



SE-10-27, MARKET RESEARCH AGREEMENT FOR PROTOTYPE HYDRAULIC CYLINDER FOR SEMI-SUBMERSIBLE OPERATION

1. SCOPE: The ACP is conducting a market research to determine the availability of acceptable hydraulic cylinder for semi-submersible operation. Any manufacturer of this type of product or prototype manufacturer who is interested in participating in this market research will be required to engineer, manufacture, furnish and deliver, at no cost of any nature to the ACP, one (1) prototype, double acting hydraulic cylinder for semi-submersible operation in accordance with these specifications. Each Manufacturer shall only submit one prototype. The ACP will operate this hydraulic cylinder in an accelerated test in Panama Canal waters. The intent of the testing is to evaluate the hydraulic cylinder performance, including but not limited to the rod sealing performance in the actual Panama Canal operating conditions. The Panama Canal Authority (ACP) will supply the hydraulic power unit, controls, material and personnel to construct the test rig at the Miraflores Locks (lake side), Panama Canal. The prototype hydraulic cylinder shall be made available to the manufacturer after the tests have been completed. Upon conclusion of the tests, the manufacturer will be required to remove the prototype at no cost to the ACP.

2. MANUFACTURERS' ORGANIZATION, EXPERIENCE, AND PAST PERFORMANCE: To be able to participate in this market research, the Prototype Manufacturer shall submit evidence that---

- a. have designed, manufactured, and commissioned not less than 20 customized hydraulic cylinders of similar type, size, complexity, and performance to the cylinder required under this agreement; and
- b. have a minimum of seven years of experience (within the last nine years) in the design, manufacturing, testing, inspection, and quality assurance of hydraulic cylinder assemblies for service in machinery and equipment similar to the hydraulic cylinders working in navigation locks, hydropower, offshore or marine industries.

Documentation evidencing compliance with this experience and past performance requirements shall be submitted within **15 days of the advertising date of this market research**, together with the formal notification required under the following Paragraph No. 3.

3. CONCURRENCE TO PARTICPATE IN AGREEMENT: Any manufacturer of the specified type of product who is interested in participating in this agreement, is required to submit within **15 days of the advertising date of this market research agreement**, a formal, written notification to the ACP indicating acceptance of the conditions of this agreement including compliance with the final delivery date specified in Paragraph 10, below.

4. APPLICABLE DOCUMENTS

4.1 Applicable Publications: Except as otherwise specified herein, design, materials, fabrication, and testing shall be in accordance with industry recognized standards and specifications such as the following:

American Iron and Steel Institute (AISI)
 American National Standards Institute (ANSI)
 American Society for Testing and Materials (ASTM)
 American Society of Mechanical Engineers (ASME)
 European Structural Steel Standard (EN 10025-2004)
 International Standards Organization (ISO)
 Society of Automotive Engineers (SAE)
 Steel Structures Painting Council (SSPC)
 National Fluid Power Association (NFLPA)
 DIN 19704 Hydraulic Steel Structures
 DIN 18800 Design Structural Steel
 ISO 6022 Mounting Dimensions for Single Rod Cylinder

4.2 Equivalent Standards: Should the Prototype Manufacturer desire to substitute equipment or materials conforming to standards other than those stated in these specifications, he will designate the exact standards so substituted and shall furnish, with its prototype, as required by the ACP Authorized Representative, a copy in the English language of each standard so substituted. This copy will be used by the ACP Authorized Representative to determine whether or not the substituted standard is an acceptable equivalent to the standard of the applicable classification and standard organization referenced in the specifications.

4.3 Drawings: The drawing listed here is part of these specifications. This drawing shows hydraulic cylinder principal design parameters, and how the hydraulic cylinder will be installed in the test rig. The ACP, if requested by the Prototype Manufacturer, will furnish one set of reproducible copies of all drawings, at no charge.

