate the system's demand for hydraulic fluid. When flow changes beyond preset limits for a preset time, a pump module is turned on or off as needed. Pump modules are selected to be started or stopped based on the AUTO Hours of that module. Pump modules with the fewest hours are started first and pump modules with the most hours are stopped first. ROD does not actively cycle pump modules to balance hours. Changes in flow are required to cause the pump modules to be started or stopped.

Port Kit Option

The following port kits are available for the 3000 psi, three bay HPU models (515.90S-1, 515.60, and 515.90) only:

- 20 JIC pressure and return connection
- 24 JIC pressure and return connection
- 24 (1-1/2”) C61 pressure and return connection

Remote Water Valve Option

The remote water valve is a valve that will shut off cooling water flow when the HPU is not running. The valve comes with the HPU but needs to be mounted in the facility pipeline. Control and power is provided by the HPU via a cable that is included and installed with this option.

Remote Water Strainer Option

The remote water strainer is a basket style water strainer used to prevent contamination of the HPU water cooling system. The strainer assembly comes with the HPU but needs to be mounted in the facility pipeline.

Caster Kit (3 bay only) Option

The caster kit option is available for the three bay HPU models (515.90S-1, 515.60, and 515.90) only. The caster kit includes a frame and four wheels for ease of movement of the HPU in a facility where the HPU needs to be mobile.

Caution:

The HPU is very heavy.

Improper handling of the HPU can seriously hurt you and damage the HPU.

Ensure that the area is clear of obstacles and personnel before moving the HPU.

HPU Electrical Control

The HPU can be controlled locally using the HMI, or remotely through an MTS controller, an RHMI, or a multi-pump controller. A PLC (programmable logic controller) manages the electrical systems within the HPU. The electrical system includes the following:

- A user interface panel that contains an HMI to program preferences and operational settings. The screens on the HMI provide a quick indication of the unit’s condition.
- Wye-delta starting reduces the initial current rush when the motor starters are engaged.
- A latchable **EmergencyStop** button that immediately shuts down the HPU (for emergency use only).
- A **Reset** button brings the unit back into operation after a fault has been detected and corrected.

- A dirty filter signal is an alarm only and will not shut the unit down, but will prevent the unit from starting.
- The power disconnect switch on the door of the main electrical enclosure ensures that power is removed from the HPU when the door is opened.

HMI Screen Reference

Introduction 36
Language Screen 36
Main Screen 38
Status Screen 43
Setup Screen 49
Run On Demand (ROD) Setup Screen 60

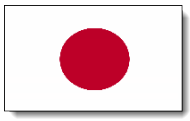
Introduction

The HMI (human machine interface) displays information and allows the user to make settings and operate the HPU. The following pages describe the HMI screens.

Language Screen

The Language screen is displayed initially when the HPU is powered up. Use the language screen on the user interface Main Display to select the language for the HMI screens.

Item	Description
	Press to select English HMI labels.
	Press to select Korean HMI labels.
	Press to select Portuguese HMI labels.
	Press to select German HMI labels.

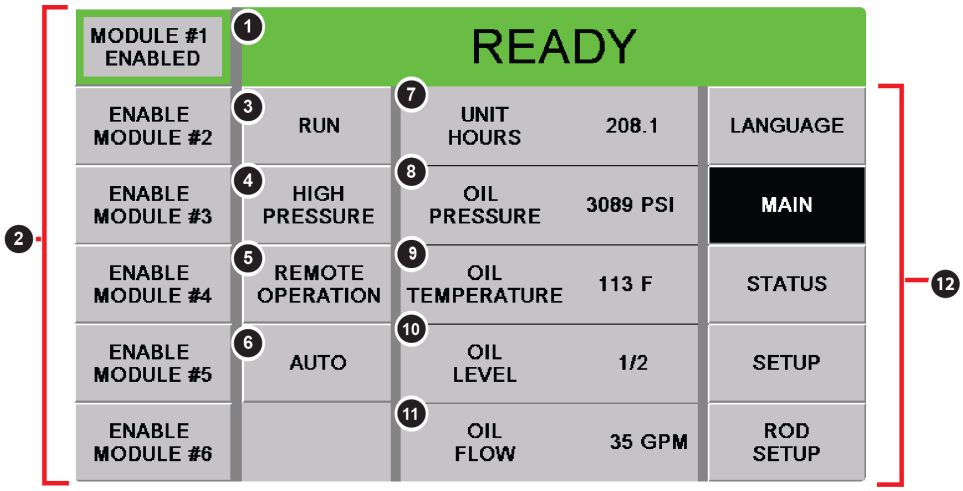
Item	Description
	Press to select Japanese HMI labels.
	Press to select French HMI labels.
	Press to select Chinese HMI labels.
	Press to select Spanish HMI labels.
	Press to select Italian HMI labels.
	Press to go to the Main screen.

Main Screen

Main Screen — Manual Mode

The following table describes the pushbuttons and indicators on the Main screen in local manual mode.

Main Screen - Manual Mode



Item	States	Description
1	System Status Bar Faulted/Enable Module/Ready/Running/High Pressure/Alarm/Overtemp Bypass	Indicator. Indicates the general state of the HPU. Reference the Status or Setup screen for specific faults and alarms. Faulted - red: Indicates when an interlock has occurred and the HPU has been shut down. Ready - green: Indicates the interlocks are cleared and the HPU is ready to start. Running - green: Indicates the HPU is running in low pressure. High Pressure - green: Indicates at least one pump module is running in high pressure. Alarm - yellow: Indicates a filter is dirty, oil temperature out of range, or oil level out of range, and needs attention. Overtemp Bypass - yellow: Indicates an over temperature interlock has occurred and the HPU has been put into a bypass mode to circulate hydraulic fluid through the heat exchanger until the hydraulic fluid level reaches an acceptable temperature. Enable Module - blue: Indicates that no modules are enabled. It alerts the user to enable one or more modules before the HPU can be started.
2	Enable Module #1 through #N Module #1 through #N Enabled	**Note:** If in Auto mode or if modules are not present, Enable Module Pushbutton/Indicator is not shown. Pushbutton/Indicator. Used to enable and disable the available pump modules. Pressing the button alternates between the two states. Enable Module #N - gray: Indicates the pump module is disabled and can not be started. Module #N Enabled - green frame: Indicates the pump module is enabled and can be started. Module #N Enabled - flashing green button: Indicates the pump module is running in low pressure. Module #N Enabled - solid green: Indicates the pump module is running in high pressure. Fault - red: lights when the module has an overload or a contactor sequence fault

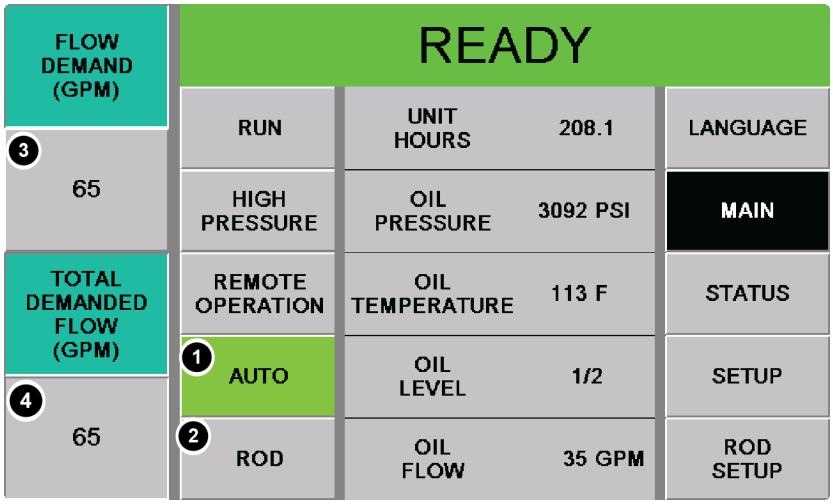
Item	States	Description
3	Run/Stop/Bypass	Pushbutton/Indicator. Used to start and stop the HPU. Run - gray, black letters: In this state, press to start the HPU. When the HPU is running, running is shown on the system status bar. Stop - gray, red letters: In this state, press to stop the HPU Bypass - blue, white letters: In this state, press to start the HPU in bypass mode. The Faulted state will turn to Overtemp Bypass. Bypass mode only occurs during an overtemperature condition and allows the HPU to run in low pressure to cool the hydraulic fluid. In remote operation, the run and bypass buttons are disabled.
4	High Pressure	Pushbutton/Indicator. Used to put the HPU in high pressure. High Pressure - gray: indicates the HPU is not in high pressure. High Pressure - green: Directs the HPU to sequence to high pressure. High Pressure is shown on the system status bar, when the pump module is in high pressure mode. In remote operation, the High Pressure button is disabled.
5	Remote Operation	Pushbutton/Indicator. Used to put the HPU into remote operation. Remote Operation - gray: Indicates the HPU is not in remote operation. Remote Operation - green: Indicates the HPU is in remote operation. You cannot change to remote operation without stopping the HPU. In remote operation, the HMI Run and High Pressure buttons are disabled.
6	Auto	See “Main Screen — Auto Mode” on page 42.
7	Unit Hours	Indicator: Indicates total running time of the HPU.
8	Oil Pressure	Indicator. Indicates output pressure of the HPU.
9	Oil Temperature	Indicator. Indicates the temperature of the hydraulic fluid in the reservoir.

Item	States	Description
10	Oil Level	Indicator. Indicates the level of the hydraulic fluid in the reservoir in 1/8 increments. The level is relative to the usable volume, not the bottom of the reservoir.
11	Oil Flow (optional)	Indicator. Indicates the total hydraulic fluid flow from all running pump modules within the HPU.
12	Screen Selection Buttons	Pushbutton/Indicator. Used to select the screen. Status - gray: In this state, press the button to select another screen. Status - black: This screen is selected and displayed. Status - blue: A blue indicator means action is required. When the indicator is blue, press the button to go to the status screen and resolve any condition that requires action.

Main Screen — Auto Mode

The following table describes the pushbuttons and indicators on the Main screen in local auto mode.

Main Screen - Auto Mode



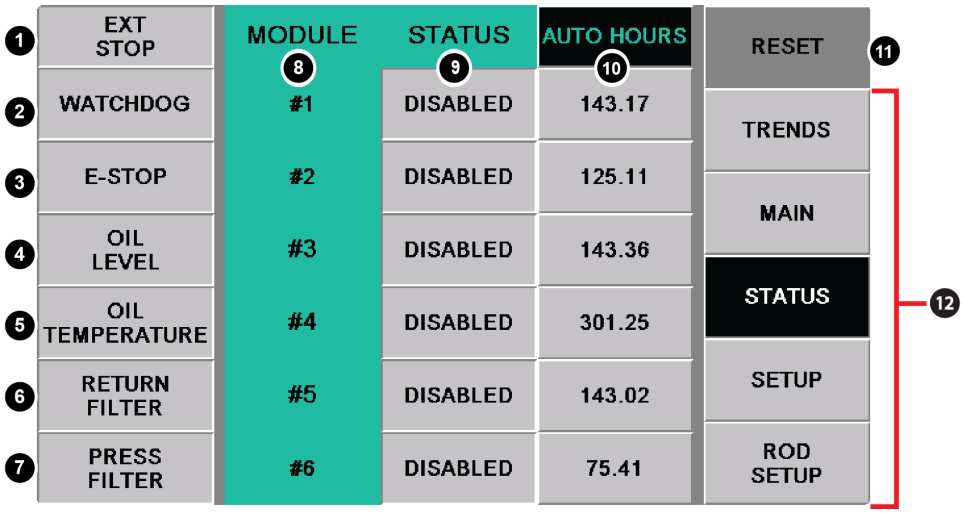
Item	States	Description
1	Auto	Pushbutton/Indicator. Used to change between manual mode and auto mode. Enable Module Pushbutton/Indicator is not shown when in this mode. Auto - gray: Indicates the HPU is in manual mode. Auto- green: Indicates the HPU is in auto mode. See Auto setup for configuration details.
2	ROD (optional)	Pushbutton/Indicator. Used to change between Auto and ROD modes. The ROD button is only shown when in auto mode. ROD - gray: Indicates Run On Demand is not enabled. ROD - green: Indicates Run On demand is enabled.
3	Flow Demand (units)	Pushbutton/Indicator. Used to enter the minimum desired flow. In auto or ROD mode, the HPU will determine how many and which pump modules to run to meet the minimum desired flow. **Important:** Input values do not automatically convert when changing units.
4	Total Demanded Flow	Indicator. Indicates the sum of Flow Demand plus any exernal inputs (such as remote HMIs or station flow managers). If in ROD mode and the Minimum Flow value is greater than the sum of the flow demands, the Minimum Flow value appears here. Background turns yellow if the

Status Screen

Status Sceen — Auto Hours Mode

The following table describes the pushbuttons and indicators on the Status screen when in Auto Hours mode.

Status Screen



Item	States	Description
1	EXT Stop	Indicator. Indicates the status of external stop input. Ext Stop - gray: Indicates that external stop is not set. Ext Stop - red: Indicates that an external control has set the external stop and stopped the HPU.
2	Watchdog	Indicator. Indicates the status of the watchdog timer. Watchdog - gray: Indicates the PLC that controls the HPU is operating normally. Watchdog - red: Indicates there is a problem with the hardware watchdog timer and the PLC is not operating correctly. A watchdog fault shuts down the HPU.
3	E-Stop	Indicator. Indicates if the safety relay is tripped. E-Stop - gray: Indicates the safety relay has not tripped. E-Stop - red: Indicates the safety relay has tripped.

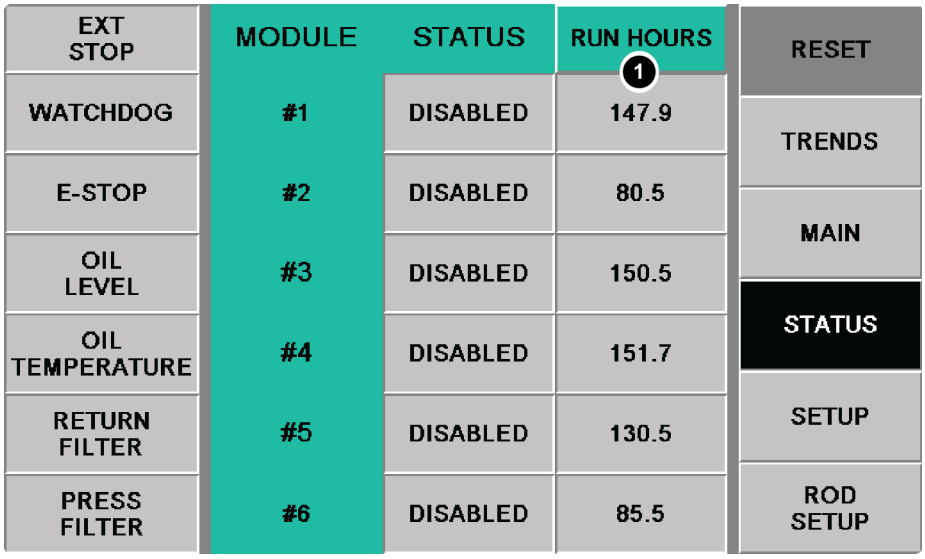
Item	States	Description
4	Oil Level	Indicator. Used to indicate if the hydraulic fluid level is within acceptable limits. Oil Level - gray: Indicates if the hydraulic fluid level is within acceptable limits. Oil Level - yellow: Indicates the hydraulic fluid level is not within acceptable limits as set on the Setup screen and an alarm is active. Oil Level - red: Indicates the hydraulic fluid level is not within acceptable limits as set on the Setup screen and an interlock is active.
5	Oil Temperature	Indicator. Indicates if the hydraulic fluid temperature is within acceptable limits. Oil Temp - gray: Indicates the hydraulic fluid temperature is within acceptable limits. Oil Temp - yellow: Indicates the hydraulic fluid temp is not within acceptable limits as set on the Setup screen and an alarm is active. Oil Temp - red: Indicates the hydraulic fluid temperature is not within acceptable limits and an interlock is active.
6	Return Filter	Indicator. Indicates if the return filter is within acceptable limits. Return Filter - gray: Indicates the contamination in the return filter is within acceptable limits. Return Filter - yellow: Indicates the contamination in the return filter is not within acceptable limits. The HPU cannot be started with an active return filter alarm.
7	Press Filter (optional)	Indicator. Indicates if the pressure filter is within acceptable limits. Press Filter - gray: Indicates the contamination in the pressure filter is within acceptable limits. Press Filter- yellow: Indicates the contamination in the pressure filter is not within acceptable limits. The HPU cannot be started with an active pressure filter alarm.
8	Module #N	Indicator. Used as an identifier for the Status and Hours/Auto Hours parameters. #N - blue-green: #1 is associated with pump module 1. #2 is associated with pump module 2. Etc.

Item	States	Description
8	Module #1	Indicator. Used as an identifier for the Status and Hours/Auto Hours parameters. #1 - blue-green: #1 is associated with pump module 1.
10	Run Hours/Auto Hours	Pushbutton/Indicator: Indicates the running time in hours of the associated module. Run Hours - blue-green/black text: Hours shown indicate actual hours on the module. Run hours cannot be set by the user. Auto Hours - black/blue-green text: Hours shown indicate user settable hours that are used for auto and ROD modes to turn on and off modules based on demand. Value - gray: The number of total hours the associated pump module has been running.
11	Reset	Pushbutton /Indicator. Used to reset interlocks. **Important:** All interlocks and alarms are latched by the HPU. A reset via the HMI reset button or remote reset input is needed to clear an interlock or alarm to reset the HPU to the ready state. Reset - gray/black text: Indicates no active interlocks. Reset - blue/white text: Indicates one or more interlocks are active. Pressing the button in this state will clear the interlock(s) provided the cause of the interlock(s) has been remedied.
12	Screen Selection	Pushbuttons. Press to navigate to the stated screen.

Status Sceen — Run Hours Mode

The following table describes the pushbuttons and indicators on the Status screen when in Run Hours mode. All items are the same as Auto Hours mode except for the Run Hours column.

Status Screen

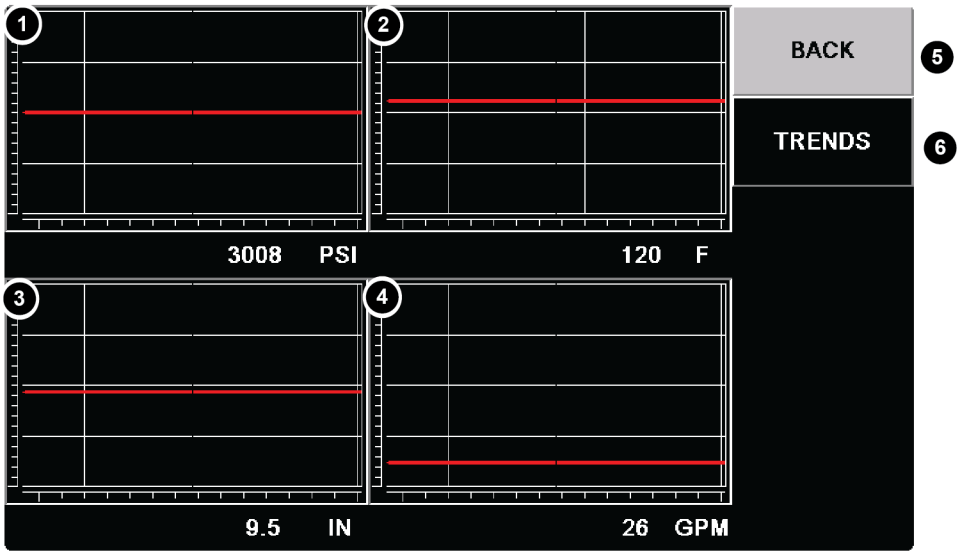


Item	Name and Location	Description
1	Run Hours	Run Hours - blue-green/black text: Hours shown indicate actual hours on the module. Run hours cannot be set by the user. Value - gray: The number of total hours the associated pump module has been running.

Trends Screen

The following table describes the pushbuttons and indicators on the Trends screen.

Trends Screen

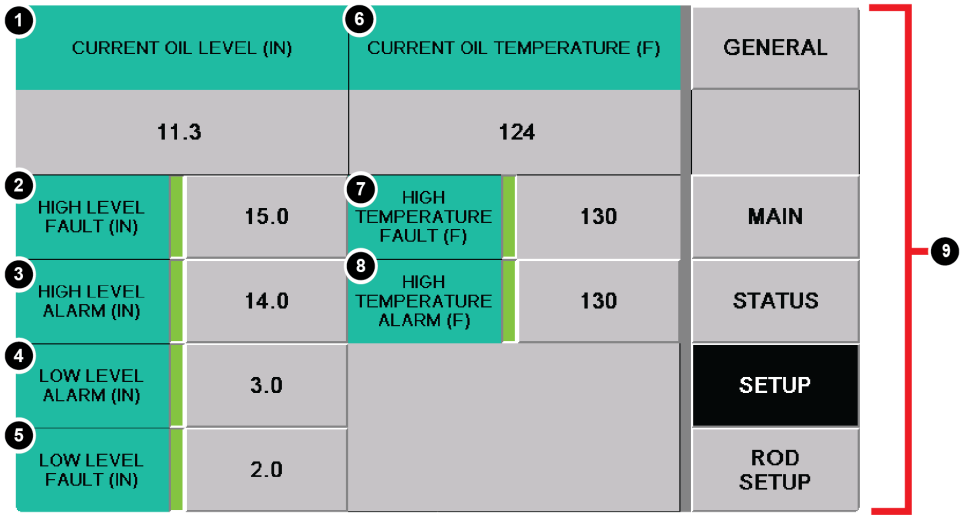


Item	Control	Descriptions
1	Pressure Trend	Graph. Shows a 300 second history of the pressure sensor with the current reading on the right edge of the plot and with history moving left. Y axis scale is 0 - 6000 psi (0 - 41.37 MPa). Text showing pressure is the current HPU fluid pressure in the units selected in the General screen.
2	Temperature Trend	Graph. Shows a 300 second history of the temperature sensor with the current reading on the right edge of the plot and with history moving left. Y axis scale is 0 - 212 °F (0 - 100 °C). Text showing temperature is the current HPU fluid temperature in the units selected in the General screen.
3	Level Trend	Graph. Shows a 300 second history of the hydraulic fluid level sensor with the current reading on the right edge of the plot and with history moving left. Y axis scale is 0 - 20 in. (0 - 50.8 cm). Text showing temperature is the current HPU fluid level in the units selected in the General screen.