DRAWING No.	DESCRIPTION
SK-412-308	Prototype Hydraulic Cylinder and Testing Rig

5. TECHNICAL REQUIREMENTS

5.1 General Requirements: The Prototype Manufacturer will be responsible for engineering and manufacturing a prototype double acting hydraulic cylinder that shall comply with these specifications and design criteria in order to be considered for testing as specified herein. The design of the hydraulic cylinder shall effectively perform and positively seal against the intrusion of contaminants into the hydraulic system. All materials, parts, components, and accessories shall be new and of the best quality, proven for the application.

5.2 Design and Performance Parameters: The prototype hydraulic cylinder shall meet the following requirements, but not be limited to:

5.2.1 Hydraulic Cylinder Assembly: The hydraulic cylinder shall be of the double acting type. The rod and rod sealing system shall be engineered and manufactured to perform while the cylinder works above water, under water, in a horizontal position and in semi-submersible conditions. Material for the hydraulic cylinder shall be carbon or alloy steel with mechanical strength as required for the application and in accordance with these specifications. Rings, bearings, packing, packing rings, retaining rings, seals, wiper-scrapers, etc., shall be fabricated from the finest selected quality materials as recommended by the manufacturers' for the application.

Piston Rod: Rod layer coating technology shall be either Laser Clad or Plasma Transferred Arc (PTA) in accordance with manufacturer's quality standards and technical specifications. The coating shall provide a homogeneous, uninterrupted layer applied by an automatically controlled machine with zero percent porosity. The layer shall be provided over the complete exposed length of the cylinder rod.

5.2.1.1 Rod Sealing System: Rod sealing system design criteria shall provide a long service life, zero leakage rates, resistance to corrosion and mechanical stresses, and positive protection against water and particle intrusion. The rod sealing system shall be able to remove any particles (of silt, dirt or a mix of sediments) that can dry off and adhere to the surface of the rod coating. Rod seals shall be capable to work with mineral oil and biodegradable oil (synthetic ester according to ASTM D5864 or better). Rod sealing system design shall allow servicing of piston rod seals without disassembling the cylinder.

5.2.1.2 Design Parameters of Cylinder: The cylinder shall comply with the design parameters as indicated on SK-412-308 and the following requirements:

3.2.1.3.1 Cylinder Duty Cycle: The cylinder and seals shall be designed for a cycling life of not less than 500,000 cycles, and not less than 500 cycles per day.

5.2.2 Fit on the Hydraulic Cylinders Test Rig Installation: The hydraulic cylinder shall be designed to suit the test rig installation as shown in SK-412-308.

5.2.3 Operating Conditions: The prototype hydraulic cylinder will operate above water, under water and in semi-submersible conditions ("in splash zone condition") in Panama Canal Locks waters with suspended contaminants (suspended contaminants are but are not limited to: oil, grease, and suspended solids in water such as silt and dust) that will dry off and adhere to the hydraulic cylinder rod coating.

5.2.4 Maintenance Free Type Design: The hydraulic cylinder assembly shall not require special maintenance procedures (such as flushing systems).

5.3 Allowable Stresses Design Basis: As a minimum, all new parts and components shall be designed to withstand the maximum force exerted by the hydraulic cylinder plus any dead loads with a minimum safety factor of 2 based on the yield strength of the materials involved. Stress concentration factors shall be used where applicable.

5.4 Corrosion Protection:

5.4.1 Corrosion Protection: Metallic construction materials shall be resistant to a corrosive industrial/tropical, marine environment, humid, and to the semi-submersible and underwater operating conditions. Manufacturing details shall allow free drainage of water and minimize the possibility of accumulation of mud and debris, which could foster corrosion. Metals to be used in contact or in conjunction with other metals shall be of the same material or compatible, such that galvanic corrosion shall be prevented. Dissimilar metals shall be separated by appropriate measures to avoid galvanic corrosion.