Item	Control	Descriptions
4	Flow Trend	Graph. Shows a 300 second history of the fluid flow sensor with the current reading on the right edge of the plot and with history moving left. Y axis scale is 0 - 200 gpm (0 - 757 lpm). Text showing temperature is the current HPU fluid temperature in the units selected in the General screen.
5	Back	Pushbutton. Press to return to the General screen.
6	Trends	Pushbutton. Press to display the screen shown.

Setup Screen

The following table describes the pushbuttons and indicators found on the Setup screen.



No.	Name	Description
1	Current Oil Level (units)	Indicator. Displays the current oil level in the reservoir. The desired units can be selected in the General screen.
2	High Level Fault (units)	Pushbutton/Indicator. Displays the current preset for the high level fault. User settable. Faulted - red: Indicates an interlock has occurred and the HPU has been shut down. Not Faulted- green: Indicates the interlock is clear.
3	High Level Alarm (units)	Pushbutton/Indicator. Displays the current preset for the high level alarm. User settable. Alarm -yellow: Indicates an alarm is set. Ready - green: Indicates the alarm is clear.
4	Low Level Alarm (units)	Pushbutton/Indicator. Displays the current preset for the low level alarm. If the low level alarm preset is exceeded, an alarm displays on the HMI, but the HPU is not shut down. User settable. Alarm -yellow: Indicates an alarm is set. Ready - green: Indicates the alarm is clear.

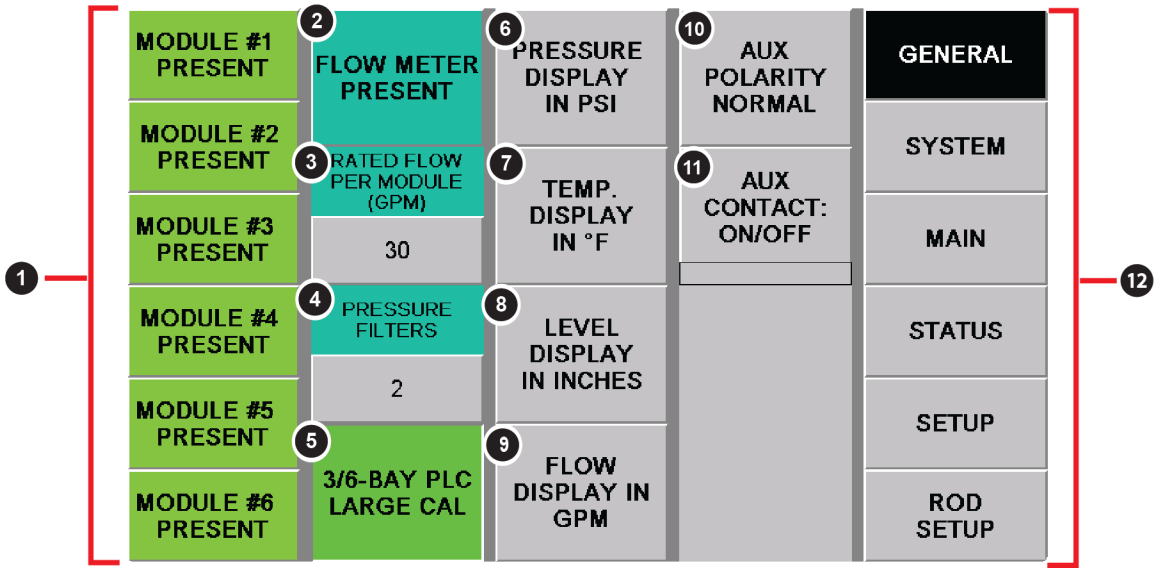
No.	Name	Description
5	Low Level Fault (units)	Pushbutton/Indicator. Displays the current preset for the low level fault. If the low level fault preset is exceeded, the PLC shuts the HPU down and does not allow restarting until the fault is corrected. User settable. Faulted - red: Indicates an interlock has occurred and the HPU has been shut down. Not Faulted- green: Indicates the interlock is clear.
6	Current Oil Temperature (units)	Indicator. Displays the current oil temperature in the reservoir. The desired units can be selected in the General screen.
7	High Temperature Fault (units)	Indicator. Displays the high temperature fault.This limit is set at 130°F. Faulted - red: Indicates an interlock has occurred and the HPU has been shut down. Not Faulted- green: Indicates the interlock is clear.
8	High Temperature Alarm (units)	Pushbutton/Indicator. Displays the current preset for the high level alarm. If the high temperature alarm preset is exceeded, an alarm displays on the HMI, but the HPU is not shut down. The HPU cannot be restarted when the high temperature alarm is tripped. User settable. Alarm -yellow: Indicates an alarm is set. Ready - green: Indicates the alarm is clear.
9	Screen Selection Buttons	Pushbuttons. Press to navigate to the stated screen.

General Screen

General Screen — Aux Contact On/Off

The following table describes the pushbuttons and indicators found on the General screen with the Aux Contact in On/Off mode.

General Screen — Aux Contact in On/Off Mode



Item	States	Descriptions
1	Module #N Present/Module #N Not Present	Pushbutton/Indicator. Used to indicate if a pump module is present. You cannot change between states without stopping the HPU. Module #N Present - green: Indicator used to show that the module is installed and available for use Module #N Not Present - gray: Indicator used to show that the module is not installed or that it is present and not available for use.
2	Flow Meter Present/Flow Meter Not Present	Pushbutton/Indicator. Used to indicate if a flow meter is present. Flow Meter Preset - blue-green: Indicator used to indicate that a flow meter is present. Flow Meter Not Present - gray: Indicator used to show that a flow meter is not present.
4	Pressure Filters	Pressure Filters - pushbutton/indicator - gray: Used to set the number of pressure filters on the HPU. Push the button to display the keypad. With the keypad displayed, use the right and left arrows to define the number of pressure filters.

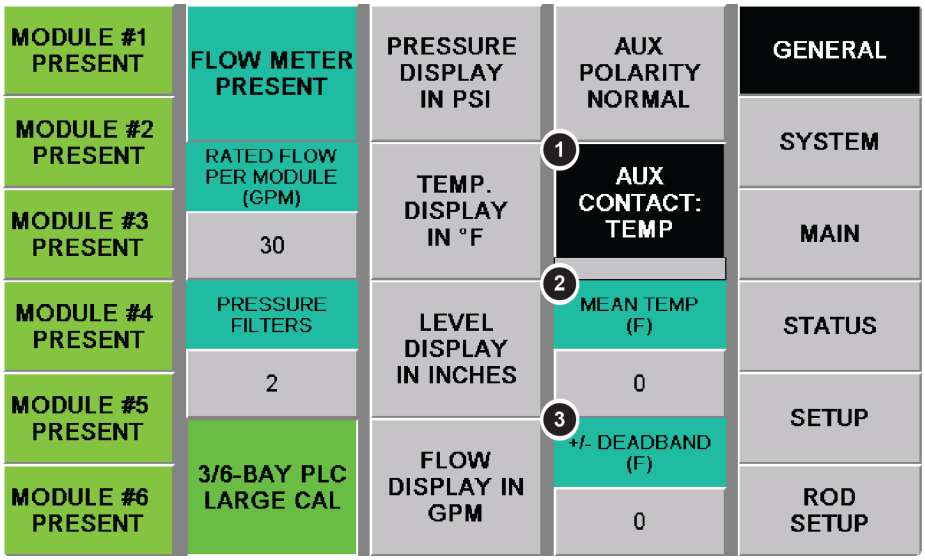
Item	States	Descriptions
5	Large PLC Large CAL	Indicator. Used to describe the PLC configuration and the calibration configuration.
	Small PLC Medium CAL	Large PLC/Large CAL - green. This is correct reading for the models covered by this manual.
	Small PLC Small CAL	Small PLC/Medium CAL - green. Reading for models not covered by this manual.
	No PLC Config	Small PLC/Small CAL - green. Reading for models not covered by this manual.
		No PLC Config - Red. No PLC has been discovered.
7	Temp in (units)	Pushbutton/Indicator.
		Temp in °F - gray/black text: Displays temperature in °F.
		Temp in °C - black/white text: Displays temperature in °C.
8	Level in (units)	Pushbutton/Indicator.
		Level in Inches - gray/black text: Displays level in inches.
		Level in CM - black/white text: Displays level in centimeters.
9	Flow Display in (units)	Pushbutton/Indicator.
		Flow Display in GPM - gray/black text: Displays flow in gallons per minute.
		Flow Display in LPM - black/white text: Displays pressure in liters per minute.

Item	States	Descriptions
10	Aux Polarity (state)	Pushbutton/Indicator. Used to change the polarity of both AUX contacts. AUX Polarity Normal - gray/black text: Both nonconfigurable and configurable auxiallary contacts are normally open and close when any pump module is turned on.. AUX Polarity Reverse - black/white text: Both nonconfigurable and configurable auxiallary contacts are normally closed and open when any pump module is turned on.
11	Aux Contact (state)	Pushbutton/Indicator. AUX Contact: On/Off - gray/black text: Configurable auxiallary contact operates only on pump modules first on last off. AUX Contact: Temp - Black/white text: Controls configurable auxiallary contact based on the mean temperature, deadband, and pump module first on last off.
12	Screen Selection Buttons	Pushbuttons. Press to navigate to the stated screen.

General Screen — Aux Contact in Temperature Mode

The following table describes the pushbuttons and indicators found on the General screen with the Aux Contact in Temp mode. All items are the same as with Aux Contact in On/Off mode except for the Aux Contact column.

General Screen — Aux Contact in Temperature Mode



Item	Control	Descriptions
1	Aux Contact (state)	Pushbutton/Indicator. AUX Contact: On/Off - gray/black text: Configurable auxiallary contact operates only on pump modules first on last off. AUX Contact: Temp - black/white text: Controls configurable auxiallary contact based on the mean temperature, deadband, and pump module first on last off.
2	Mean Temp (units)	Pushbutton/Indicator. Used to set the mean tempertaure for the hydraulic fluid in the reservoir. Push the button to display the keypad to set the mean. When done, press **Enter** to set the value.
3	+/- Deadband (units)	Pushbutton/indicator. Used to set the allowable deviation from the mean level operating temperature of the hydraulic fluid. Push the button to display the keypad to set the deadband. When done, press **Enter** to set the value.

System Screen

The following table describes the pushbuttons found on the System screen.

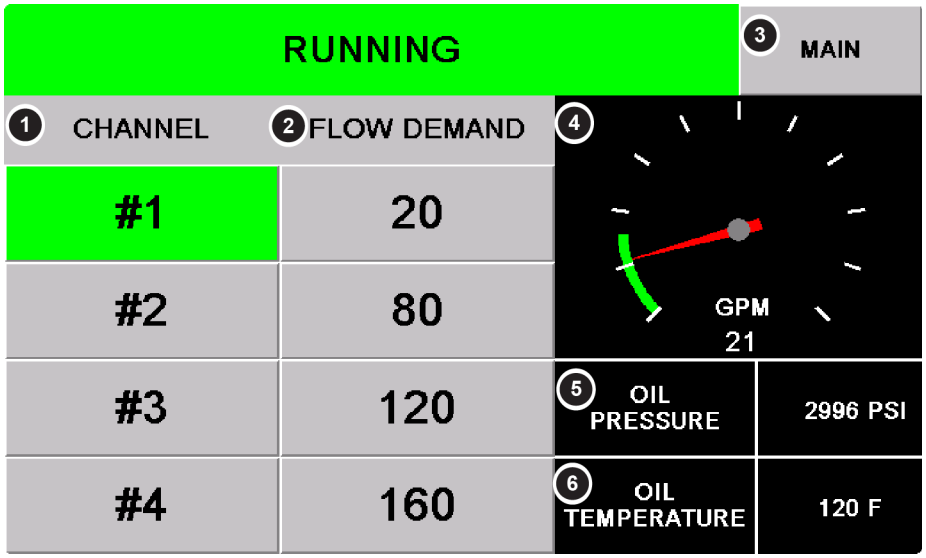
System Screen

Item	Control	Descriptions
1	Screen Selection Buttons	Pushbuttons. Press to navigate to the stated screen.

Station Flow Manager Screen

The following table describes the pushbuttons and indicators found on Station Flow Manager screen.

Station Flow Manager Screen

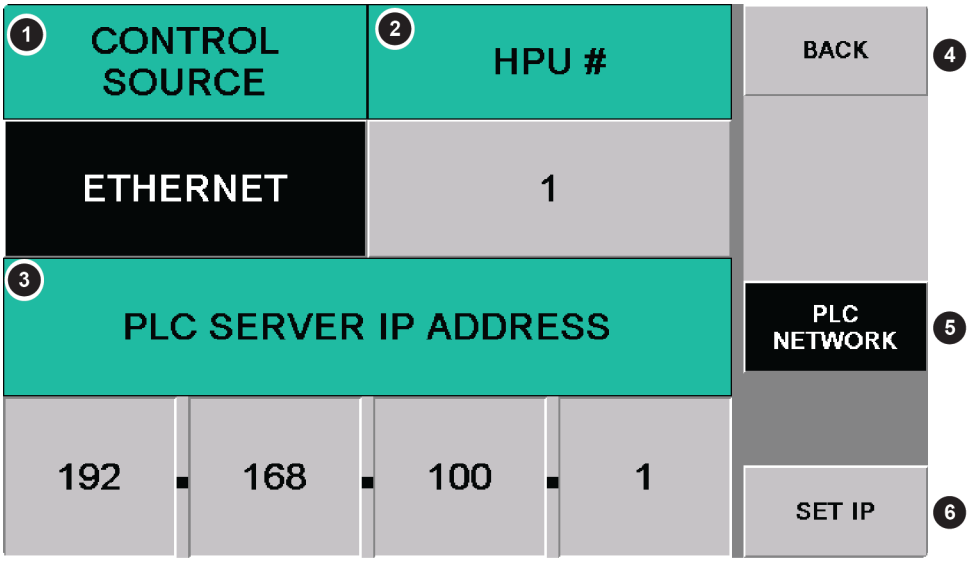


Item	Control	Descriptions
1	Channel	Pushbutton/Indicator. Indicates the digital input number that can be used to turn on/off the flow demand associated with the channel. Disabled - gray. Enabled - green. When enabled by a digital input, the Channel is not accessible manually.
2	Flow Demand	Pushbutton/Indicator. Used to enter the desired flow demand for the associated channel.
3	Main	Pushbutton. Press to go to the Main screen.
4	Analog Flow Display (units)	Indicator. Full scale of the gauge is the maximum flow the HPU can produce. The green band on the gauge indicates the flow capacity that is currently running. If the HPU has a flow meter, the needle indicates the current flow rate out of the HPU. If the HPU does not have a flow meter, the needle indicates the Total Flow Demand. The numeric display on the gauge will reflect the needle value in the units selected.
5	Oil Pressure	Indicator. Indicates output pressure of the HPU.
6	Oil Temperature	Indicator. Indicates the temperature of the hydraulic fluid in the reservoir.

PLC Network Screen

The following table describes the pushbuttons and indicators found on the PLC network screen.

PLC Network Screen



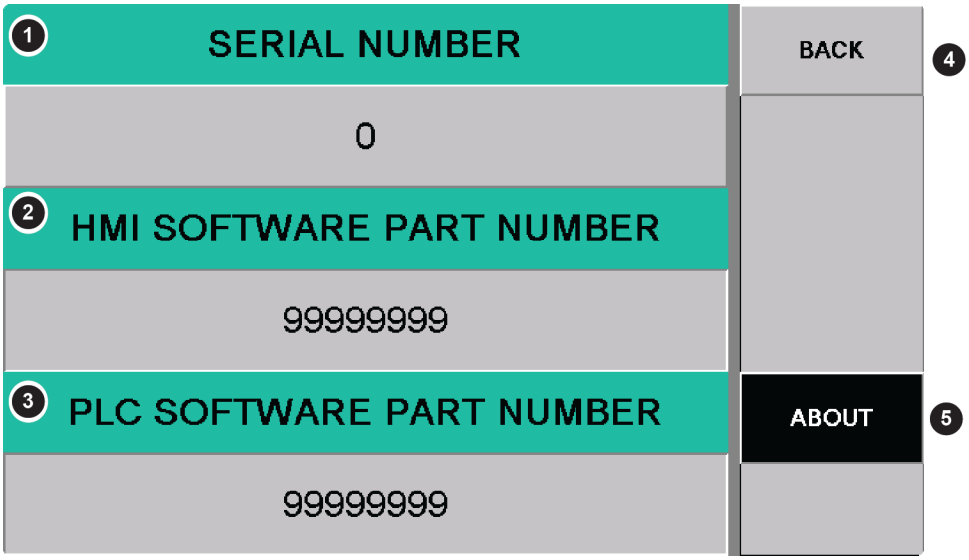
Item	Control	Descriptions
1	Control Source	Pushbutton/Indicator. Used to indicate the control source for the HPU. DIO/RHMI - gray/black text - Use this mode to control the HPU from an MTS controller or an RHMI controller. Ethernet - black/white text - Use this mode to control the HPU from an MPCM controller.
2	HPU #	Pushbutton/Indicator. Used to indicate the last octet in the HPU PLC IP address. Push the button to display the keypad. Set the IP address as desired, then press Set IP to implement the change.
3	PLC Server IP Address	Indicator. Used to show the current HPU PLC IP address. **Note:** If the current HPU PLC IP address and the HPU# do not match, press Set IP to update the last octet of the IP address to the HPU#.

Item	Control	Descriptions
4	Back	Pushbutton. Press to return to the General screen.
5	PLC Network	Pushbutton. Press to display the screen shown.
6	Set IP	Pushbutton. Press to update the last octet of the IP address (shown in this screen) to the HPU#.

About Screen

The following table describes the pushbuttons and indicators found on the About screen.

About Screen



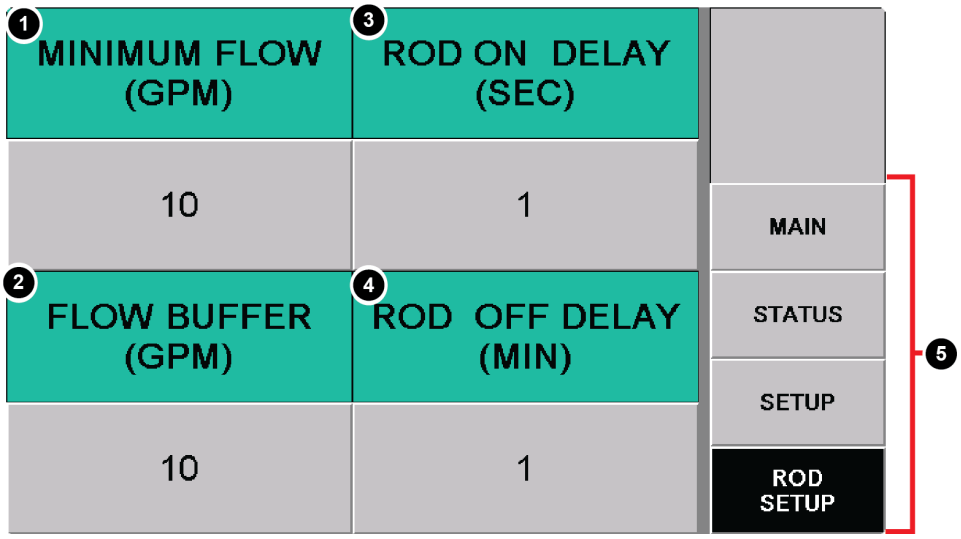
Item	Control	Descriptions
1	Serial Number	Numerical readout. Displays the serial number of the HPU
2	HMI Software Part Number	Numerical readout. Displays the part number of the HMI software.
3	PLC Software Part Number	Numerical readout. Displays the part number of the PLC software.
4	Back	Pushbutton. Press to return to the General screen.
5	About	Pushbutton. Press to display the screen shown.

Run On Demand (ROD) Setup Screen

Note: ROD (Run On Demand) is a purchased option.

To select this screen, press the ROD Setup button.

ROD Setup



Item	Control	Descriptions
1	Minimum Flow (units)	Pushbutton/Indicator. Used to set the Minimum Flow available for ROD. Press to show the keypad to set the Minimum Flow value. When done, press Enter to set the value.
2	Flow Buffer (units)	Pushbutton/indicator. Used to set the reserve flow capacity for run on demand. Press to show the keypad to set the Flow Buffer value. When done, press Enter to set the value. See "Run On Demand Detailed Example" on page 72 for more information.
3	ROD On Delay (units)	Pushbutton/indicator. Used to set the delay in seconds. The flow must be above the trigger level for this amount of time before the next pump motor turns on. Press to show the keypad that is used to set the delay. When done, press Enter to set the value. **Note:** Minimum time for this setting is 1 second.

Item	Control	Descriptions
4	ROD Off Delay (units)	Pushbutton/indicator. Used to set the delay in seconds. The flow must be below the trigger level for this amount of time before the next pump motor turns off. Press to show the keypad that is used to set the delay. When done, press Enter to set the value. **Note:** The allowed time for this setting is 10 minutes. This is intended to prevent constant pump motor cycling when flow demand is fluctuating slightly above and below the trigger level.
5	Screen Selection Buttons	Pushbuttons. Press to navigate to the stated screen.

HMI Setup

Auto Mode Setup 64
ROD (Run on Demand) Mode Setup 64
Hydraulic Fluid Level Alarm and Fault Limits Setup 65
Oil Temperature Alarm Limit Setup 65

Auto Mode Setup

1. Go to the General screen by selecting **Main>Setup>General**.
2. Verify that the **Rated Flow Per Module** is correct. The flow per module value can be calculated from the HPU information label. The flow capacity is listed on the label. This value must be divided by the number of pump modules in the HPU. Use the following table to determine the number of pump modules in your HPU:

Number of Pump Modules by Model Number

	515.90S-1 515.180S-1	515.60 515.180S-2	515.90 515.180S-3	515.120	515.150	515.180
Number of Pump Modules	1	2	3	4	5	6

Also, be sure to use the correct value for the units selected on the HPU.

For example:

- The HPU label lists the model as 515.120, so you have 4 pump modules.
- Flow Display is set to **gpm** on the General screen of the HPU HMI.
- The HPU information label lists the flow as 120 **gpm**.

Then the Flow Per Module would be calculated:

- 120 / 4 = 30
- Flow per module is 30 gpm

ROD (Run on Demand) Mode Setup

1. Go to the ROD Setup screen by selecting **Main>Setup>General>ROD Setup**.

   Note: See "Run On Demand Detailed Example" on page 72 for help understanding the following parameters.

2. Set the **Minimum Flow** value.

   Minimum Flow is the minimum flow that will always be available in ROD mode. It is not dependent on current flow rate.

3. Set the **ROD On Delay** value.

   ROD On Delay is the period of time that the current flow rate must exceed the sum of the **Minimum Flow Rate** and **Flow Buffer** or current flow rate and **Flow Buffer**, *whichever is greater*, before another pump module is started.

4. Set the **Flow Buffer** value.

Flow Buffer is the flow that should be available above the current flow rate.

5. Set the **ROD Off Delay** value.

   ROD Off Delay is the period of time that the sum of the current flow rate, **Flow Buffer** and **Rated Flow Per Module** must be less than the current available flow before a pump module is stopped.

Hydraulic Fluid Level Alarm and Fault Limits Setup

Note: It is not necessary that the HPU reservoir be full to set level limits. It must contain enough oil to insure that the oil level does not fall below the Low Level Fault level.

To set the hydraulic fluid level limits, navigate to the Setup screen on the HPU HMI. The actual level sensor reading is displayed near the top of the screen.

The Low Level Alarm, High Level Alarm, Low Level Fault, and High Level Fault can be set by the user. The Faults cannot be set outside of MTS limits. The best settings of these values depends on the system to which the HPU is connected. By monitoring the level during normal operation, optimal settings for these faults and alarms can be found.

Oil Temperature Alarm Limit Setup

To set oil temperature alarm limit, navigate to the Setup screen on the HPU HMI. The actual temperature sensor reading is displayed near the top of the screen.

The High Temperature Fault cannot be changed. The High Temperature Alarm can be set by the user. The best settings of the High Temperature Alarm depends on the system to which the HPU is connected. By monitoring the temperature during normal operation, an optimal setting for this alarm can be found.

Operation

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Operating Modes 68
Recover From an Alarm or Fault 74
Reset the Motor Starter Protectors and Circuit Breakers 77
Changing the Cooling Water Flow 77
Adjust Hydraulic Pressure 78
Low/High Pressure Functionality 79

Introduction

The HMI indicates the current status of the pressure, temperature, level, and optional flow sensors. If sensor values exceed set values, the PLC shuts down the HPU. The PLC also controls the solenoids that control low and high oil pressures. The HPU is designed to start in low pressure mode to reduce the amperage needed for starting which will extend the life of the pump and motor. When operating in this mode, low pressure hydraulic fluid circulates back to the reservoir through the manifold, heat exchanger, and return filter. The direct fluid path back to the reservoir limits pressure and flow available to the external hydraulic circuit. When high pressure is selected, solenoid valves force pressurized hydraulic fluid out to the hydraulic circuit.

Operating Modes

Manual Mode Operation

The manual operation mode allows an operator to control HPU functions that could otherwise be controlled automatically. This type operation may be necessary during setup or troubleshooting. Operation can be from the HMI at the HPU or from a remote device such as a controller or MPCM.

1. Make a general inspection of the HPU.
    A. Ensure that cooling system is operational and all valves are open.
    B. Ensure there are no alarms or faults (see “Recover From an Alarm or Fault” on page 74, if necessary).
2. If not already displayed, press **Main** to display the Main screen.
3. Verify that the **Remote Operation** button is gray. If the button is green, press the button to change it to gray (indicating local mode).
4. Verify that at least one pump module is enabled.
5. Press **Run** to start the pump module(s). The pump module(s) start sequentially to prevent an electrical overload. Each pump module starts in low pressure mode.
6. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. If necessary, determine the cause and fix the problem before restarting the HPU.
7. Press **High Pressure** to turn on high hydraulic pressure.

    Note: If the HPU generates an interlock during operation (such as low fluid level or high temperature), the HPU will stop. Once the cause has been corrected, press the **Reset** button before restarting.
8. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. Determine the cause and fix the problem before restarting the HPU.
9. Stop the HPU.
10. If running the HPU remotely:
    A. Press **Remote Operation** on the Main screen. It should turn green indicating the HPU is in remote control.v The HPU can now be run from the remote device.

B. Enable the desired modules.

C. Run the HPU for about 30 minutes or until the hydraulic fluid is up to operating temperature [typically 43–49°C (110–120°F)] before using your test system.

D. Enable/disable modules as needed.

11. If running the HPU locally:

    A. Verify that the **Remote Operation** button is gray, indicating that the HPU is in local control. Enable the desired modules.

    B. Press **Run**. The pump module(s) will start and run in Low Pressure.

    C. Press **High Pressure**. The pump module will immediately transition to High Pressure.

    D. To return to Low Pressure (Running) press **High Pressure**.

    E. To stop the HPU, press **Stop**.

Auto Mode Operation

The Auto mode allows the HPU to control which pump modules are used based on the Total Flow Demand and the Auto Hours value associated with each pump module. By changing the Total Flow Demand via either the Flow Demand at the HPU or Flow Demands that come into the HPU (e.g. from an RHMI), the number of pump modules running can be varied. The advantage of Auto mode is that as Total Flow Demand changes up or down; the HPU will automatically start the pump module with the fewest hours or stop the pump module with the most hours. This helps to insure that all pump modules share the load.

A change in demand is required to start/stop the pump modules.

1. Make a general inspection of the HPU.

    A. Ensure that cooling system is operational and all valves are open.

    B. Ensure there are no alarms or faults (see “Recover From an Alarm or Fault” on page 74, if necessary).

2. If not already displayed, press **Main** to display the Main screen.
3. Verify that the **Remote Operation** button is gray. If the button is green, press the button to change it to gray (indicating local mode).
4. Verify that at least one pump module is enabled.
5. Press **Run** to start the pump module(s). The pump module(s) start sequentially to prevent an electrical overload. Each pump module starts in low pressure mode.
6. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. Determine the cause and fix the problem before restarting the HPU.
7. Press **High Pressure** to turn on high hydraulic pressure.

Note: If the HPU generates an interlock during operation (such as low fluid level or high temperature), the HPU will stop. Once the cause has been corrected, press the Reset button before restarting.

8. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. Determine the cause and fix the problem before restarting the HPU.
9. Stop the HPU.

   Note: Auto mode cannot be enabled/disabled while the HPU is running.
10. Press **Auto** on the MAIN screen. The Module Enable buttons will disappear being replaced by the **Flow Demand** Button and **Total Flow Demand** Display.
    - **Flow Demand**: This is the flow being requested of the HPU by the operator at the HMI of the HPU and can be changed at any time the HPU is in Auto mode.
    - **Total Flow Demand**: This is the sum of the Flow Demand value above, any external flow demands from other devices (such as a RHMI) and any flow demands from the Station Flow Manager screen.
11. If running the HPU remotely:
    A. Press Remote Operation on the Main screen. It should turn green indicating the HPU is in remote control. The HPU can now be run from the remote device.
    B. Set the desired FLOW DEMAND or enable HPU or remote flow demand channels
    C. Run the HPU for about 30 minutes or until the hydraulic fluid is up to operating temperature [typically 43–49°C (110–120°F)] before using your test system.
12. If running the HPU locally:
    A. Verify the Remote Operation button is grey, indicating the HPU is in local control.
    B. Set the desired FLOW DEMAND or enable HPU or remote flow demand channels
    C. Run the HPU for about 30 minutes or until the hydraulic fluid is up to operating temperature [typically 43–49°C (110–120°F)] before using your test system.
13. Changing the Flow Demand
    A. Press the value under Flow Demand to bring up the keypad.
       a. Minimum Flow Demand is 1.
       b. Maximum Flow Demand is determined by the number of present pump modules and the Rated Flow Per Module (see HPU setup).
       c. Values entered are integer values in the units selected on the SETUP screen.
    B. Type in a value and press Enter to set or Esc to exit without changing the value.
14. Press **Run**.

    The required number of pump modules to support the Total Flow Demand will be started in Low Pressure. Pump Modules will be started based on the Auto Hours of the pump modules, lowest first.
15. Press **High Pressure** to go to high pressure.
16. Edit the Flow Demand as needed.

Pump modules will be started and stopped based on the Total Flow Demand and the Auto Hours of the pump module.

ROD Mode Operation (Optional)

The ROD (Run On Demand) mode can only be used if Auto mode is enabled. ROD mode works only with Auto mode. In ROD mode, when the Total Flow Demand exceeds the Flow Buffer value, the Total Flow Demand will override the Flow Buffer value for ROD operation. ROD will allow for the HPU to automatically increase/decrease the running capacity of the HPU based on the current flow of the HPU and the setup of ROD and Auto modes.

1. Make a general inspection of the HPU.
    A. Ensure that cooling system is operational and all valves are open.
    B. Ensure there are no faults or alarms, see recovering from an interlock
2. If not already displayed, press **Main** to display the Main screen.
3. Verify that the **Remote Operation** button is gray. If the button is green, press the button to change it to gray (indicating local mode).
4. Verify that at least one pump module is enabled.
5. Press **Run** to start the pump module(s). The pump module(s) start sequentially to prevent an electrical overload. Each pump module starts in low pressure mode.
6. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. Determine the cause and fix the problem before restarting the HPU.
7. Press **High Pressure** to turn on high hydraulic pressure.

    Note: If the HPU generates an interlock during operation (such as low fluid level or high temperature), the HPU will stop. Once the cause has been corrected, press the Reset button before restarting.
8. Check the HPU for leaks and unusual sounds. Stop the HPU immediately if leaks or unusual sounds are noted. Determine the cause and fix the problem before restarting the HPU.
9. Stop the HPU.
10. Press the **Auto** button. The **Auto** button should turn green and reveal the ROD button.
11. Press the **ROD** button to enable ROD. The button should turn green.

    Note: It is not required to manipulate the Flow Demand for ROD to work. However, the Flow Demand via Auto mode may be utilized simultaneously with ROD.

    The Module Enable buttons will disappear being replaced by the **Flow Demand** Button and **Total Flow Demand** Display.

    - **Flow Demand**: This is the flow being requested of the HPU by the operator at the HMI of the HPU and can be changed at any time the HPU is in Auto mode.
    - **Total Flow Demand**: This is the sum of the Flow Demand value above, any external flow demands from other devices (such as a RHMI) and any flow demands from the Station Flow Manager screen.

12. If running the HPU remotely:
    A. Press **Remote Operation** on the Main screen. It should turn green indicating the HPU is in remote control. The HPU can now be run from the remote device.
    B. Set the desired Flow Demand or enable HPU or remote flow demand channels
    C. Run the HPU for about 30 minutes or until the hydraulic fluid is up to operating temperature [typically 43–49°C (110–120°F)] before using your test system.
13. If running the HPU locally:
    A. Verify the Remote Operation button is grey, indicating the HPU is in local control.
    B. Set the desired FLOW DEMAND or enable HPU or remote flow demand channels
    C. Run the HPU for about 30 minutes or until the hydraulic fluid is up to operating temperature [typically 43–49°C (110–120°F)] before using your test system.
14. Change Flow Demand as desired:
    A. Press the value under Flow Demand to bring up the keypad.
        a. Minimum Flow Demand is 1.
        b. Maximum Flow Demand is determined by the number of present pump modules and the Rated Flow Per Module (see HPU setup).
        c. Values entered are integer values in the units selected on the SETUP screen.
    B. Type in a value and press **Enter** to set or **Esc** to exit without changing the value.
15. Press **Run**.

    The required number of pump modules to support the Total Flow Demand will be started in Low Pressure. Pump Modules will be started based on the Auto Hours of the pump modules, lowest first.
16. Press **High Pressure** to go to high pressure.
17. Edit the Flow Demand as needed.

    Pump modules will be started and stopped based on the Total Flow Demand and the Auto Hours of the pump module.

Run On Demand Detailed Example

Run On Demand (ROD) is a system that monitors the output flow of the Hydraulic Power Unit (HPU) and turns on and off pump modules as needed to best meet the users demands. The parameters for ROD that need to be set by the user include:

- **On Delay**: the period of time that must pass where the criteria are met or exceeded before the next module(s) will be turned on.
- **Off Delay**: the period of time that must pass where the criteria are met or exceeded before the next module(s) will be turned off.
- **Module Flow**: the flow capability of a single pump module within the HPU (see table).
- **Minimum Flow**: the minimum flow capacity that should be available when the HPU is on.

- **Buffer Flow**: the minimum flow that should be available beyond the actual current flow. (6 gpm is added to this value in order to compensate for the circulation pump within the HPU).

The following example uses these settings:

- **Module Flow** is set at 30 gpm.
- **Minimum Flow** is set at 10 gpm.
- **Buffer Flow** is set at 10 gpm.
- Δton represents the **On Delay**.
- Δtoff represents **Off Delay**.

The HPU starts out with one module running to create 30 gpm of available flow. This satisfies both the Minimum Flow requirement (10 gpm) and the Buffer Flow requirement (10 gpm). The demand rises and eventually hits 20 gpm.

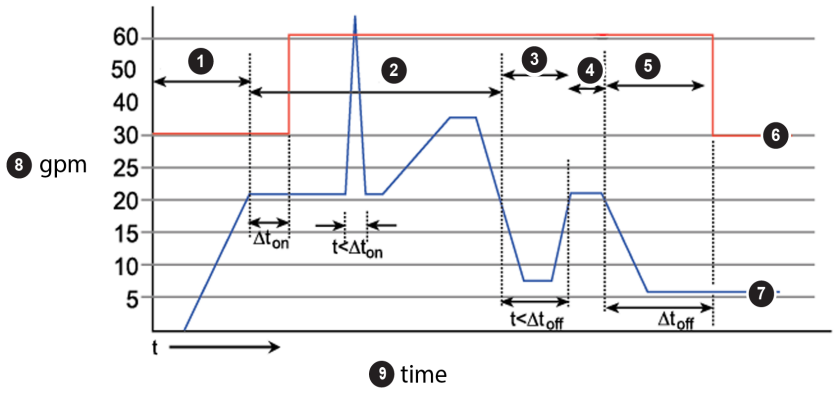
At this point the On Delay is started because the 20 gpm of actual flow and 10 gpm of Buffer Flow meet or exceed the available 30 gpm. Because the flow stays above 20 gpm for the length of time Δton, another pump module is started and available flow goes to 60 gpm.

Then a spike occurs which exceeds the available flow but because the duration of the spike is less than Δton, another pump module is not started. Flow then continues to increase, but never exceeding the next trigger point of 50 gpm for a duration of Δton.

Then flow drops off below 20 gpm. Because the flow does not stay below 20 gpm for the period of time Δtoff, no pump modules are turned off.

Finally the flow tapers off and flow is below 20 gpm for the time Δtoff and the second pump module is turned off.

ROD Example



Item	Description
1	Demand<20
2	50>Demand>20
3	Demand<20
4	50>Demand>20
5	Demand<20
6	Red Line = Available Flow
7	Blue Line = Actual Flow
8	gpm
9	time

Recover From an Alarm or Fault

Introduction

When a Fault or Alarm occurs on the HPU, go to the Status screen to determine the type of Fault or Alarm. It is possible for multiple Faults and Alarms to be active. An Alarm will not stop a HPU but a Fault will cause the HPU to shut down. All Faults and Alarms must be cleared before the HPU can be started.

EXT Stop Fault

This means that an external input (such as a smoke alarm, door interlock, or oil detection system)has triggered the external stop input to the HPU. Find the cause of the activated input and correct.

Recovery

Press **Reset** to clear the interlock and return to normal operation.

Watchdog Fault

A watchdog timer is used to monitor the HPU PLC for operation. If the HPU PLC is not operating properly the hardware watchdog timer will generate an HPU E-stop. A watchdog fault causes the HPU to shutdown. Perform the following procedure to attempt to recover from this fault.

Recovery

1. Turn the power disconnect switch on the main enclosure to off.
2. Wait at least 60 seconds, then close the power disconnect switch.
3. From the Language screen, press the **Main Display** button.
4. On the Main Display screen, press the **Reset** button.
5. If the Watchdog Fault condition does not clear, contact MTS Systems.

E-Stop (Emergency Stop) Fault

This means that the safety relay within the HPU has been tripped. The cause of a safety relay trip is either the main panel E-stop button, an external e-stop button, or the HPU watchdog timer.

Recovery

Press **Reset** to clear the interlock and return to normal operation.

Oil Level Alarm and Fault

Yellow (Alarm)

If the oil level is out of the alarm range, an alarm displays on the HMI, but the HPU is not shut down. The HPU cannot be restarted when the oil level alarm is tripped. To clear the alarm, correct the condition and press **Reset** on the Status screen. To set the alarm and fault ranges, press the value.

Red (Fault)

If the oil level is out of the fault range, the PLC shuts down the HPU and does not allow restarting until the fault is corrected. To clear the interlock, correct the condition and press **Reset** on the Status screen. To set the alarm and fault ranges, press the value.

Recovery

1. Verify that the hydraulic fluid level sensor is detecting the correct fluid level.
2. Determine the cause for the fluid level interlock and correct it.
3. Add or remove hydraulic fluid to the reservoir until the gauge indicates the proper level.
4. Press **RESET** to clear the interlock and return to normal operation.

Oil Temperature Alarm and Fault

Yellow (Alarm)

This indicates that the hydraulic fluid temperature has exceeded the high temperature alarm limit set for the HPU. To set the alarm and fault ranges, press the value.

Red (Fault)

This indicates that the hydraulic fluid temperature has exceeded the high temperature fault limit set for the HPU. To set the alarm and fault ranges, press the value.

Recovery

A hydraulic fluid oil temperature fault is indicated on the Main screen by a flashing red Faulted indicator, a blue Bypass indicator, a red Oil Temp indicator, and a blue Status indicator. The interlock is generated when the temperature exceeds 55°C (130°F). The fault will automatically shut down the HPU. The HPU cannot return to normal operation until the fluid has cooled. Perform the following to correct an overtemperature fault:

1. Verify that the hydraulic fluid temperature sensor is detecting the correct hydraulic fluid temperature.
2. Verify that the cooling system is functioning and that all necessary valves are open.

3. Determine the cause for the hydraulic fluid temperature interlock and correct it.
4. Press **Reset** to clear the interlock and return to normal operation.
5. Start cooling the hydraulic fluid by circulating hydraulic fluid through the heat exchanger using the Overtemp Bypass mode.
    A. If necessary, press the Main button to select the Main screen.
    B. Ensure that Pump Module #1 is Enabled.
    C. Press **Bypass**. Pump module #1 will start and run to circulate the hydraulic fluid through the heat exchanger. The red flashing Faulted indicator changes to yellow Overtemp Bypass and the Bypass button changed to Stop.
6. If the there is no change in the Oil Temp reading after several minutes, determine if the hydraulic fluid is receiving adequate cooling.
    - The cooling water inlet temperature affects the efficiency of cooling the hydraulic fluid.
    - Check the cooling water inlet-to-outlet pressure differential. It should be between 0.24–0.31 MPa (35–45 psi). If necessary, adjust the water pressure at its source.
7. After the displayed fluid temperature drops below 55°C (130°F), press the **Stop** button.
8. Press the **Reset** button to clear the interlock and turn the indicator off.