5.4.2 Coated Metals: Surfaces to be painted shall be properly prepared to eliminate all weld slag and spatter, sharp edges and corners, and other irregularities, to provide smooth, round surfaces appropriate for painting. Metal surfaces to be in contact with porous, leak proof and noise barrier materials

shall be appropriately coated to avoid corrosion. All protective coating used shall be lead and chromate free, designed to protect against heavy corrosion in industrial/tropical marine environment, sun exposure, and chemical splash and spillage. All protective coatings shall be applied in accordance with manufacturers' recommendations and the intended purpose.

6. TESTING BY ACP

6.1 Accelerated Testing: The cylinder rod will be retracted and extended in an accelerated test in a testing pool with Canal lake waters to simulate working conditions in the Panama Canal. After the cylinder rod is briefly submerged, water will be quickly dried (by any artificial method) which allows the suspended contaminants of the water to adhere to the rod coating surface before the retraction of the rod begins. After the accelerated test is completed, the prototype hydraulic cylinder will be taken back, as is, by its manufacturer regardless the outcome of the test. If the prototype cylinder is damaged before or during test procedures, the ACP will not be liable for these damages and the manufacturer shall have no rights to claim any costs of any nature for damages or loss of use arising out the tests performed with and to the prototype. Prototype manufacturer shall be aware of the risks involved when delivering the goods; if any damages occur while delivery is taken place that may affect the prototype cylinder's performance during the test or void the prototype cylinder from being tested, it is the responsibility of the Prototype Manufacturer to repair it, if necessary, the aforementioned damages if the cylinder requires it in order to be tested by the ACP.

6.2 Factors to be tested or analyzed: Water and particle ingress, oil leakages, and wear of sealing components, will be the test criteria. Oil cleanness and water contamination will be measured according to standard for hydraulic systems. Wear of sealing components will be tested by direct measurements of the components.

6.2.1 Before the tests start an oil sample will be taken from a strategic point on the system to make sure that the dissolved water concentration and particle count are under acceptable levels. During the test, samples will be taken to monitor and determine the cylinder sealing effectiveness.

6.2.2 Maximum Acceptable Hydraulic Oil Water Contamination Level: 150 ppm.

6.2.3 Required Hydraulic Oil Cleanliness Level: ISO 4406 17/15/12 or better.

7. PRESERVATION, PACKAGING, AND PACKING

7.1 Preservation, packaging, and packing shall provide adequate protection against corrosion, deterioration, and physical damage during shipment from manufacturer's plant to ACP delivery destination.

7.2 Packaging and packing shall comply with the requirements of ASTM D 3951.

8. PROTOTYPE INFORMATION FOR REVIEW:

8.1 Design and Manufacturing Data: The Prototype Manufacturer will be required to submit within **30 days of the advertising date of this market research agreement**, as a minimum, the following information:

8.1.1 Design drawings of the double acting hydraulic cylinder, including the flange connection to the test rig.

8.1.2 Manufacturer's catalog data and descriptive literature of all standard components and products to be incorporated in the work, technical specifications and dimensions of standard and commercial items.

8.1.3 Manufacturers' dimensional drawings of rod sealing components.

8.1.4 Complete material and components list and specifications.

8.2 Standards Compliance: When materials must conform to standards and specifications, proof of such conformance shall be submitted to the ACP Authorized Representative for information purposes.

8.3 Certificates of Conformance: With the delivery of the prototype, submit certification from the Prototype Manufacturer attesting that materials and components to be furnished for this research comply with the requirements of these specifications and the referenced publications. Pre-printed certifications will not be acceptable; certifications shall be in the original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.

8.3.1 A certificate of compliance shall be provided that the materials and the components, and assemblies meet Market research specifications and drawings.

8.4 Operation and Maintenance Instructions: The Prototype Manufacturer will also furnish at no cost to the ACP, at the time of delivery of the prototype, in Microsoft electronic format and/or PDF format three (3) complete sets of instructions containing the manufacturer's operating and maintenance instructions for hydraulic cylinder to the ACP Authorized Representative. The instructions shall include, but not limited to the following: cross-section drawing of the double acting hydraulic cylinder with parts list; operating and maintenance instructions including troubleshooting instructions; manufacturer's bulletins, catalogs, and descriptive data; recommended spare parts.

9. WARRANTIES: The hydraulic cylinder to be furnished by the Prototype Manufacturer will be a prototype for testing. However, notwithstanding inspection and testing by the ACP of the double acting hydraulic cylinder furnished under the terms herein or any provision hereunder concerning the conclusiveness thereof, the Prototype Manufacturer shall warrant from the date of delivery of the hydraulic cylinder that each item furnished by the Prototype Manufacturer will be free from any defects in workmanship and will conform to the specifications and all other requirements of the Agreement.

10. FINAL DELIVERABLE: Prototype cylinders must be delivered to the ACP not later than **120 calendar days after the period established in paragraph 8.** (*Prototype Information For Review*) for delivery of design and manufacturing data.

11. PROTOTYPE DELIVERY INSTRUCTIONS: Unless otherwise indicated, prototype shall be consigned to the ACP, to the following destination:

D.D.U. Building #50, MIRAFLORES LOCKS, REPÚBLICA DE PANAMA
Autoridad del Canal de Panamá
División de Esclusas
Miraflores, República de Panamá

12. PROTOTYPE INFORMATION: The information submitted by the Prototype Manufacturer shall be precise, factual and responsive, and shall be comprehensive enough to provide a thorough basis to enable its test by the ACP. The ACP reserves the right to verify the information provided or requested.

12.1 Prototype Information: It shall as a minimum include:

12.1.1 Preliminary Design of the Hydraulic Cylinder: Whenever the use of a commercial component is proposed, the Prototype Manufacturer shall clearly indicate it. The preliminary design shall as a minimum include the following:

(a) **Preliminary Specifications:** The Prototype Manufacturer shall provide the required information to demonstrate compliance with all design and performance requirements of paragraph 3. It shall include but it shall not be limited to: (1) preliminary design description and specifications of the hydraulic cylinder to be furnished by the Prototype Manufacturer.

(b) **Preliminary Design Drawing(s):** Preliminary design drawing(s) shall be of high quality and complete to permit the ACP a through test of the technical solution provided for the proposed retrofit kits. The preliminary drawing(s) shall include but not limited to: General Arrangement of the proposed hydraulic cylinder assembly, including principal dimensions and clearances.

(c) **Maintainability, Maintenance Requirements:** Design features that enhance maintainability shall be explained. Maintainability as used here means the ease with which the rod sealing flange and its components can be accessed, removed, repaired, reinstalled, inspected, etc. Maintenance requirements shall be explained.

12.1.2 Warranty: Prototype Manufacturer shall indicate its proposed warranty terms, which shall conform to terms indicated in paragraph 9.

13. ACP DISCLAIMER:

13.1 The ACP shall not be liable for any wear and tear, loss or damage of any kind produced to the prototypes arising out of or caused by or related to this Market Research.

13.2 Nothing contained herein and as a result of the terms contained herein shall be considered as an evaluation or acceptance by the ACP of the prototypes or create expectations in the prototypes manufacturers for ACP future procurement processes related to the prototypes being tested.