Return Filter Alarm

This indicates that the return filter is dirty and needs replacement. Note that cold oil and high flow rates can cause false alarms. In these cases the alarm will go away when the HPU reaches operating temperature.

Recovery

If the HPU is stopped while a dirty filter condition exists then the reset button must be pushed to reset the alarm. If a filter alarm occurs and clears during normal HPU operation then the alarm will automatically reset.

Pressure Filter Alarm

This indicates that the pressure filter is dirty and needs replacement. Note that cold oil and high flow rates can cause false alarms. In these cases the alarm will go away when the HPU reaches operating temperature.

Recovery

If the HPU is stopped while a dirty filter condition exists then the reset button must be pushed to reset the alarm. If the filter alarm occurs and clears during normal HPU operation then the alarm will automatically reset.

Sequence Fault

The Sequence fault produces a pump module contactor fault and an HPU alarm. While it shuts down the faulted module, it does not shut down the HPU if other modules are running.

Recovery

To recover form a sequence fault, navigate to the Status screen and press the Reset button. If the fault continues to occur, call MTS Service.

Reset the Motor Starter Protectors and Circuit Breakers

The branch circuit for each motor is protected by a combination circuit breaker/motor overload device called a motor circuit protector (MCP). If a short circuit or motor overload occurs on the branch circuit, the MCP will trip and automatically disconnect the pump motor from the branch circuit.

Reset the MCP as follows:

1. Turn the main circuit breaker switch counterclockwise to remove the feed power form the motor circuits of the HPU.

   Warning:
   Power will still be present at the top of the main circuit breaker terminals.

   Contact with or close proximity to incoming power terminals could result in injury or death.

   Stay clear of incoming power terminals.

2. Open the HPU enclosure door using the enclosure door handle.
3. Locate the tripped MCP and check the associated branch circuit for a short circuit. Correct if necessary.
4. Reset the MCP by pushing the front toggle handle of the MCP down to the "off" position and then lifting it to the "on" position.
5. If the MCP continues to trip call MTS Service.

Changing the Cooling Water Flow

On water-cooled units, water is used to maintain hydraulic fluid temperature. (Air cooled units use the hydraulic oil for cooling. See the Air-Cooling Product Information manual, regarding air-cooling units.) The cooling control valve, senses the hydraulic fluid temperature and automatically controls fluid flow to the heat exchanger.

The cooling control valve is adjusted at MTS Systems Corporation to maintain the hydraulic fluid temperature within the range of 43–49°C (110–120°F). However, the design of your cooling system and ambient conditions might require you to readjust the valve.

To set the operating temperature of the hydraulic fluid.

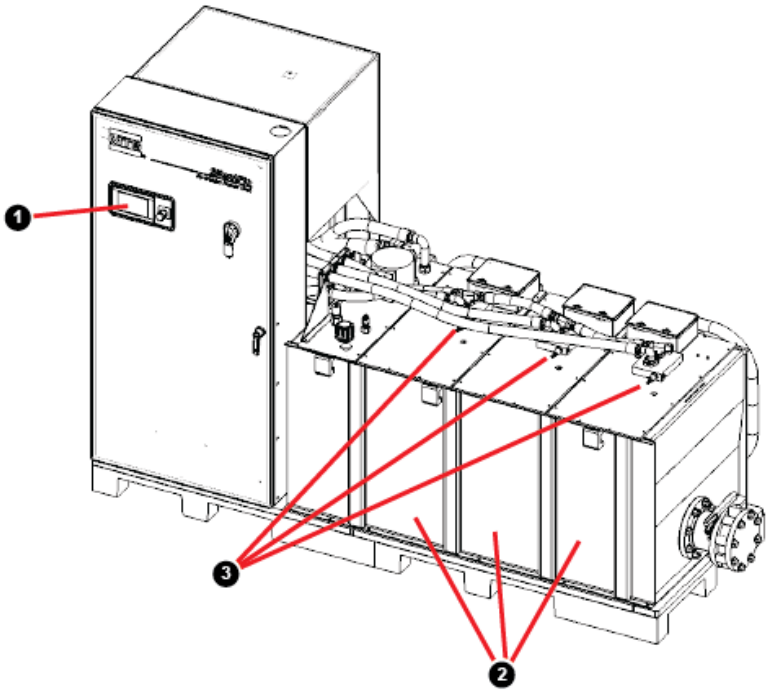
1. Start all pump modules and select High Pressure (see local control in “Manual Mode Operation” on page 68 for instructions, if necessary).
2. Observe the Oil Temp on the Main screen as the hydraulic fluid temperature rises. Note the temperature where the hydraulic temperature stabilizes.

3. Adjust the cooling control valve. One full turn (360°) of the adjusting screw produces a change in hydraulic fluid temperature of a few degrees.
    - Adjust the screw clockwise to decrease the operating temperature.
    - Adjust counterclockwise to increase the operating temperature.
4. Note the effect after 15 minutes.
5. Repeat Steps 5 and 6 until the hydraulic fluid temperature stabilizes between 43°C–49°C (110°F–120°F).

Adjust Hydraulic Pressure

The output pressure can be adjusted from a low pressure value of 2 MPa (300 psi) to the maximum setting of the working pressure listed onthe HPU information label. If you have a special testing requirement, you can reduce the HPU output pressure.

Control Locations (515.90 shown)



Item	Description
1	HMI
2	Pump Modules
3	Output Pressure Controls

Perform the following procedure to adjust the output pressure. Perform this procedure on one pump module at a time.

Caution:
The pump module and motor are designed to operate below a specified pressure.

Setting the hydraulic pressure above the HPU information label working pressure can damage the HPU.

Do not adjust the output pressure higher than that specified on the HPU information label.

1. If not already selected, press the **Main** button on the user interface panel to select the Main screen. Ensure that you are in local control mode and not in auto mode. Run the HPU up to the normal operating temperature before proceeding. Stop the HPU.
2. Select Module #_ Enabled for the first pump module to be adjusted.

   Ensure that no other pump modules are enabled.
3. Press Run to start the HPU in low pressure.
4. Press the **High Pressure** button to select high pressure mode.
5. Loosen the nut securing the output pressure control of the enabled pump module.
6. While an assistant monitors the Hydraulic Fluid Pressure on the Main screen, adjust the output pressure as follows until the desired pressure is displayed. The recommended pressure setting can be found on the HPU information label under working pressure.
   - Turn the output pressure control clockwise to increase the pressure.
   - Turn the output pressure control counterclockwise to decrease the pressure.
7. Hold the output pressure control to prevent it from moving and tighten the nut to secure it.
8. Check the Oil Pressure on the Main screen to ensure that the desired hydraulic pressure is being maintained.
9. Select Module #_ Enabled for the next pump module to be adjusted to enable it.

   Select Enable Module #_ for the previously adjusted pump module to disable it.
10. Repeat Steps 5 through 9 until all pump modules have been adjusted to the desired pressure.
11. After the output pressure has been adjusted on all the pump modules, the pump modules are now ready for operation.

Low/High Pressure Functionality

This section clarifies the low and high pressure functionality of the HPU. There are certain cases where it is advantageous to use the HPU in low pressure versus high pressure.

Series 515 HPUs are started in low pressure to reduce the amount of current inrush at motor start-up. A solenoid valve that opens a direct flow path to the return line commands the pressure setting. Since this direct path offers little resistance to the full flow, minimal system pressure is developed (low

pressure). Low pressure operation of a Series 515 HPU provides several useful functions when high pressure is not required by the external system.

Maintenance

Routine Maintenance Schedule 82
Maintenance Procedures 83

Routine Maintenance Schedule

Note:
In the table below, an 'X' indicates service that should be performed by equipment operators. Most of these procedures involve visual checks that should not interfere with test systems operation. These checks are also completed by trained field service engineers on each routine maintenance visit.

'MTS' indicates service performed by trained field service engineers as part of an MTS Routine Maintenance plan. Some of these procedures require special service tools and/or specific training to complete.

Maintenance Schedule noted

Running Time-Hours	Daily Every 8	Weekly Every 40	Monthly Every 160	Annually Every 500	Annually Every 1000	Annually Every 2,000	Annually Every 5,000	Annually Every 10,000
Check dirty filter indicators	X							
Check for leaks	X							
Check oil level	X							
Check pressure	X							
Check HPU hydraulic fluid color and odor		X						
Check interlock devices		X						
Check electrical cables and connectors			X					
Check optional accumulator precharge pressure			X					
Check optional accumulator for oil				MTS				
Inspect heat exchanger for leaks				MTS				
Check HPU operating temperature				MTS				
Inspect hydraulic hoses for leaks				MTS				
Verify dirty filter indicators status				MTS				
Verify HPU hydraulic fluid level				MTS				
Verify alarm and fault devices				MTS				
Recommend MTS Hydraulix oil sample				MTS				
Replace all filters					MTS			

Maintenance Schedule noted (continued)

Running Time-Hours	Daily Every 8	Weekly Every 40	Monthly Every 160	Every 500	Annually Every 1000	Annually Every 2,000	Annually Every 5,000	Annually Every 10,000
Verify operation and settings of psi control and relief valves					MTS			
Check pump/motor coupling for wear and debris						MTS		
Check pump voltage and current						MTS		
Check case drain flow						MTS		
Recommend replacement or rebuild of heat exchanger							MTS	
Recommend replacement of hoses								MTS
Inspect motor bearings[1]								MTS
Determine if replacement or rebuild of pump required*								MTS
Determine if replacement or rewind of motor is required*								MTS
Recommend hydraulic fluid change								MTS

Maintenance Procedures

Spare parts

Parts that are specified in the maintenance procedures of this section can be obtained from MTS Systems Corporation. See “Contact information” on the back of the title page to order spare parts.

Lockout/tagout

For your safety, follow all appropriate lockout/tagout procedures while performing HPU maintenance.

Operating the HPU

When running the HPU, become familiar with the sounds and smells of the HPU. Changes in the sounds and smells of the HPU might indicate that maintenance or service is needed.

[1]Generally an inspection would be done every 10,000 hours. Replacement/repair is typically done at 30,000 hours.

Checking the Hydraulic Fluid Level Sensor

1. Disconnect the electrical connector from the hydraulic fluid level sensor.
2. Remove the hydraulic fluid level sensor from the reservoir.
3. Reconnect the electrical connector to the hydraulic fluid level sensor.
4. Move the float from one end of the sensor to the other insuring that the fluid level readout on the Setup screen smoothly follows the movement of the float.
    A. Dead spots or intermittent operation indicate the hydraulic fluid level sensor may need service or replacement.
5. If the sensor works correctly reinstall in reverse order.

Checking the Emergency Stop

1. Start the HPU.
2. Actuate the e-stop (emergency stop) button.
3. The HPU should immediately stop and being to relive pressure.
    A. If the HPU does not immediately stop and begin to relieve pressure, discontinue use immediately and determine the cause.
4. If the e-stop works correctly, see Recovering from an e-stop.

Checking the Electrical Cables and Connectors

1. Follow the cables out from the back of the HPU electrical enclosure to their termination point
2. If any of the following issues or other damage are found, fix the issue immediately
    A. Check the cables for cuts, nicks, abrasion or other damage.
    B. Check the connectors for loose or otherwise damaged components.

Checking the Hydraulic Hoses

1. Follow each hose from one end to the other.
2. Check the hoses for cuts, nicks, abrasions, leaks or other damage.

Warning:
Do not use your fingers or hands to check for leaks in hydraulic or pneumatic hoses.

Substantial pressures can build up, especially if the hole is small. These high pressures can cause the oil or gas to penetrate your skin, causing painful and dangerously infected wounds.

Turn off the hydraulic supply and allow the hydraulic pressure to dissipate before checking for leaks in any hose or pressurized component.

A. If damage is found that affects more than the outermost protective cover of the hose, it should be replaced.

B. If the hose is more than 5 years old, the hose should be replaced.

Checking the Hydraulic Fluid Level

1. Document the hydraulic fluid level during operation and when shut down.

   It is not required that the HPU hydraulic fluid level be at the maximum level. This should be determined based on the use of the HPU and the type(s) of system(s) to which the HPU is connected.

2. Lower levels indicate there may be a hydraulic fluid leak.
3. High levels indicate that other fluids may be getting into the hydraulic fluid.

Checking the Hydraulic Fluid

1. Check the hydraulic fluid color. Clean hydraulic fluid is amber in color.
2. Keep a sample of brand-new hydraulic fluid in a clean glass container for comparison. A change in color canmean that the fluid is contaminated or that it has broken down chemically. If the hydraulic fluid appears different than the clean sample, see the “Appearance of Hydraulic Fluid Sample” table.
3. Open the filler cap and check the smell the hydraulic fluid. Burnt-smelling hydraulic fluid can indicate a chemical breakdown.

   If you detect a distinct change in the smell of hydraulic fluid, have it chemically analyzed by the manufacturer.

4. Keep records of the maximum reservoir temperature.

   High operating temperatures can cause the fluid to break down. If your records indicate a pattern of overheating, consult your MTS Field Service Engineer to determine if changes or adjustments to your hydraulic systemare required.

Checking the Pump Module Output Pressure

1. After switching the pump module to High Pressure, check the pump module for the correct output pressure.
2. If adjustment is necessary, see Adjusting Hydraulic pressure.
3. If the pressure is correct, move on to the next pump module.

Checking the Operating Temperature

1. Monitor hydraulic fluid temperature during operation.
2. See Changing the Cooling Flow

Sampling the Hydraulic Oil

1. Taking an oil sample requires kit 555896-01, follow the instructions within the kit.
2. The oil sample port is located on the HPU near the pressure outlet in port P 02.

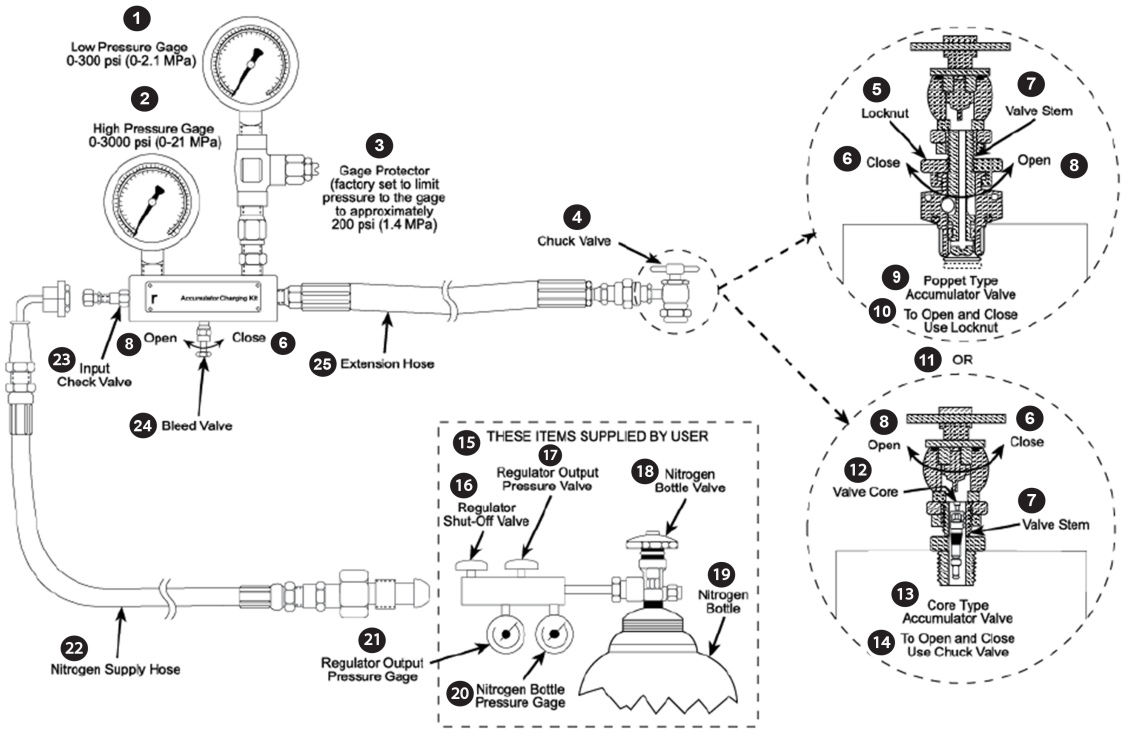
Note: On models with high pressure filter option. The sample port may be moved to port P-WF-02 or P-WF-03 in order to check oil quality after the high pressure filter. Reinstall the fitting originally installed in P-WF-02 or P-WF-03 in port P 02.

Check the Accumulator Precharge Pressure

Checking the Precharge Pressure

1. Monitor the pressure gauge.
2. If the pressure reading is outside the proper range, increase or decrease the pressure as appropriate.
   - The nitrogen precharge should be approximaterly 33% of the output pressure.
   - For an output pressure of 21 MPa or 3000 psi, the correct precharge pressure is 7 MPa (1000 psi).

Charging Kit



Item	Description
1	Low pressure Gage 0-3.00 psi (0-2.1 MPa)
2	High Pressure Gage 0-3000 psi (0-21 MPa)
3	Gage Protector (factory set to limit pressure to the gage to approximately 200 psi (1.4 MPa)
4	Chuck Valve
5	Locknut
6	Close
7	Valve Stem
8	Open
9	Poppet Type Accumulator Valve
10	To open and close use locknut
11	Or
12	Valve Core
13	Core Type Accumulator Valve
14	To open and close use Chuck Valve
15	THESE ITEMS SUPPLIED BY USER
16	Regulator Shut-Off Valve
17	Regulator Output Pressure Valve
18	Nitrogen Bottle Valve
19	Nitrogen Bottle
20	Nitrogen Bottle Pressure Gage
21	Regulator Output Pressure Gage
22	Nitrogen Supply Hose
23	Input Check Valve
24	Bleed Valve
25	Extension Hose

Decreasing the Accumulator Precharge Pressure

1. Slowly open the bleed valve on the charging kit until gas begins to escape. When the pressure reading on the appropriate pressure gage drops to the level required, close the bleed valve.
2. Close the locknut. Open the bleed valve on the accumulator charging kit and remove the chuck valve from the accumulator.
3. Install the valve stem cap and protective cover.

Increasing the Accumulator Precharge Pressure

1. Close the locknut on the accumulator.
2. Open the bleed valve two turns.

Warning:
Precharging with a gas other than dry nitrogen will cause the existing nitrogen within the accumulator to be mixed with the new gas.

Mixing gases can produce unpredictable results.

Use only dry nitrogen gas to precharge the accumulator.

---

4. Connect the nitrogen supply hose from the supply bottle pressure regulator output to the input check valve on the charging kit.
5. Open the nitrogen bottle valve. Check the nitrogen bottle pressure gage on the regulator. (The bottle must contain sufficient pressure to provide an adequate gas volume.)
6. Monitor the regulator output pressure gage and adjust the regulator output pressure valve to the required level.

Caution:
Do not transfer gas from a supply bottle to an accumulator at a high rate.

Pressure differentials higher than 2.1 MPa (300 psi) across the input check valve in an accumulator can damage valve seals.

When charging an accumulator, transfer gas from the supply bottle at a low rate. Gradually open the regulator valve on the bottle just enough to transfer gas from the bottle to the accumulator.

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8. Slowly open the regulator shut-off valve until gas is heard escaping from the accumulator charging kit bleed valve. Allow gas to slowly escape for approximately ten seconds, and then close the bleed valve. Immediately close the regulator shut-off valve before the pressure reading on either the high or low charging kit pressure gage exceeds the pressure level of the accumulator.
9. Open the locknut. Slowly open the regulator shut-off valve until the pressure indicator on either the high or low charging kit pressure gage begins to rise. When the pressure is at the required pressure level, close the regulator shut-off valve.

10. Close the locknut.
11. Open the bleed valve on the charging kit and remove the chuck valve from the accumulator.
12. Install the valve stem cap and protective cover. Close the valve on the nitrogen bottle.

Checking the HPU for Leaks

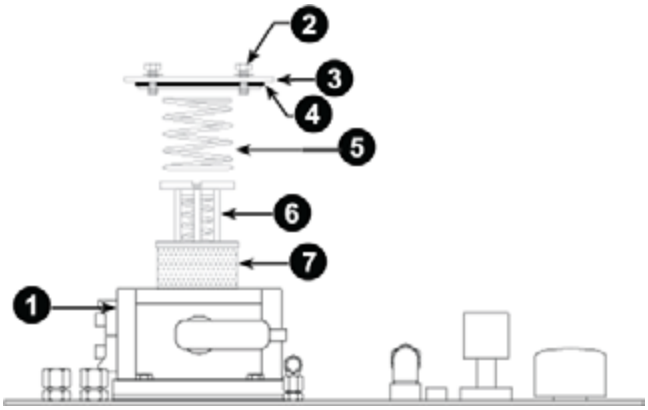
Walk around the HPU opening covers and removing access panels as needed. Check all fluid components (hoses, manifolds, valves, etc) for leakage.

Replacing the Return-Line Filter

The standard filter is a return-line filter. There is also an optional high pressure filter that can exist on any particular unit.

Required equipment

- Filter element (MTS part number 100-029-989)
- O-ring (MTS part number 010-010-927)
- Filter Components



Item	Description
1	Filter Housing
2	Capscrews (4) 53 N-M(39 ft-lb)
3	Filter Cap
4	O-Ring
5	Spring
6	Bypass Valve Assembly
7	Filter Element

Procedure

1. Turn off the HPU. Ensure that the hydraulic pressure is at zero before proceeding.

   Caution:
   The system pressure does not immediately drop to zero when the HPU is turned off.

   Residual pressure can produce a high pressure spray that can hurt you.

   Do not start this procedure until all pressure gages read zero.

2. Unlock and open the small cover next to the electrical enclosure to access the filter assembly.
3. Remove the four cap screws that secure the filter cap to the filter housing.
4. Remove the spring, bypass valve assembly, and filter element. Discard the dirty element according to local environmental codes.
5. Clean the bypass valve and spring, as needed.
6. Check the filter housing for signs of serious contamination such as large pieces of grit, rubber particles, and metal shards.
7. Find and correct the cause of this contamination before operating your system again.
8. Install the new filter element, bypass valve, and spring.
9. Reinstall the filter cap. Make sure that its O-ring has remained in place. Torque the four cap screws to 53 N-M (39 ft-lb).
10. Apply low pressure and check for leaks.

Replacing the Optional High-Pressure Filter

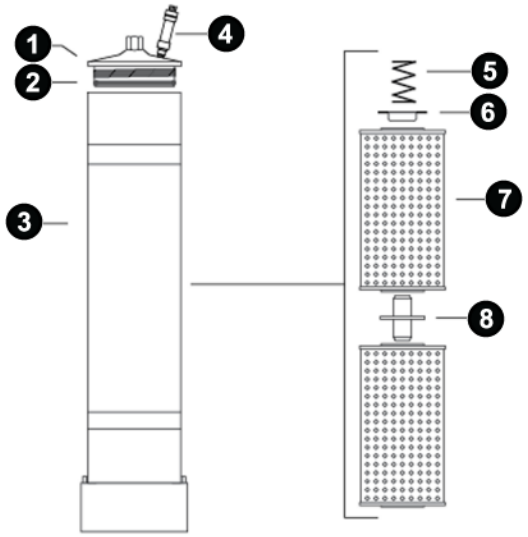
Required equipment

You will need filter elements (MTS part number 010-053-305); quantity 2 for the 515.60/.90, quantity 4 for 515.120/.180) and seal kit (MTS part number 011-425-803). Also available is the O-ring used at the base inlet and outlet (MTS part number 010-010-907).

Procedure

To change the filter element:

High Pressure Filter



Item	Description
1	Filter Cap
2	O-ring and Backup Ring
3	Filter Housing
4	Electric Dirt Alarm
5	Spring
6	Spring Plate
7	Filter Element
8	Plastic Union

1. Turn off the HPU. Ensure that the hydraulic pressure is at zero before proceeding. Wait until all pressure gages read zero before starting the next step.
2. Remove the dirty filter element.
    A. Use a 7/8 inch socket or wrench to unscrew the filter cap.
    B. Remove the spring, spring plate, and two dirty filter elements.
    C. Save the plastic union that commons the two filter elements. Discard the dirty elements, following applicable environmental guidelines.

Warning:
When working with hydraulic components, hydraulic fluid can spill and collect on floors or work platforms.

Floors or work platforms with spilled hydraulic fluid are very slippery. Injury or death can result from personnel falling on slippery surfaces.

Do not allow personnel to stand on or walk through hydraulic fluid. Place warning signs around the spill area to alert personnel of the hazard. Clean and dry the spill promptly.

3. Clean and inspect the filter housing.
    A. Clean and inspect the filter cap O-ring and backup ring. Replace them if necessary.
    B. Lubricate the O-ring with clean hydraulic fluid.
    C. Look inside the housing for signs of serious contamination such as pieces of grit, rubber particles, and metal shards. Correct the cause of this contamination before operating your system again.
4. Install the new elements.
    A. Insert two clean elements, with the plastic union between them, into the filter housing.
    B. Insert the spring plate and spring.
    C. Screw down the filter cap. Take care not to damage its O-ring and backup ring. Torque the filter cap to the value stated on its label.
5. Operate the pump module at low pressure for 5 minutes to remove air from the filter housing. Check for leaks before going to high pressure operation.

Replacing the Hydraulic Hoses

MTS recommends that all hoses be replaced every 5 years or 10,000 hours of operation.

Hydraulic Power Unit Maintenance and Service Logs

Service Every 8 Hours/Daily 94
Service Every 40 Hours/Weekly 95
Service Every 160 Hours/Biweekly 95
Service Every 500 Hours 96
Service Every 1000 Hours 98
Service Every 2000 Hours 99
Service Every 5000 Hours 99
Service Every 10,000 Hours 100

Service Every 8 Hours/Daily

8 Hours/Daily Service Interval Recommendation

	Check Console Verification	Check Dirty Filter Indicators	Check for Leaks	Check oil Level	Check Pressure	
Date	Performed by	Performed by	Performed by	Performed by	Performed by	Notes

Service Every 40 Hours/Weekly

40 Hours/Weekly Service Interval Recommendation

	Check Fluid Color and Odor	Check Interlock Devices	
Date	Performed by	Performed by	Notes

Service Every 160 Hours/Biweekly

160 Hours/Monthly Service Interval Recommendation

	Check Cables and Connectors	Check Console Air Filter	
Date	Performed by	Performed by	Notes

160 Hours/Monthly Service Interval Recommendation (continued)

	Check Cables and Connectors	Check Console Air Filter	
Date	Performed by	Performed by	Notes

Service Every 500 Hours

500 Hours Service Interval Recommendations

	Check All Accumulators for Proper Precharge Pressure and Oil	Check Condition of All Electrical Cables and Cable Connections	Check HPU Hydraulic Fluid Color, and Odor	Check HPU Operating Pressure and Temperature	
Date	Performed by	Performed by	Performed by	Performed by	Notes

[500 Hours Service Interval Recommendations]

	Clean Control Cabinet Air Filter, Replace if Required	Inspect Heat Exchanger for Leaks or “flow (when off)”	
Date	Performed by	Performed by	Notes

500 Hours Service Interval Recommendations

	Inspect Pump Hoses for Leaks	Lubricate-Grease motor Bearings (non-515)	Verify Dirty Filter Indicators Status	Verify HPU Hydraulic Fluid Level	Verify Warning and Interlock Devices	
Date	Performed by	Performed by	Performed by	Performed by	Performed by	Notes

500 Hours Service Interval Recommendations (continued)

	Inspect Pump Hoses for Leaks	Lubricate-Grease motor Bearings (non-515)	Verify Dirty Filter Indicators Status	Verify HPU Hydraulic Fluid Level	Verify Warning and Interlock Devices	
Date	Performed by	Performed by	Performed by	Performed by	Performed by	Notes

Service Every 1000 Hours

1000 Hours Service Interval Recommendation

	All 500 hr Maintenance Procedures	Replace All Filters	Verify Operation and Settings of psi Control and Relief Valves	
Date	Performed by	Performed by	Performed by	Notes

Service Every 2000 Hours

2000 Hours Service Interval Recommendation

	All 1000 hr Maintenance Procedures	Check Pump/Motor Coupling for Wear and Debris	Check Pump Voltage and Current	Check Case Drain Flow	Recommend MTS Hydraulix Oil Sample	
Date	Performed by	Performed by	Performed by	Performed by	Performed by	Notes

Service Every 5000 Hours

5000 Hours Service Interval Recommendation

	Recommend R/R Heat Exchanger	
Date	Performed by	Notes

5000 Hours Service Interval Recommendation (continued)

	Recommend R/R Heat Exchanger	
Date	Performed by	Notes

Service Every 10,000 Hours

10,000 Hours Service Interval Recommendation

	Recommend R/R Heat Exchanger	Recommend Replacement of Hoses	Inspect Motor Bearings	
Date	Performed by	Performed by	Performed by	Notes

10,000 Hours Service Interval Recommendation

	Determine if Replacement or Rebuild of Pump needed	Determine if Replacement or Rebuild of Motor needed	Recommend Hydraulic Fluid Change & Clean Pump Inlet	
Date	Performed by	Performed by	Performed by	Notes

Declaration of Conformity

MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290
Telephone 952-937-4000
Fax 952-937-4515

ORIGINAL

DECLARATION OF CONFORMITY
IN ACCORDANCE WITH ANNEX II 1A OF COUNCIL DIRECTIVE 2006/42/EC

Equipment Identification:

Hydraulic Power Unit Model	Serial No. (select one only)
515.07	
515.11	
515.20	
515.30	
515.90	
515.180	
Optional Equipment:	**Serial No.** (or other similar identification)
Air Cooler Assembly	

Equipment Description:
The Hydraulic Power Unit with an integral water cooled heat exchanger provides hydraulic power for servo-hydraulic testing systems. The Air Cooler Assembly is alternate equipment that is used to cool the hydraulic fluid from Hydraulic Power Unit by forced air cooling. The Hydraulic Power Unit and the Air Cooler Assembly are supplied with Product Information Manuals that allow them to be assembled and integrated to work as assemblies of machinery.

Manufacturer:
MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290, U.S.A.

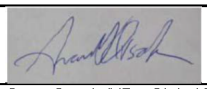
Authorized Representative:
Martin Smaller
MTS Systems Ltd
Brook House, Somerford Court
Somerford Road
Cirencester GL7 1TW
Glos. - UK

Applicable Directive(s):
Machinery Safety Directive 2006/42/EC
Low Voltage Directive 2006/95/EC
EMC Directive 2004/108/EC
Pressure Equipment Directive 97/23/EC (Article 3(3) Sound Engineering Practice)

Harmonized or Other Standards Referenced:
EN ISO 4413 Hydraulic fluid power – General rules and safety requirements for systems and their components
EN ISO 12100 Safety of machinery – General principles for design – Risk assessment and risk reduction
EN 60204-1 Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Technical Construction File in accordance with Annex VII Part A:
A copy (electronic and paper) of the Technical Construction File for this machinery is available on request from:
Authorized Representative

We, MTS Systems Corporation, hereby declare that the machinery described above conforms with the relevant provisions of Annex I Essential Health and Safety Requirements of Directive 2006/42/EC and that the Annex VIII Conformity Assessment Procedure has been carried out.

Place of Issue:	Eden Prairie, MN 55344, USA
Date of Issue:	
Signature:	
Name and Title:	Grant Ovsak (VP – Global Engineering)

Page 1 of 1 DoC 515 HPU July 20, 2015

MTS Systems Corporation
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Eden Prairie, MN 55344-2290 USA
Email: info@mts.com
www.mts.com

ISO 9001 Certified Quality Management System

*** END OF SECTION ***

Section F: HPU complete specification

Model	515.07		515.11		515.20		515.30	
	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz
Operating Pressure 3000 psi 4000 psi	207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi	
Relief valve setting 3000 psi 4000 psi	220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi	
Flow Rates: 3000 psi 4000 psi	26.5 lpm / 7.0 gpm 19.9 lpm / 5.3 gpm	22.7 lpm / 6.0 gpm 19.9 lpm / 5.3 gpm	41.6 lpm / 11.0 gpm 31.2 lpm / 8.3 gpm	37.9 lpm / 10.0 gpm 31.2 lpm / 8.3 gpm	73.8 lpm / 19.5 gpm 56.8 lpm / 15.0 gpm	60.6 lpm / 16.0 gpm 56.8 lpm / 15.0 gpm	113.6 lpm / 30 gpm 85.2 lpm / 22.5 gpm	100.7 lpm / 26.6 gpm 85.2 lpm / 22.5 gpm
Reservoir Capacity, Maximum	223 liters / 59 gallons		223 liters / 59 gallons		352 liters / 93 gallons		352 liters / 93 gallons	
Reservoir Capacity, Minimum	106 liters / 28 gallons		106 liters / 28 gallons		227 liters / 60 gallons		227 liters / 60 gallons	
Usable Oil Volume	117 liters / 31 gallons		117 liters / 31 gallons		125 liters / 33 gallons		125 liters / 33 gallons	
Reservoir Level, Maximum to floor	70 cm / 27.5 inches		70 cm / 27.5 inches		74.7 cm / 29.4 inches		74.7 cm / 29.4 inches	
Reservoir Level, Minimum to floor	42 cm / 16.5 inches		42 cm / 16.5 inches		53.3 cm / 21.0 inches		53.3 cm / 21.0 inches	
Standard Filtration, Return Line	3 micron		3 micron		3 micron		3 micron	
Sound Level[2], 1m / 3 ft @ 3000 psi	58 db(A)		60 db(A)	60 db(A)	63 db(A)		63 db(A)	
Width	77.0 cm / 30.3 inches		77.0 cm / 30.3 inches		89.7 cm / 35.3 in		89.7 cm / 35.3 in	
Height	119.9 cm / 47.2 inches		119.9 cm / 47.2 inches		138.9 cm / 54.7 inches		138.9 cm / 54.7 inches	
Length	114.3 cm / 45 inches		114.3 cm / 45 inches		163.1 cm / 64.2 inches		163.1 cm / 64.2 inches	
Weight without oil	381 kg / 840 lb		404 kg / 890 lb		676 kg / 1490 lb		712 kg / 1570 lb	
Weight with minimum oil	476 kg / 1050 lb		499 kg / 1100 lb		866 kg / 1910 lb		903 kg / 1990 lb	
Weight with maximum oil	581 kg / 1280 lb		603 kg / 1330 lb		984 kg / 2170 lb		1021 kg / 2250 lb	
Reservoir Material	Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum	
Ambient Operating Temperature Range	5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)	
Ambient Operating Relative Humidity Range	0-85% non-condensing		0-85% non-condensing		0-85% non-condensing		0-85% non-condensing	
Atmospheric Heat Load, 70°F/21°C ambient[3]	0.8 kw / 2800 Btu/hr		0.8 kw / 2800 Btu/hr		1 kw / 3500 Btu/hr		1 kw / 3500 Btu/hr	
Cooling water requirments: **Water Inlet Temperature**	**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**	
15.5°C / 60°F	4.9 lpm / 1.3 gpm		9.1 lpm / 2.4 gpm		23.7 lpm / 6.26 gpm		35.2 lpm / 9.3 gpm	
21.1°C / 70°F	6.0 lpm / 1.6 gpm		12.1 lpm / 3.2 gpm		30.5 lpm / 8.06 gpm		45.4 lpm / 12.0 gpm	
26.7°C / 80°F	8.3 lpm / 2.2 gpm		18.9 lpm / 5.0 gpm		42.8 pm / 11.3 gpm		64.7 lpm / 17.1 gpm	
32.2°C / 90°F	15.9 lpm / 4.2 gpm		49.2 lpm / 13.0 gpm		60.6 lpm / 16.0 gpm		90.8 lpm / 24.0 gpm	
40% Propylene Glycol mix								
15.5°C / 60°F	7 lpm / 1.9 gpm		12.5 lpm / 3.3 gpm		34.1 lpm / 9.0 gpm		48.5 lpm / 12.8 gpm	
21.1°C / 70°F	8.9 lpm / 2.3 gpm		16.8 lpm / 4.4 gpm		45.0 lpm / 11.9 gpm		63.2 lpm / 16.7 gpm	
26.7°C / 80°F	11.5 lpm / 3.0 gpm		26.8 lpm / 7.1 gpm		59.4 lpm / 15.7 gpm		91.6 lpm / 24.2 gpm	
32.2°C / 90°F	22.3 lpm / 5.9 gpm		NA		85.2 lpm / 22.5 gpm		NA	
Heat Exchanger	Stainless steel plate style		Stainless steel plate style		Stainless steel plate style		Stainless steel plate style	
Maximum heat removal capacity	11.2 kw / 38200 Btu/hr		18.7 kw / 63700 Btu/hr		29.9 kw / 102000 Btu/hr		44.8 kw / 153000 Btu/hr	
Required water pressure differential (at HPU)	0.2-0.3 MPa / 35-45 psi		0.2-0.3 MPa / 35-45 psi		0.2-0.3 MPa / 35-45 psi		0.2-0.3 MPa / 35-45 psi	
Maximum inlet pressure	0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi	
Cooling water pipe/hose diameter[7]	1.9 cm / 0.75 inches		1.9 cm / 0.75 inches		2.5 cm / 1.0 in		2.5 cm / 1.0 in	

1) FLA= Full Load Amps, SF = Service Factor

2) Sound pressure level (db(A)) applies only to 3000 psi models and is expressed as a free field value. Readings may vary with the acoustic environment.

3) Estimated values.

4) Locked rotor current.

5) Sum of all other motors running and the last motor starting - Locked rotor current.

6) Units supplied with NPT "female" pipe thread.

7) SAE ORB (O-Ring Boss) ports. Hose barb adapters included.

8) Models in parentheses correspond to values in parentheses where applicable. These are the specifications as delivered; considerations should be taken for the requirements when all modules are installed in the HPU.

9) For Crimp Lug Option, reference 100-324-505

10) This is NOT a specification for a facility circuit breaker; this is the circuit breaker internal to the HPU. MTS recommends a type/class "D" breaker for the facility breaker.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO
ADDED 4000 PSI DATA ADDED TO NOTE 10, TYPE "D" BREAKER RECOMMENDED FOR FACILITY 515.007/11/20/30 "PEAK IN RUSH CURRENT" WAS NOTE 5 NOTE 7 WAS "HOSE BARBS INCLUDED"	PJR	PJR	9-20-16	B	500050892
UPDATED NOTE 2, APPLIES ONLY TO 3000 PSI MODELS UPDATED FLOW RATE FOR 515.20, 3000 PSI CORRECTED USABLE OIL VOLUME LITERS FOR 515.120/150/180. ADDED SCCR FOR SOFT START (SS) 515.07/11/20/30	PJR	PJR	9/7/17	C	500062749

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180✓

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
PJR	-	PJR	-
DATE 11/24/15	DATE -	DATE 11/24/15	DATE -

TITLE: HPU SPECIFICATION-515

NEXT LEVEL -----

PRODUCT CODE 515

SIZE D

NUMBER 700-007-695 REV C

SHEET 1 OF 3

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

Model[8]	515.90S-1MDL (515.180S-1MDL)[8]		515.60 (515.180S-2MDL)[8]		515.90 (515.180S-3MDL)[8]		515.120		515.150		515.180	
	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz
Operating Pressure 3000 psi 4000 psi	207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi		207 bar / 3,000 psi 276 bar / 4,000 psi	
Relief valve setting 3000 psi 4000 psi	220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi		220 bar / 3,191 psi 300 bar / 4,352 psi	
Flow Rates: 3000 psi 4000 psi	113.6 lpm / 30.0 gpm 85.2 lpm / 22.5 gpm	100.7 lpm / 26.6 gpm 85.2 lpm / 22.5 gpm	227.1 lpm / 60.0 gpm 170.3 lpm / 45.0 gpm	201.4 lpm / 53.2 gpm 170.3 lpm / 45.0 gpm	340.7 lpm / 90.0 gpm 255.5 lpm / 67.5 gpm	302.1 lpm / 79.8 gpm 255.5 lpm / 67.5 gpm	454.2 lpm / 120.0 gpm 340.7 lpm / 90.0 gpm	402.8 lpm / 106.4 gpm 340.7 lpm / 90.0 gpm	567.8 lpm / 150.0 gpm 425.9 lpm / 112.5 gpm	503.5 lpm / 133.0 gpm 425.9 lpm / 112.5 gpm	681.4 lpm / 180gpm 511 .0 lpm / 135gpm	604.2 lpm / 159.6 gpm 511 .0 lpm / 135gpm
Reservoir Capacity, Maximum[8]	1211 liters / 320 gallons (see 515.180)		1211 liters / 320 gallons (see 515.180)		1211 liters / 320 gallons (see 515.180)		2188 liters / 578 gallons		2188 liters / 578 gallons		2188 liters / 578 gallons	
Reservoir Capacity, Minimum[8]	606 liters / 160 gallons (see 515.180)		606 liters / 160 gallons (see 515.180)		606 liters / 160 gallons (see 515.180)		1102 liters / 291 gallons		1102 liters / 291 gallons		1102 liters / 291 gallons	
Usable Oil Volume	605 liters / 160 gallons (see 515.180)		605 liters / 160 gallons (see 515.180)		605 liters / 160 gallons (see 515.180)		1086 liters / 287 gallons		1086 liters / 287 gallons		1086 liters / 287 gallons	
Reservoir Level, Maximum to floor	95 cm / 37.3 inches		95 cm / 37.3 inches		95 cm / 37.3 inches		95 cm / 37.3 inches		95 cm / 37.3 inches		95 cm / 37.3 inches	
Reservoir Level, Minimum to floor	57 cm / 22.3 inches		57 cm / 22.3 inches		57 cm / 22.3 inches		57 cm / 22.3 inches		57 cm / 22.3 inches		57 cm / 22.3 inches	
Standard Filtration, Return Line	3 micron		3 micron		3 micron		3 micron		3 micron		3 micron	
Sound Level[2], 1m / 3 ft @ 3000 psi	68 db(A)		68 db(A)		68 db(A)		70 db(A)		71 db(A)		72 db(A)	
Width[8]	104.4 cm / 41.1 inches (see 515.180)		104.4 cm / 41.1 inches (see 515.180)		104.4 cm / 41.1 inches (see 515.180)		104.4 cm / 41.1 inches		104.4 cm / 41.1 inches		104.4 cm / 41.1 inches	
Height[8]	199.4 cm / 78.5 inches (see 515.180)		199.4 cm / 78.5 inches (see 515.180)		199.4 cm / 78.5 inches (see 515.180)		199.4 cm / 78.5 inches		199.4 cm / 78.5 inches		199.4 cm / 78.5 inches	
Length[8] ± 1.8 cm / 0.7 inches	287.3 cm / 113.1 inches (see 515.180)		287.3 cm / 113.1 inches (see 515.180)		287.3 cm / 113.1 inches (see 515.180)		431.3 cm / 169.8 inches		431.3 cm / 169.8 inches		431.3 cm / 169.8 inches	
Weight without oil[8]	1769 kg / 3900 lb (1905 kg / 4200 lb)		2041 kg / 4500 lb (2200 kg / 4850 lb)		2336 kg / 5150 lb (2495 kg / 5500 lb)		2790 kg / 6150 lb		3084 kg / 6800 lb		3447 kg / 7600 lb	
Weight with minimum oil[8]	2291 kg / 5050 lb (2880 kg / 6350 lb)		2585 kg / 5700 lb (3175 kg / 7000 lb)		2880 kg / 6350 lb (3470 kg / 7650 lb)		3765 kg / 8300 lb		4060 kg / 8950 lb		4423 kg / 9750 lb	
Weight with maximum oil[8]	2812 kg / 6200 lb (3833 kg / 8450 lb)		3107 kg / 6850 lb (4128 kg / 9100 lb)		3402 kg / 7500 lb (4423 kg / 9750 lb)		4717 kg / 10400 lb		5012 kg / 11050 lb		5375 kg / 11850 lb	
Reservoir Material[8]	Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum		Stainless Steel or Aluminum	
Ambient Operating Temperature Range	5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)		5-40 °C (40-104 °F)	
Ambient Operating Relative Humidity Range	0-85% non-condensing		0-85% non-condensing		0-85% non-condensing		0-85% non-condensing		0-85% non-condensing		0-85% non-condensing	
Atmospheric Heat Load[3] 70°F/21°C ambient	3.5 kw / 12,000 Btu/hr		3.5 kw / 12,000 Btu/hr		3.5 kw / 12,000 Btu/hr		4.7 kw / 16,000 Btu/hr		4.7 kw / 16,000 Btu/hr		4.7 kw / 16,000 Btu/hr	
Cooling water requirments: **Water Inlet Temperature**	**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**		**Minimum Required Flow**	
15.5°C / 60°F	35.2 lpm / 9.3 gpm		41.6 lpm / 11 gpm		64.3 lpm / 17 gpm		83.2 lpm / 22 gpm		103 lpm / 27 gpm		128.7 lpm / 34 gpm	
21.1°C / 70°F	45.4 lpm / 12 gpm		56.8 lpm / 15 gpm		83.3 lpm / 22 gpm		113.6 lpm / 30 gpm		135 lpm / 36 gpm		166.5 lpm / 44 gpm	
26.7°C / 80°F	64.7 lpm / 17.1 gpm		83.3 lpm / 22 gpm		128.7 lpm / 34 gpm		166.6 lpm / 44 gpm		210 lpm / 55 gpm		257.4 lpm / 68 gpm	
32.2°C / 90°F	90.8 lpm / 24 gpm		177.9 lpm / 47 gpm		268.7 lpm / 71 gpm		355.8 lpm / 94 gpm		440 lpm / 116 gpm		537.5 lpm / 142 gpm	
40% Propylene Glycol mix												
15.5°C / 60°F	48.5 lpm / 12.8 gpm		48.5 lpm / 12.8 gpm		74.8 lpm / 19.8 gpm		99 lpm / 26.2 gpm		122.4 lpm / 32.3 gpm		152.6 lpm / 40.3 gpm	
21.1°C / 70°F	63.2 lpm / 16.7 gpm		67.5 lpm / 17.8 gpm		99.1 lpm / 26.2 gpm		138.1 lpm / 36.5 gpm		167 lpm / 44.1 gpm		202.7 lpm / 53.6 gpm	
26.7°C / 80°F	91.6 lpm / 24.2 gpm		102.4 lpm / 27.1 gpm		158.2 lpm / 41.8 gpm		210.3 lpm / 55.6 gpm		261.4 lpm / 69.1 gpm		324.8 lpm / 85.8 gpm	
32.2°C / 90°F	NA		226.9 lpm / 59.9 gpm		NA		467.8 lpm / 123.6 gpm		570.3 lpm / 150.7 gpm		NA	
Heat Exchanger	Stainless steel plate style		Stainless steel plate style		Stainless steel plate style		Stainless steel plate style		Stainless steel plate style		Stainless steel plate style	
Maximum heat removal capacity	44.8 kw / 153000 Btu/hr		89.7 kw / 306000 Btu/hr		134.5 kw / 459000 Btu/hr		179.4 kw / 612000 Btu/hr		224.2 kw / 765000 Btu/hr		269.0 kw / 918000 Btu/hr	
Required water pressure differential (at HPU)	0.2-0.3 MPa / 35-45 psi		0.2 - 0.3 Mpa / 35-45 psi		0.2 - 0.3 Mpa / 35-45 psi		0.2 - 0.3 Mpa / 35-45 psi		0.2 - 0.3 Mpa / 35-45 psi		0.2 - 0.3 Mpa / 35-45 psi	
Maximum inlet pressure	0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi		0.8 MPa / 120 psi	
Cooling water pipe/hose diameter[6]	3.8 cm / 1.5 in NPT pipe (see 515.180)		3.8 cm / 1.5 in NPT pipe (see 515.180)		3.8 cm / 1.5 in NPT pipe (see 515.180)		5.1 cm / 2.0 in NPT pipe		5.1 cm / 2.0 in NPT pipe		5.1 cm / 2.0 in NPT pipe	

1) FLA= Full Load Amps, SF = Service Factor

2) Sound pressure level (db(A)) applies only to 3000 psi models and is expressed as a free field value. Readings may vary with the acoustic environment.

3) Estimated values.

4) Locked rotor current.

5) Sum of all other motors running and the last motor starting - Locked rotor current.

6) Units supplied with NPT "female" pipe thread.

7) SAE ORB (O-Ring Boss) ports. Hose barb adapters included.

8) Models in parentheses correspond to values in parentheses where applicable. These are the specifications as delivered; considerations should be taken for the requirements when all modules are installed in the HPU.

9) For Crimp Lug Option, reference 100-324-505

10) This is NOT a specification for a facility circuit breaker; this is the circuit breaker internal to the HPU. MTS recommends a type/class "D" breaker for the facility breaker.

REVISIONS

DESCRIPTION			LETTER	ECN NO
DRAWN	ENGR	DATE		

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES

ANGLE	±2°
X/Y	±1/4
.X	±.1
.XX	±.03
.XXX	±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
PJR	-	PJR	-
DATE 11/24/15	DATE -	DATE 11/24/15	DATE -

TITLE
HPU
SPECIFICATION-515

NEXT LEVEL -----

PRODUCT CODE 515

SIZE D

NUMBER 700-007-695

REV C

SHEET 2 OF 3

	Control Voltage	Motor Starter Configuration	Number of Pump Modules	Motor Size	VAC:	200		208	220		230		240	380		400		415	440		460	480	575
					Hz:	50	60	60	50	60	50	60	60	50	60	50	60	50	50	60	60	60	60
515.07	24 VDC	Wye-Delta	1	15 HP 11 kw	Main lug wire range[9]	#14-#3/0 for 3 phase power, #14-#2/0 for ground								#14-#3/0 for 3 phase power, #14-#2/0 for ground									#14-#1/0
					Main lug quantity[9]	1 per phase and 1 for ground																	
					Circuit Breaker Rating (internal to HPU)[10]	100 A								50 A									30 A
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START) / 5 KA (SOFT START)																	10 KA (WYE-DELTA START) / 5 KA (SOFT START)
					Motor FLA / SF FLA[1]	46.5 / 54	45.5 / 52	44 / 49.6	42.5 / 50	41 / 47.3	41 / 46.5	39.5 / 44.9	38.2 / 43	24.6 / 28.9	23 / 27.2	23.3 / 26.7	22.9 / 25.8	22.5 / 26.5	21.4 / 24.3	20.4 / 23.6	19.8 / 22.4	19.1 / 21.5	15.9 / 17.9
					Unit FLA / Unit SF FLA[1]	47.5 / 55	46.5 / 53	45 / 50.6	43.5 / 51	42 / 48.3	42 / 47.5	40.5 / 45.9	39.2 / 44	25.6 / 29.9	24 / 28.2	24.3 / 27.7	23.9 / 26.8	23.5 / 27.5	22.4 / 25.3	21.4 / 24.6	20.8 / 23.4	20.1 / 22.5	16.9 / 18.9
					Peak inrush current[4]	198	230	246	158	187	172	200	213	92	122	100	129	84	91	94	101	107	90
515.11	24 VDC	Wye-Delta	1	25 HP 18.5 kw	Main lug wire range[9]	#14-#3/0 for 3 phase power, #14-#2/0 for ground								#14-#3/0 for 3 phase power, #14-#2/0 for ground									#14-#1/0
					Main lug quantity[9]	1 per phase and 1 for ground																	
					Circuit Breaker Rating (internal to HPU)[10]	150 A								70 A									50 A
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START) / 5 KA (SOFT START)																	65 KA (WYE-DELTA START) / 5 KA (SOFT START)
					Motor FLA / SF FLA[1]	80 / 92	80 / 90	80 / 89	72 / 83	71 / 80	70 / 80	69 / 78	68 / 77	41.5 / 47.8	41.5 / 46.9	40 / 46	37.7 / 46.2	38 / 43.7	36.5 / 41.8	35.5 / 39.8	34.5 / 38.8	34.1 / 38.5	28.8 / 32.1
					Unit FLA / Unit SF FLA[1]	81 / 93	81 / 91	81 / 90	73 / 84	72 / 81	71 / 81	70 / 79	69 / 78	42.5 / 48.8	42.5 / 47.9	41 / 47	38.7 / 47.2	39 / 44.7	37.5 / 42.8	36.5 / 40.8	35.5 / 39.8	35.1 / 39.5	29.8 / 33.1
					Peak inrush current[4]	367	430	459	294	350	319	374	398	171	227	184	239	157	168	176	188	200	167
515.20	24 VDC	Wye-Delta	1	40 HP 30 kw	Main lug wire range[9]	#8-350MCM for 3 phase power, #14-#2/0 for ground								#14-#3/0 for 3 phase power, #14-#2/0 for ground									#8-350MCM
					Main lug quantity[9]	1 per phase and 1 for ground																	
					Circuit Breaker Rating (internal to HPU)[10]	250 A								100 A									
					SCCR (Short Circuit Current Rating)	65 KA (WYE-DELTA START) / 5 KA (SOFT START)																	
					Motor FLA / SF FLA[1]	121 / 140	119 / 141	117 / 140	110 / 126	108 / 125	105 / 122	105 / 123	101 / 121	64 / 72	62 / 74	61 / 70	61 / 73	53 / 67	55 / 64	54 / 63	53 / 61	51 / 61	42.2 / 51
					Unit FLA / Unit SF FLA[1]	122 / 141	120 / 142	118 / 141	111 / 127	109 / 126	106 / 123	106 / 124	102 / 122	65 / 73	63 / 75	62 / 71	62 / 74	54 / 68	56 / 65	55 / 64	54 / 62	52 / 62	43.2 / 52
					Peak inrush current[4]	526	654	710	467	522	457	569	615	269	345	264	370	248	240	262	285	308	258
515.30	24 VDC	Wye-Delta	1	60 HP 45 kw	Main lug wire range[9]	#8-350MCM for 3 phase power, #14-#2/0 for ground								#14-#3/0 for 3 phase power, #14-#2/0 for ground									#8-350MCM
					Main lug quantity[9]	1 per phase and 1 for ground																	
					Circuit Breaker Rating (internal to HPU)[10]	250 A								150 A									
					SCCR (Short Circuit Current Rating)	65 KA (WYE-DELTA START) / 5 KA (SOFT START)																	
					Motor FLA / SF FLA[1]	168 / 192	171 / 191	137 / 187	149 / 172	152 / 169	147 / 165	147 / 166	145 / 162	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	169 / 193	172 / 192	138 / 188	150 / 173	153 / 170	148 / 166	148 / 167	146 / 163	89 / 101	89 / 102	85 / 97	88 / 99	80 / 92	78 / 88	77 / 86	75 / 84	74 / 82	62 / 69
					Peak inrush current[4]	1001	1048	1105	851	851	891	911	957	471	552	501	575	452	467	426	456	479	400

	Control Voltage	Motor Starter Configuration	Number of Motor/Pump	Motor Size	VAC:	380		400		415	440		460	480	575
					Hz:	50	60	50	60	50	50	60	60	60	60
515.90S-1MDL 515.180S-1MDL	24 VDC	Wye-Delta	1	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	All models: 2 per phase (power), 515.90S-1MDL: 1 for ground, 515.180S-1MDL: 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	515.90 S-1MDL = 400 A, 515.180S-1MDL = 600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	89 / 101	89 / 102	85 / 97	88 / 99	80 / 92	78 / 88	77 / 86	75 / 84	74 / 82	62 / 69
					Peak inrush current[4]	471	552	501	575	452	467	426	456	479	400
515.60 515.180S-2MDL	24 VDC	Wye-Delta	2	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	All models: 2 per phase (power), 515.60: 1 for ground, 515.180S-2MDL: 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	515.60 = 400 A, 515.180S-2MDL = 600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	177 / 201	177 / 203	169 / 193	175 / 197	159 / 183	155 / 175	153 / 171	149 / 167	147 / 163	123 / 137
					Peak inrush current[5]	559	640	585	662	531	544	502	530	552	461
515.90 515.180S-3MDL	24 VDC	Wye-Delta	3	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	All models: 2 per phase (power), 515.90: 1 for ground, 515.180S-3MDL: 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	515.90 = 400 A, 515.180S-3MDL = 600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	265 / 301	265 / 304	253 / 289	262 / 295	238 / 274	232 / 262	229 / 256	223 / 250	220 / 244	184 / 205
					Peak inrush current[5]	647	728	669	749	610	621	578	604	625	522
515.120	24 VDC	Wye-Delta	4	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	2 per phase (power), 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	353 / 401	353 / 405	337 / 385	349 / 393	317 / 365	309 / 349	305 / 341	297 / 333	293 / 325	245 / 273
					Peak inrush current[5]	735	816	753	836	689	698	654	678	698	583
515.150	24 VDC	Wye-Delta	5	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	2 per phase (power), 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	441 / 501	441 / 506	421 / 481	436 / 491	396 / 456	386 / 436	381 / 426	371 / 416	366 / 406	306 / 341
					Peak inrush current[5]	823	904	837	923	768	775	730	752	771	644
515.180	24 VDC	Wye-Delta	6	60 HP 45 kw	Main lug wire range[9]	#2-500MCM for 3 phase power, #6-350MCM for ground									
					Main lug quantity[9]	2 per phase (power), 2 for ground									
					Circuit Breaker Rating (internal to HPU)[10]	600 A									
					SCCR (Short Circuit Current Rating)	35 KA (WYE-DELTA START)									
					Motor FLA / SF FLA[1]	88 / 100	88 / 101	84 / 96	87 / 98	79 / 91	77 / 87	76 / 85	74 / 83	73 / 81	61 / 68
					Unit FLA / Unit SF FLA[1]	529 / 601	529 / 607	505 / 577	523 / 589	475 / 547	463 / 523	457 / 511	445 / 499	439 / 487	367 / 409
					Peak inrush current[5]	911	992	921	1010	847	852	806	826	844	705

1) FLA= Full Load Amps, SF = Service Factor

2) Sound pressure level (db(A)) applies only to 3000 psi models and is expressed as a free field value. Readings may vary with the acoustic environment.

3) Estimated values.

4) Locked rotor current.

5) Sum of all other motors running and the last motor starting - Locked rotor current.

6) Units supplied with NPT "female" pipe thread.

7) SAE ORB (O-Ring Boss) ports. Hose barb adapters included.

8) Models in parentheses correspond to values in parentheses where applicable. These are the specifications as delivered; considerations should be taken for the requirements when all modules are installed in the HPU.

9) For Crimp Lug Option, reference 100-324-505

10) This is NOT a specification for a facility circuit breaker; this is the circuit breaker internal to the HPU. MTS recommends a type/class "D" breaker for the facility breaker.

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
PJR	-	PJR	-
DATE 11/24/15	DATE -	DATE 11/24/15	DATE -

TITLE: HPU SPECIFICATION-515

NEXT LEVEL -----

SIZE D

NUMBER 700-007-695

REV C

PRODUCT CODE 515

SHEET 3 OF 3

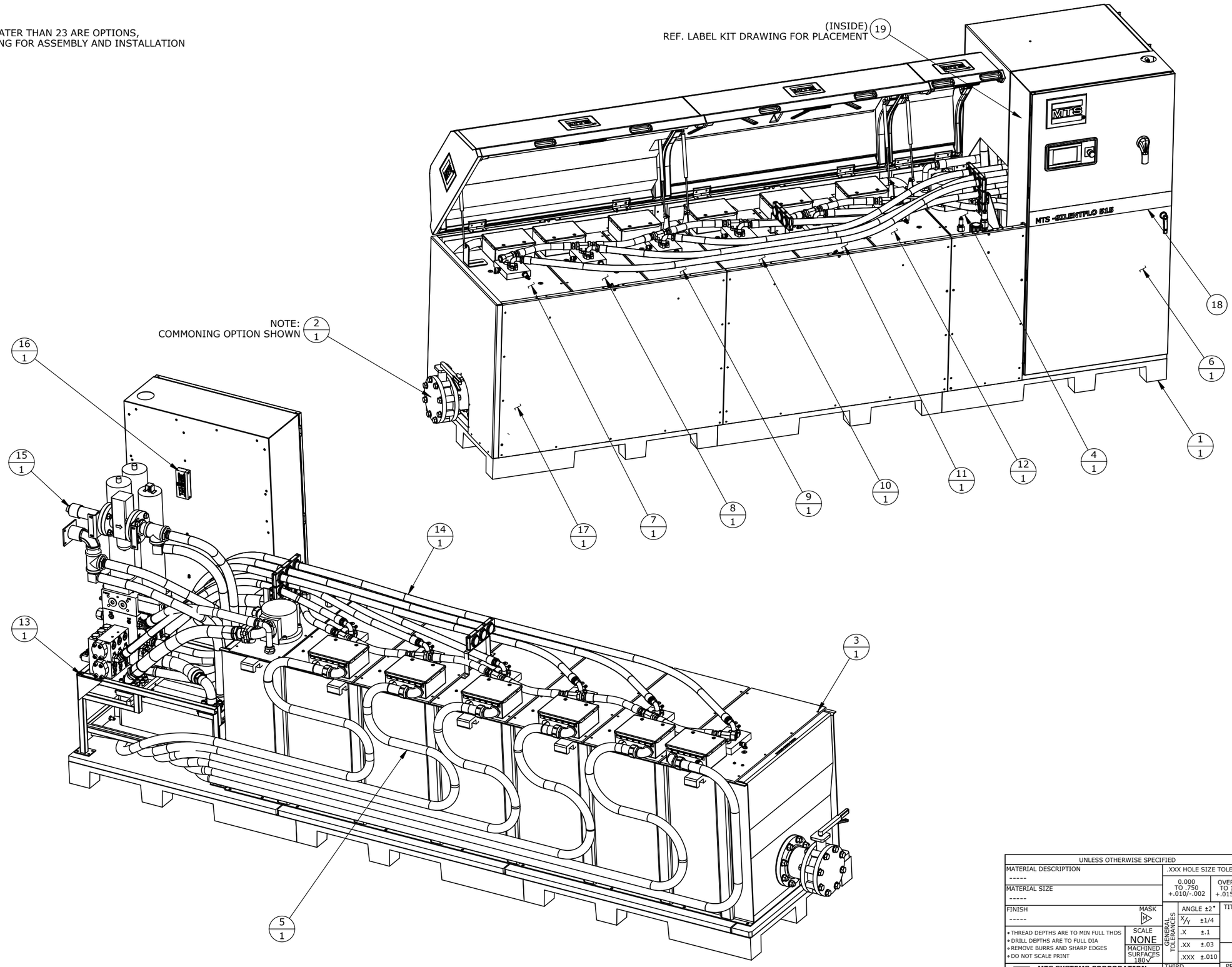
MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

*** END OF SECTION ***

Section G: Power unit assembly drawings

NOTES:

1. BOM ITEM NUMBERS GREATER THAN 23 ARE OPTIONS,
   SEE ASSOCIATED DRAWING FOR ASSEMBLY AND INSTALLATION



20 PRODUCT INFORMATION

21 PLC CODE

22 HMI CODE

23 HMI-PLC CODE

REVISIONS

DESCRIPTION			LETTER	ECN NO
DRAWN	ENGR	DATE		

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: -----

MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
DCP	-	PJR	-
DATE 07/09/15	DATE -	DATE 07/09/15	DATE -

TITLE: CONFIGURATION DRAWING-515,6BAY,LH

NEXT LEVEL: -----

PRODUCT CODE: 515

SIZE: D

NUMBER: 700-007-774 REV: A

SHEET 1 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

4.0 [101.6] MIN. RECOMMENDED CLEAR SPACE

3.2 [80]

36.0 [914] MIN. RECOMMENDED CLEAR SPACE

31.9 [809]

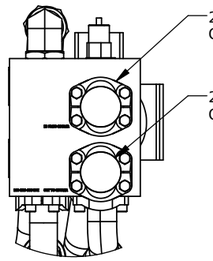
76.3 [1938] DOOR CLEARANCE

4.0 [102] MIN. RECOMMENDED CLEAR SPACE WITHOUT COMMONING

24.0 [610] MIN. RECOMMENDED CLEAR SPACE WITH COMMONING

36.0 [914] MIN. RECOMMENDED CLEAR SPACE

42.0 [1067] MIN. RECOMMENDED CLEAR SPACE



2.5"(74.2MM) SAE CODE 61 OIL IN FROM COOLER

2.5"(74.2MM) SAE CODE 61 OIL OUT TO COOLER

DETAIL A
AIR COOLED OPTION SHOWN

M27 OR MPCM BULKHEAD AND ETHERNET CONNECTION

2"(50.8MM) SAE CODE 61 PRESSURE WITH HIGH PRESSURE FILTER ONLY

4.6 [116]

3.5 [89]

ELECTRICAL POWER IN

(133.3) [3386]

36.0 [914] ENCLOSURE WIDTH

ELECTRICAL POWER DISCONNECT SWITCH

2"(50.8MM) FEMALE NPT WATER IN

2"(50.8MM) FEMALE NPT WATER OUT

A

-20 JIC DRAIN

2"(50.8MM) SAE CODE 61 PRESSURE WITHOUT HIGH PRESSURE FILTER ONLY

63.8 [1620]

59.0 [1500]

"A" PRESSURE (SEE SECTION B-B ON SHT. 4)

35.5 [901]

"A" PRESSURE (SEE SECTION B-B ON SHT. 4)

28.1 [713]

78.5 [1994]

57.3 [1455]

SEE SECTION B-B ON SHT. 4

"C" PRESSURE (SEE SECTION B-B ON SHT. 4)

2"(50.8MM) SAE CODE 61 RETURN

11.9 [303]

3X 14.2 [362]

A
SHT. 3

7.9 [201]

169.8±.7 [4313]

"B" PRESSURE (SEE SECTION B-B ON SHT. 4)

40.6 [1032] BASE WIDTH

43.0 [1092]

REVISIONS

DESCRIPTION			LETTER	ECN NO
DRAWN	ENGR	DATE		

-

SOURCE/REF DRAWING -

PROPRIETARY DATA

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: -----

MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

	DRAWN	CHECK	ENGR	MFG
	DCP	-	PJR	-
DATE	07/09/15	-	07/09/15	-

TITLE: CONFIGURATION DRAWING-515,6BAY,LH

NEXT LEVEL: -----

PRODUCT CODE: 515

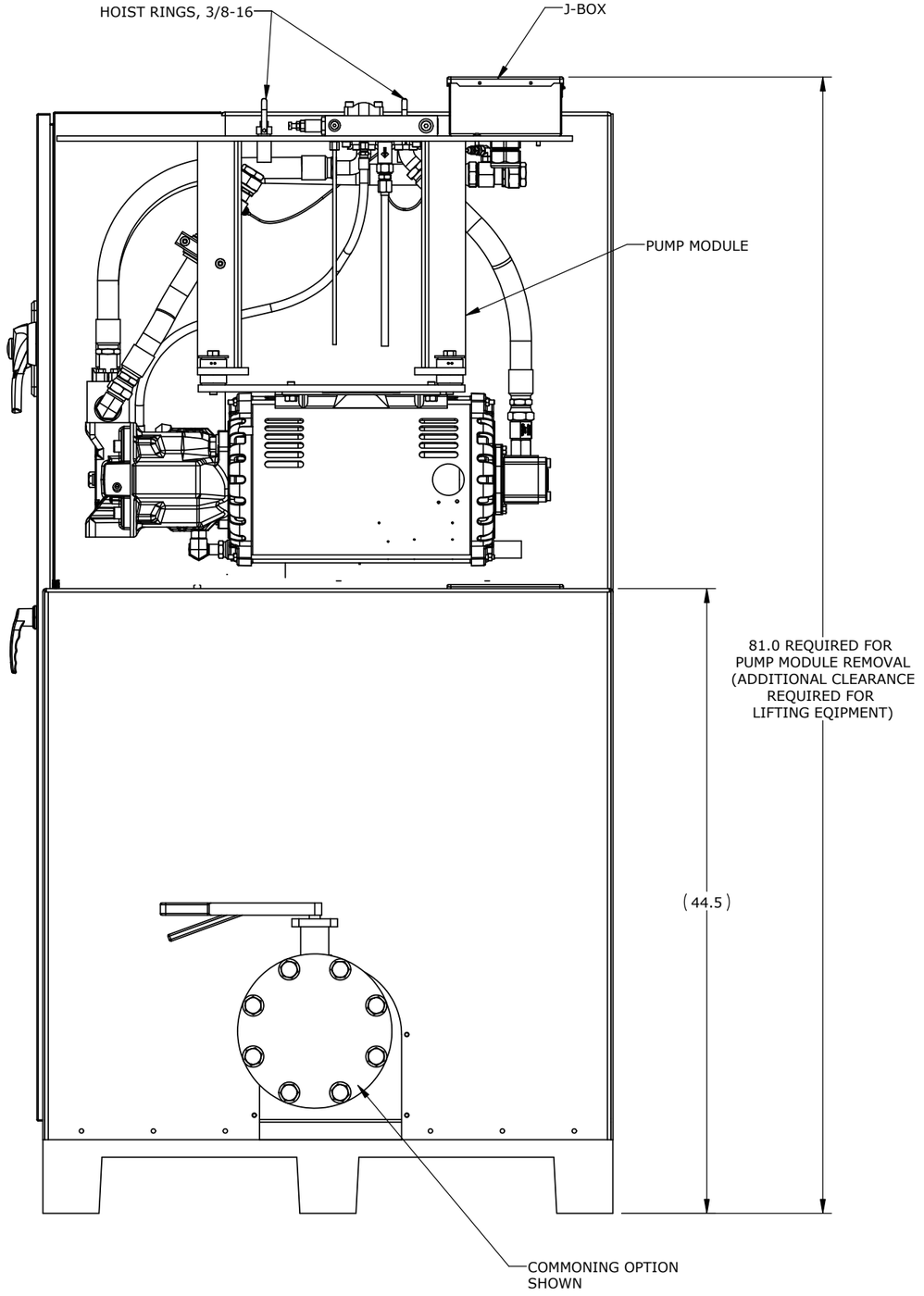
SIZE: D

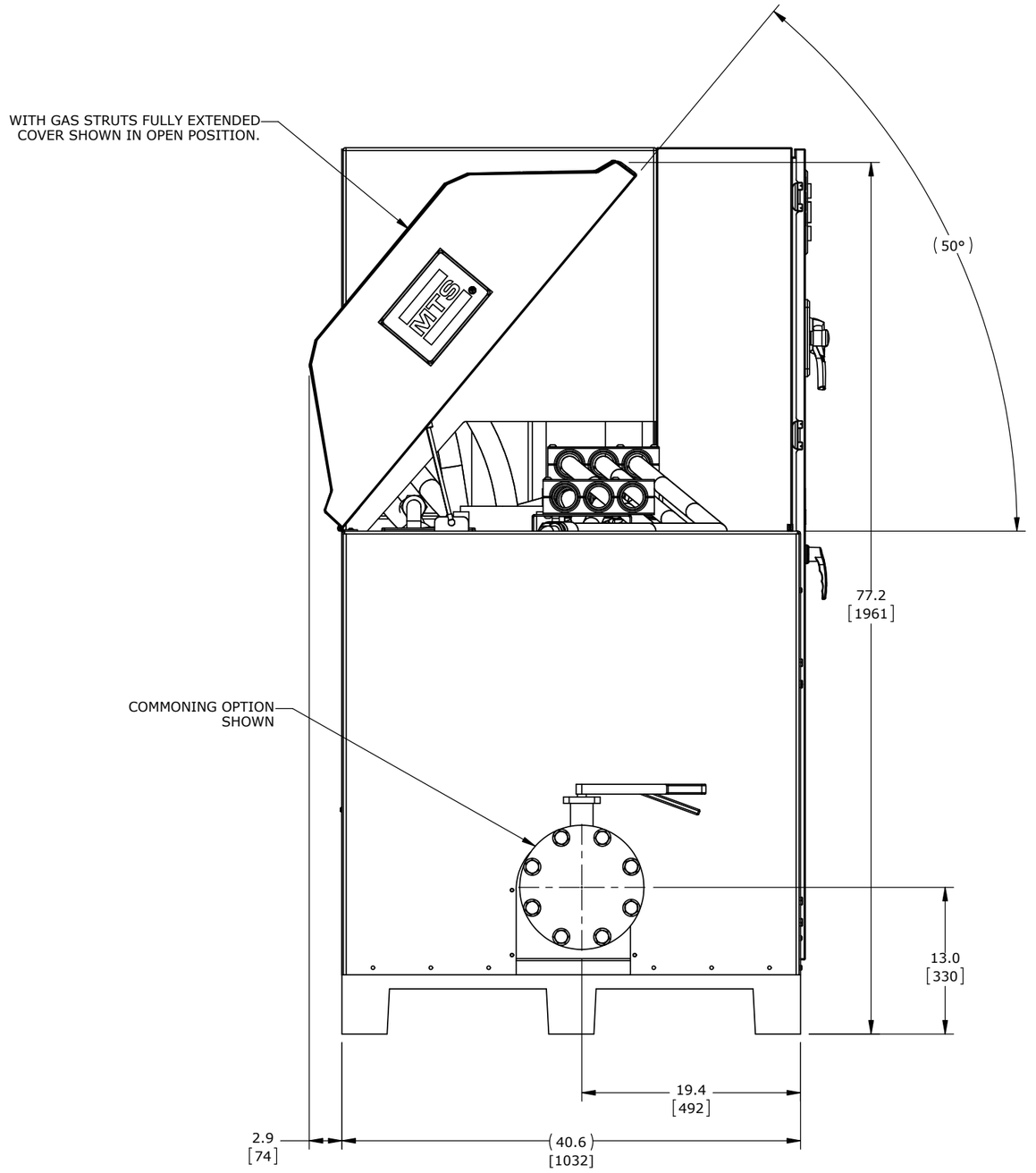
NUMBER: 700-007-774

REV: A

SHEET 2 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.





VIEW A-A

SCALE: NONE

REVISIONS					
DESCRIPTION				LETTER	ECN NO
DRAWN	ENGR	DATE			

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION: -----

MATERIAL SIZE: -----

FINISH: ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE: NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
DCP	-	PJR	-
DATE 07/09/15	DATE -	DATE 07/09/15	DATE -

TITLE: CONFIGURATION DRAWING-515,6BAY,LH

NEXT LEVEL: -----

PRODUCT CODE: 515

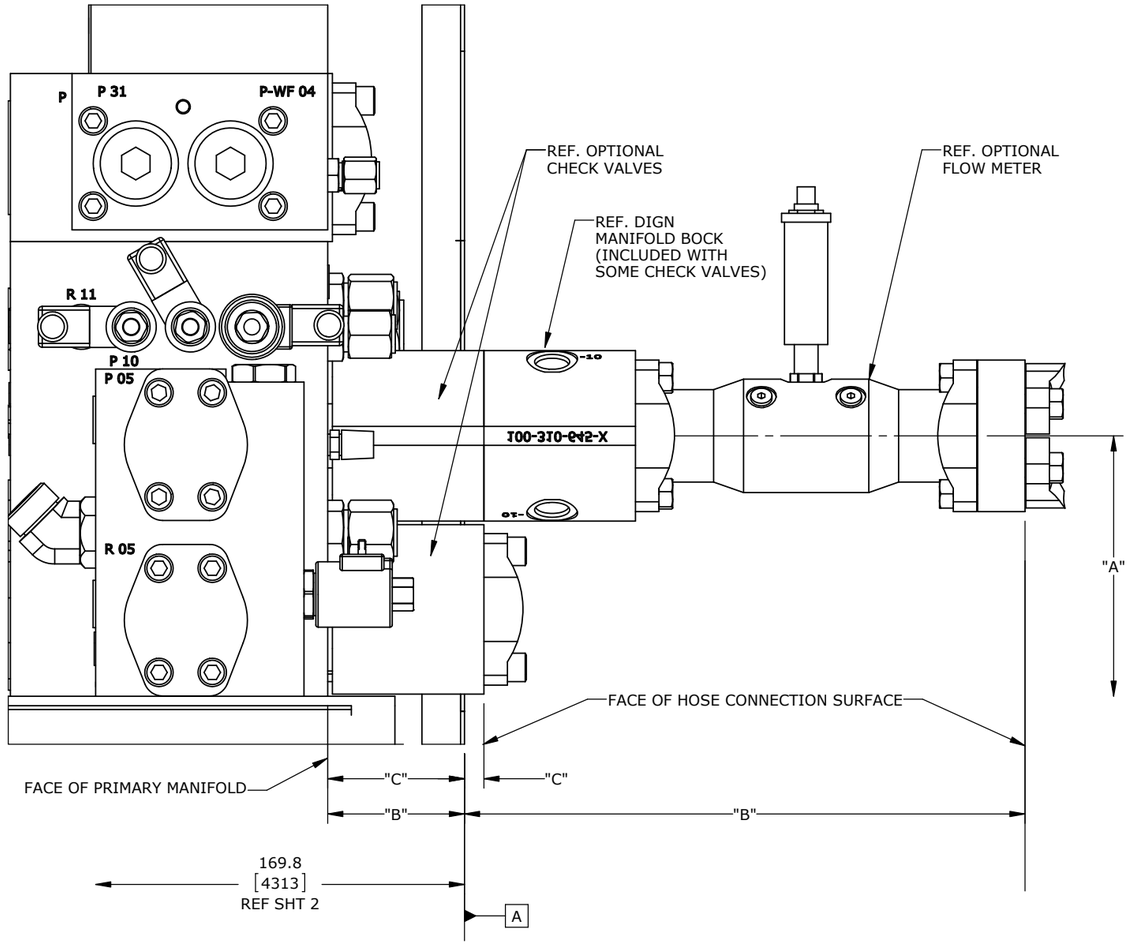
SIZE: D

NUMBER: 700-007-774

REV: A

SHEET 3 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.



SECTION B-B

SCALE: NONE

OPTIONS SHOWN MAY NOT REFLECT HPU ORDERED

OPTION(S)		PRESSURE OUTLET "A" (VERTICAL)	PRESSURE OUTLET "B" (AXIAL)	RETURN INLET "C" (AXIAL)
	NONE	830.6 mm / 32.7 in	-91.4 mm / -3.6 in	-106.7 mm / -4.2 in
	FLOW METER (ROD)	830.6 mm / 32.7 in	196.3 mm / 7.7 in	-106.7 mm / -4.2 in
WITH DIGN MANIFOLD	CHECK VALVES	830.6 mm / 32.7 in	114.3 mm / 4.5 in	-2.5 mm / -.1 in
	HIGH PRESSURE FILTER (HPF) REQUIRES CHECK VALVES	1016.0 mm / 40.0 in	114.3 mm / 4.5 in	-2.5 mm / -.1 in
	HIGH PRESSURE FILTER (HPF) W/ FLOW	1016.0 mm / 40.0 in	402.1 mm / 15.8 in	-2.5 mm / -.1 in
WITHOUT DIGN MANIFOLD	CHECK VALVES	830.6 mm / 32.7 in	12.7 mm / 0.5 in	-2.5 mm / -.1 in
	HIGH PRESSURE FILTER (HPF) REQUIRES CHECK VALVES	1016.0 mm / 40.0 in	12.7 mm / 0.5 in	-2.5 mm / -.1 in
	HIGH PRESSURE FILTER (HPF) W/ FLOW METER (ROD) REQUIRES CHECK VALVES	1016.0 mm / 40.0 in	300.5 mm / 11.8 in	-2.5 mm / -.1 in

NOTES:

1. (-) DIMENSIONS LEFT OF DATUM A
   (+) DIMENSIONS RIGHT OF DATUM A

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO
-					

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
DCP	-	PJR	-
DATE 07/09/15	DATE -	DATE 07/09/15	DATE -

TITLE

CONFIGURATION
DRAWING-515,6BAY,LH

NEXT LEVEL -----

PRODUCT CODE 515

SIZE D

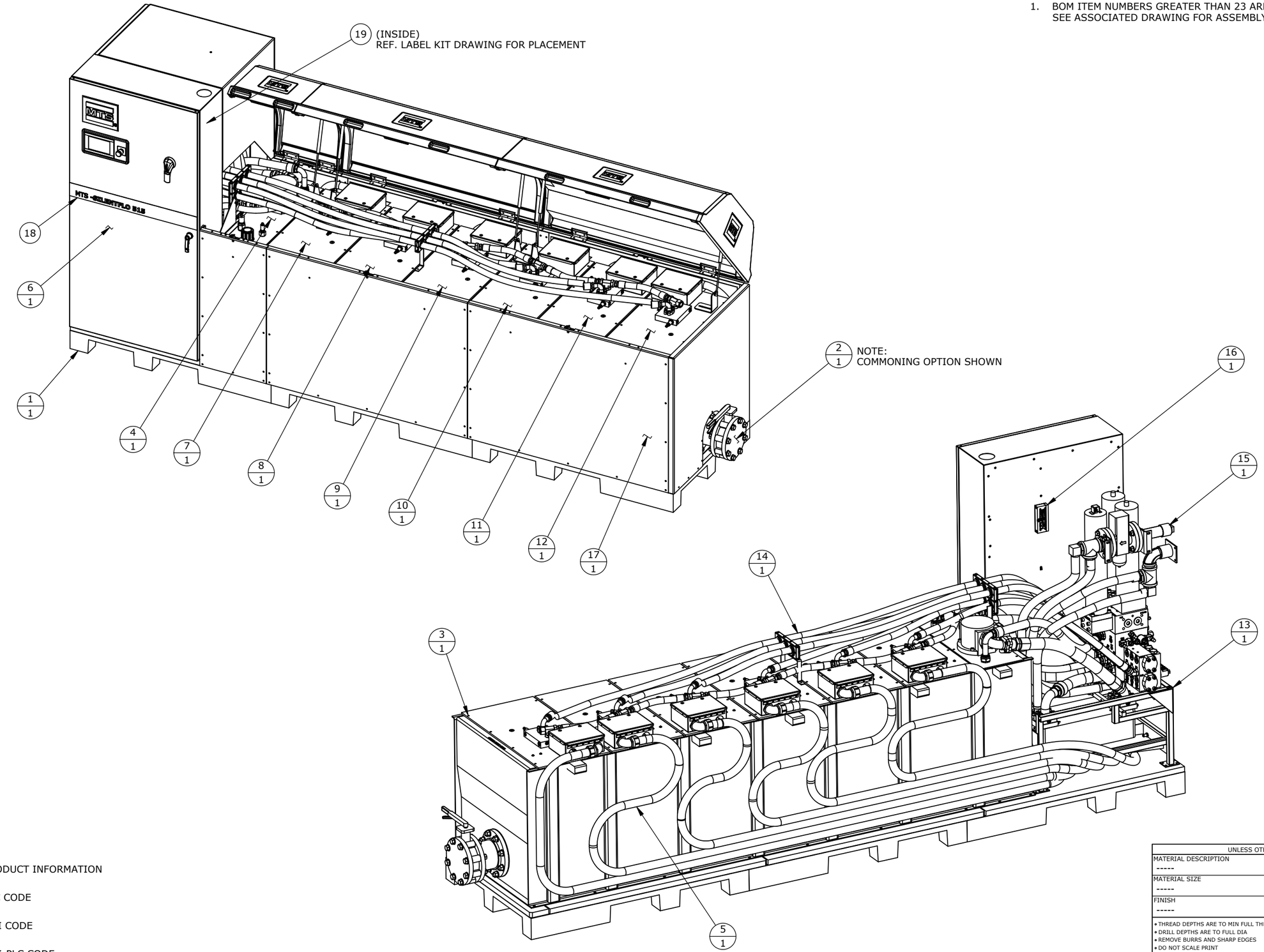
NUMBER 700-007-774 REV A

SHEET 4 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

NOTES:

1. BOM ITEM NUMBERS GREATER THAN 23 ARE OPTIONS, SEE ASSOCIATED DRAWING FOR ASSEMBLY AND INSTALLATION



20 PRODUCT INFORMATION

21 PLC CODE

22 HMI CODE

23 HMI-PLC CODE

REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO
SHEET 2, VERITCAL "A" DIM WAS "B"	PJR	PJR	11/24/15	B	500039422

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180

THIRD ANGLE PROJ

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

DRAWN	CHECK	ENGR	MFG
DCP	-	PJR	-
DATE 01/15/14	DATE -	DATE 07/08/15	DATE -

TITLE

CONFIGURATION DRAWING-515,6BAY,RH

NEXT LEVEL -----

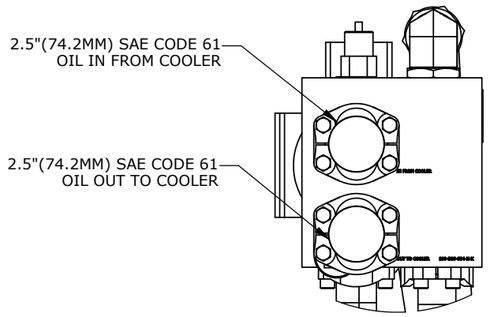
PRODUCT CODE 515

SIZE D

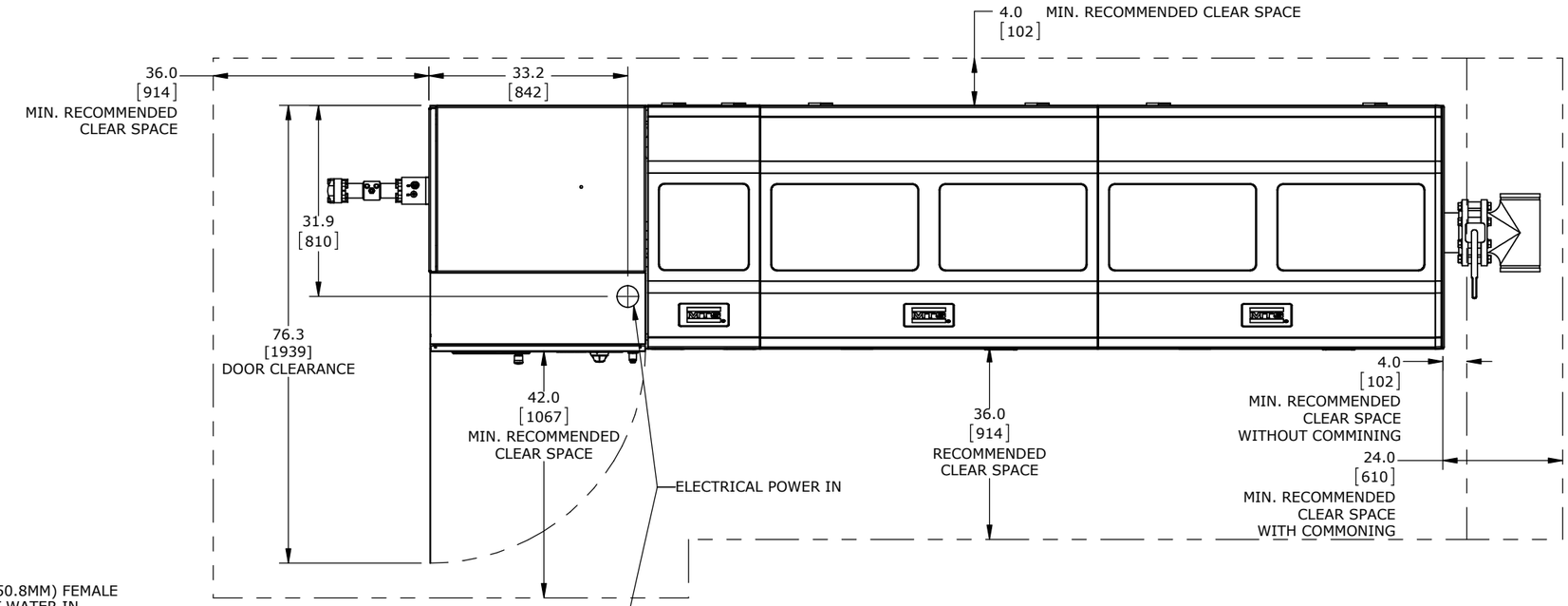
NUMBER 700-007-773 REV B

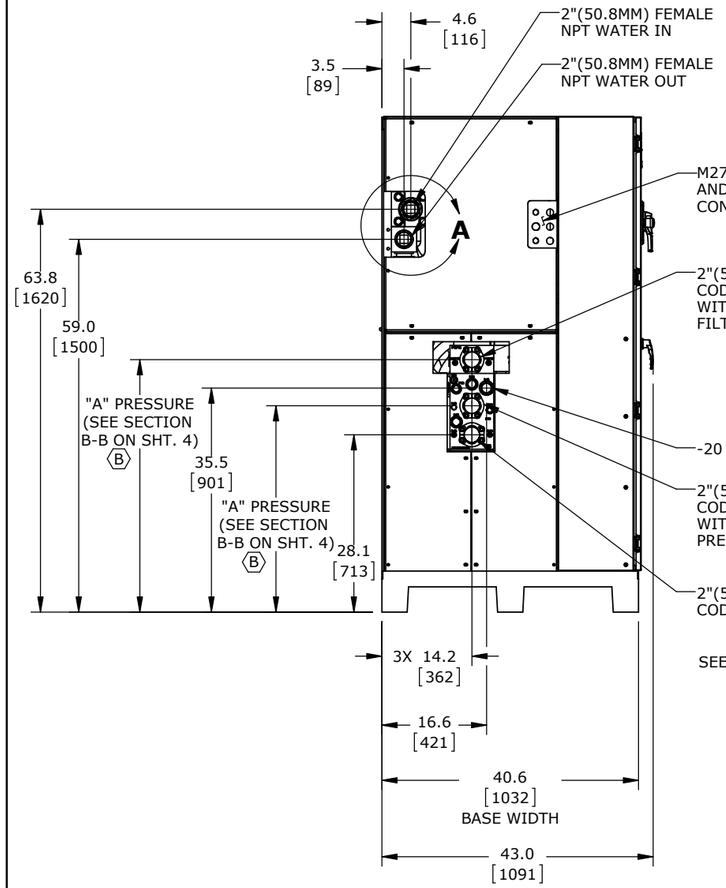
SHEET 1 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.



DETAIL A
AIR COOLED OPTION SHOWN





REVISIONS

DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION	.XXX HOLE SIZE TOLERANCE		DRAWN	CHECK	ENGR	MFG
-----	0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003	DCP	-	PJR	-
MATERIAL SIZE -----			DATE 01/15/14	DATE -	DATE 07/08/15	DATE -

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

GENERAL TOLERANCES: ANGLE ±2° | X/√ ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

TITLE
CONFIGURATION
DRAWING-515,6BAY,RH

NEXT LEVEL -----

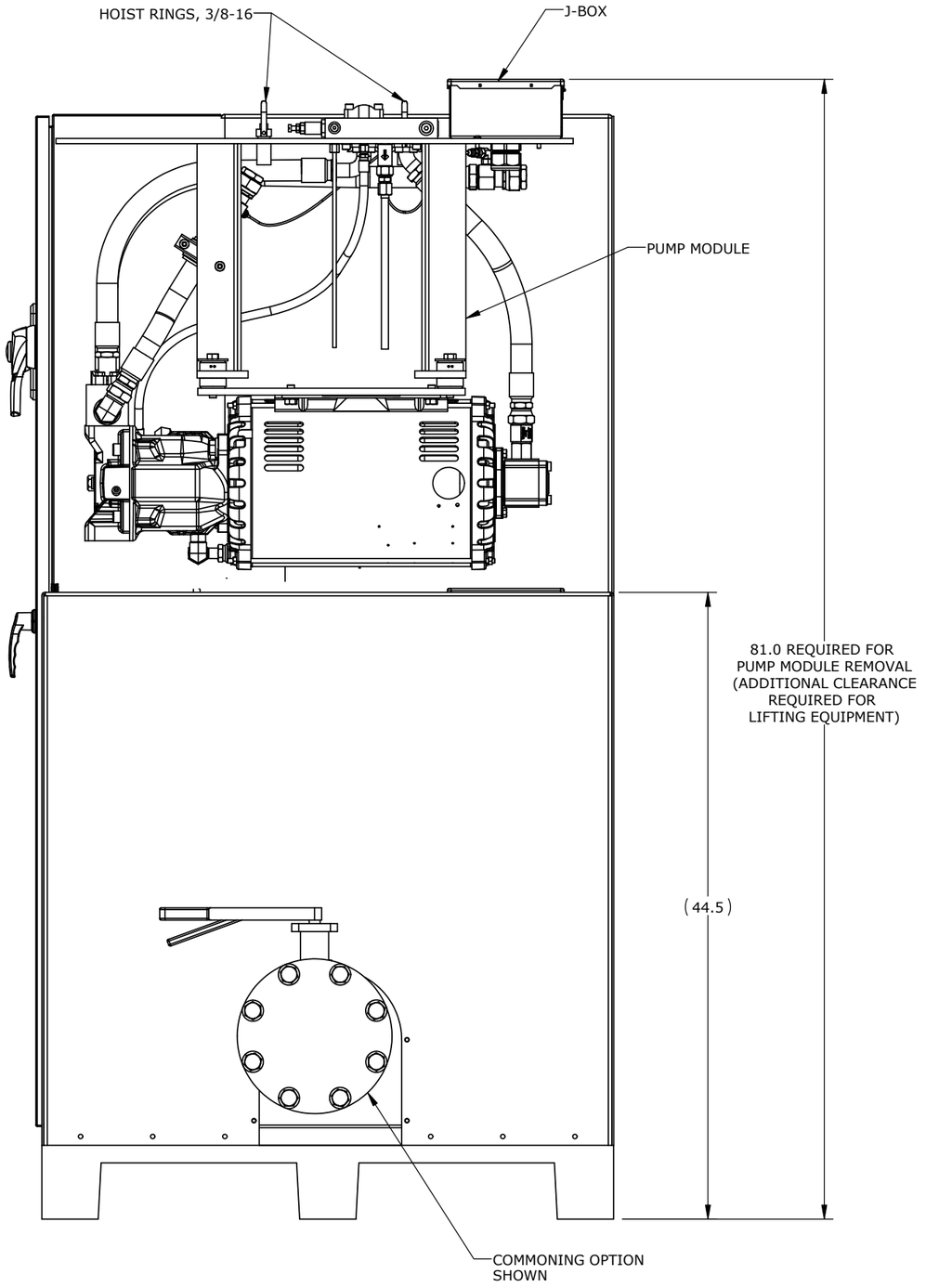
SIZE D

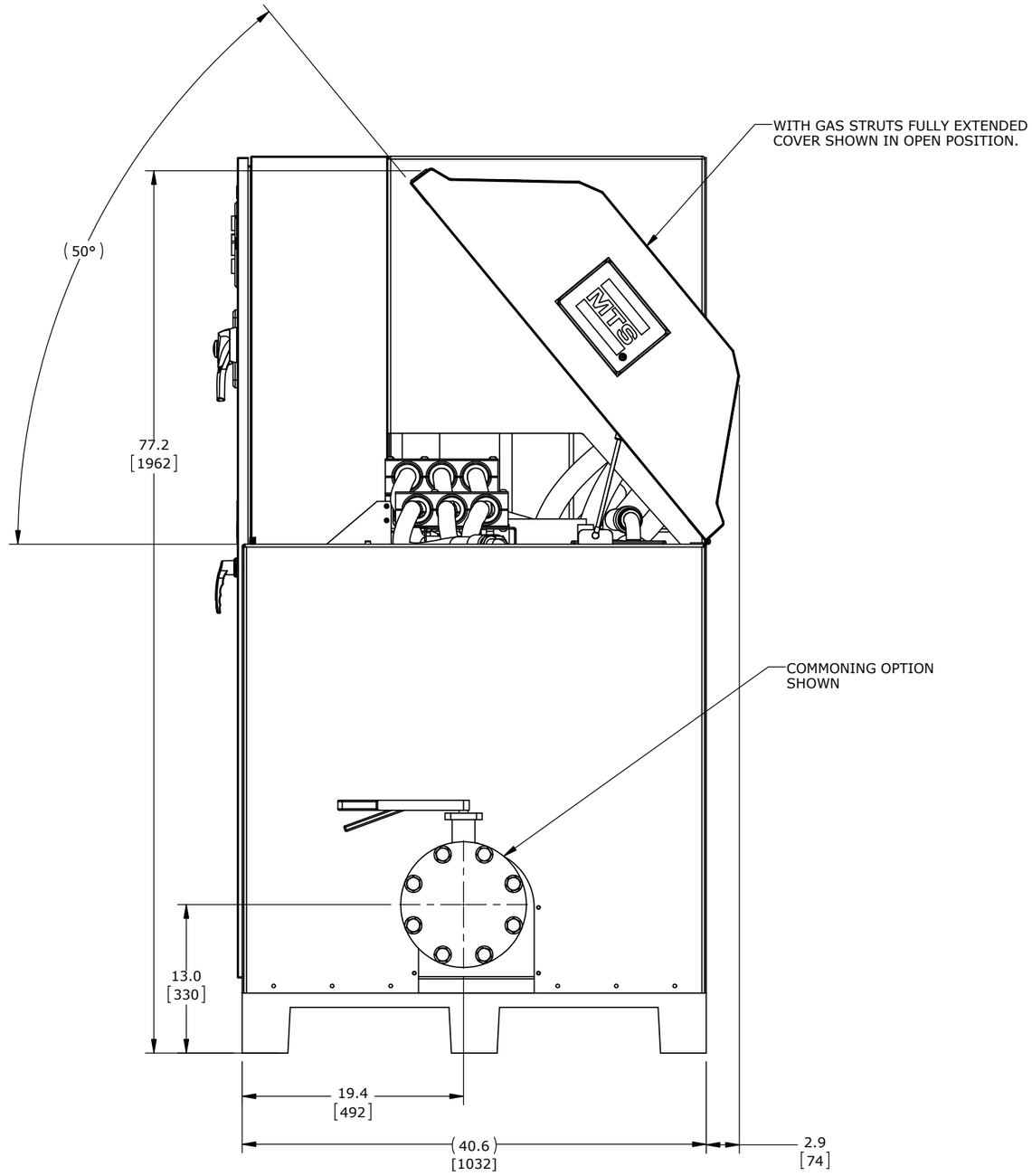
NUMBER 700-007-773 REV B

PRODUCT CODE 515

SHEET 2 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.





VIEW A-A

SCALE: NONE

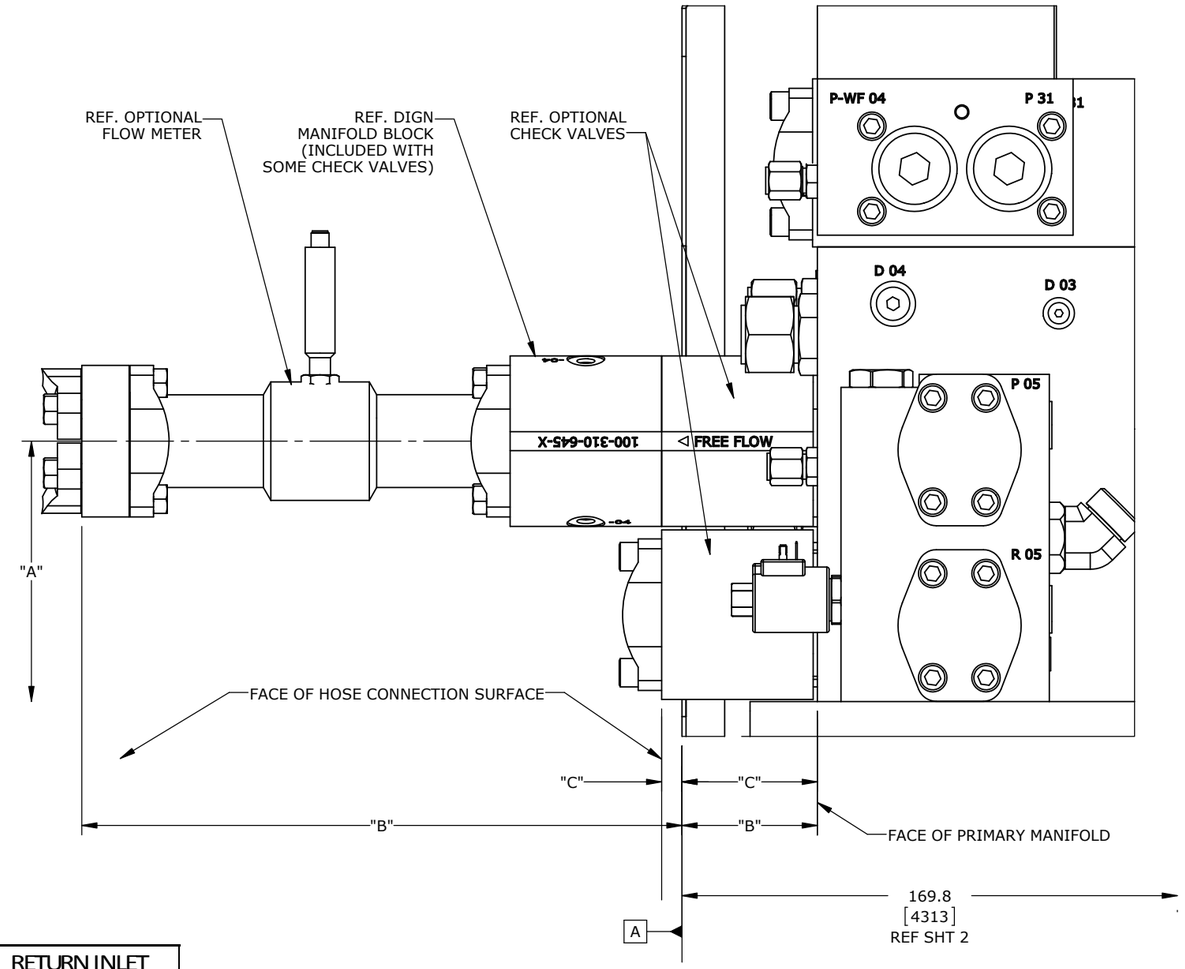
REVISIONS					
DESCRIPTION	DRAWN	ENGR	DATE	LETTER	ECN NO

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----	.XXX HOLE SIZE TOLERANCE: 0.000 TO .750 +.010/-.002; OVER .750 TO 1.500 +.015/-.003	DRAWN DCP / DATE 01/15/14	CHECK - / DATE -	ENGR PJR / DATE 07/08/15	MFG - / DATE -
MATERIAL SIZE -----					
FINISH ----- MASK	GENERAL TOLERANCES: ANGLE ±2° ; X ±1/4 ; .X ±.1 ; .XX ±.03 ; .XXX ±.010	TITLE: CONFIGURATION DRAWING-515,6BAY,RH			
• THREAD DEPTHS ARE TO MIN FULL THDS • DRILL DEPTHS ARE TO FULL DIA • REMOVE BURRS AND SHARP EDGES • DO NOT SCALE PRINT	SCALE NONE MACHINED SURFACES 180√				
MTS SYSTEMS CORPORATION EDEN PRAIRIE, MINNESOTA U.S.A.	THIRD ANGLE PROJ	NEXT LEVEL -----	SIZE D	NUMBER 700-007-773	REV B
		PRODUCT CODE 515		SHEET 3 OF 4	



OPTION(S)		PRESSURE OUTLET "A" (VERTICAL)	PRESSURE OUTLET "B" (AXIAL)	RETURN INLET "C" (AXIAL)
	NONE	830.6 mm / 32.7 in	-91.4 mm / -3.6 in	-106.7 mm / -4.2 in
	FLOW METER (ROD)	830.6 mm / 32.7 in	196.3 mm / 7.7 in	-106.7 mm / -4.2 in
WITH DIGN MANIFOLD	CHECK VALVES	830.6 mm / 32.7 in	114.3 mm / 4.5 in	-2.5 mm / -.1 in
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WITHOUT DIGN MANIFOLD	CHECK VALVES	830.6 mm / 32.7 in	12.7 mm / 0.5 in	-2.5 mm / -.1 in
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	HIGH PRESSURE FILTER (HPF) W/ FLOW METER (ROD) REQUIRES CHECK VALVES	1016.0 mm / 40.0 in	300.5 mm / 11.8 in	-2.5 mm / -.1 in

NOTES:
1. (-) DIMENSIONS RIGHT OF DATUM A
   (+) DIMENSIONS LEFT OF DATUM A

SECTION B-B
SCALE: NONE
OPTIONS SHOWN MAY NOT REFLECT HPU ORDERED

REVISIONS

DESCRIPTION			LETTER	ECN NO
DRAWN	ENGR	DATE		

-

SOURCE/REF DRAWING -

UNLESS OTHERWISE SPECIFIED

MATERIAL DESCRIPTION -----

MATERIAL SIZE -----

FINISH ----- MASK

- THREAD DEPTHS ARE TO MIN FULL THDS
- DRILL DEPTHS ARE TO FULL DIA
- REMOVE BURRS AND SHARP EDGES
- DO NOT SCALE PRINT

SCALE NONE

MACHINED SURFACES 180√

.XXX HOLE SIZE TOLERANCE

0.000 TO .750 +.010/-.002	OVER .750 TO 1.500 +.015/-.003

GENERAL TOLERANCES: ANGLE ±2° | X/Y ±1/4 | .X ±.1 | .XX ±.03 | .XXX ±.010

THIRD ANGLE PROJ

DRAWN	CHECK	ENGR	MFG
DCP	-	PJR	-
DATE 01/15/14	DATE -	DATE 07/08/15	DATE -

TITLE
CONFIGURATION
DRAWING-515,6BAY,RH

NEXT LEVEL -----

PRODUCT CODE 515

SIZE D

NUMBER 700-007-773

REV B

SHEET 4 OF 4

MTS SYSTEMS CORPORATION
EDEN PRAIRIE, MINNESOTA U.S.A.

*** END OF SECTION ***