14. RIGHTS IN DATA AND INFORMATION:

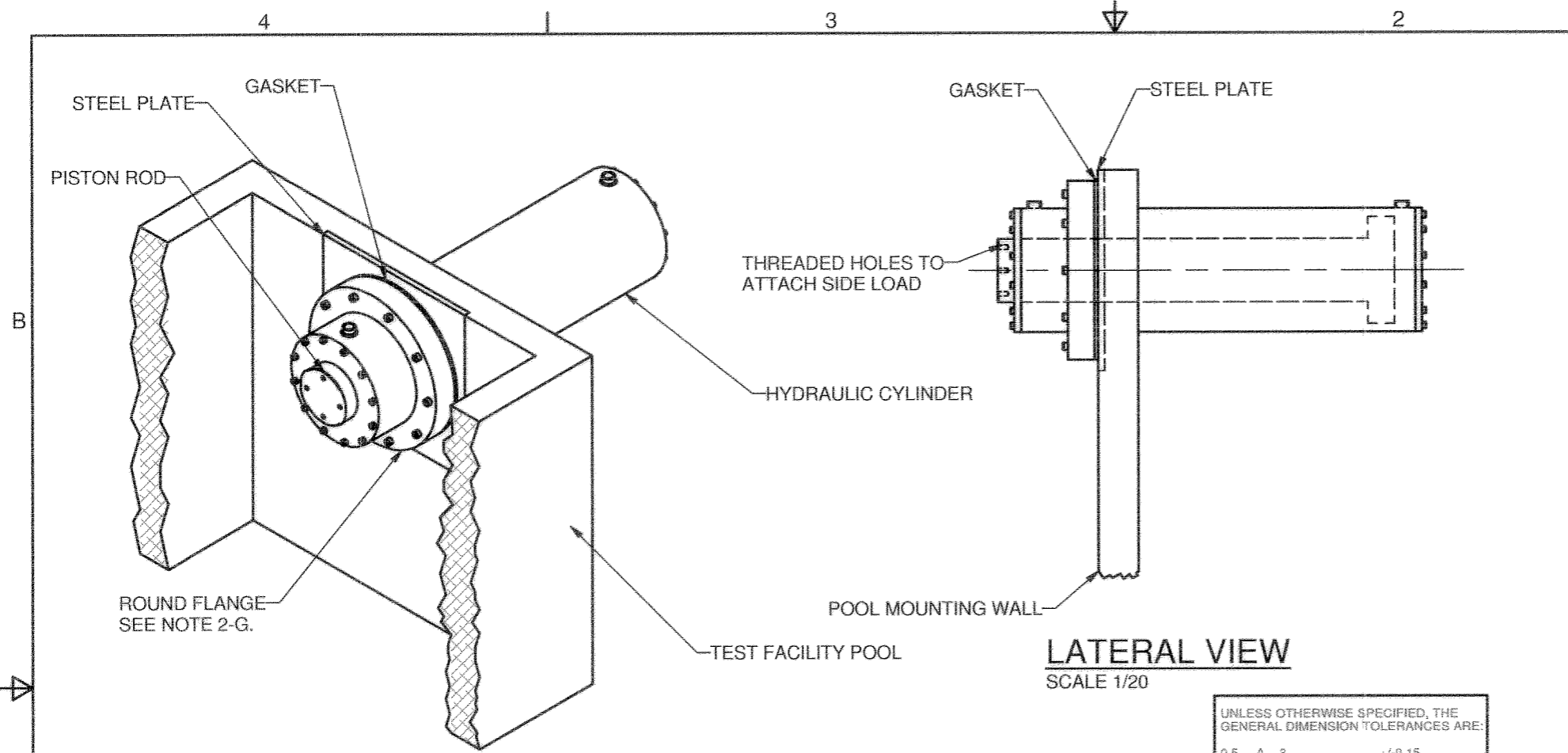
14.1 “Data and Information” to be submitted or provided under this market research agreement means calculations, computer information and other software, drawings, design information, manuals, specifications and other documents of a technical nature required to be prepared, provided and supplied by the Prototype Manufacturer or developed in the course of or for the purposes of the work to be carried out by or on behalf of the ACP under this agreement.

14.2 By entering into this agreement, the Prototype Manufacturer hereby grants to the ACP an irrevocable, worldwide, non-exclusive, non-terminable transferable, royalty free license to copy, use, communicate, and modify any Data and Information provided by the Prototype Manufacturer under and as a result of this market research agreement including using modification of such Data and Information as the ACP may deem necessary or appropriate to satisfy its needs, but subject to Sub-clause 14.3 it shall not be permitted to arrange for other contractors to manufacture duplicates. This license shall entitle the ACP, its employees, agents and any other person authorized by the ACP to copy, modify, use, communicate and use modifications of the Data and Information provided by the Prototype Manufacturer for the purposes stated under this agreement.

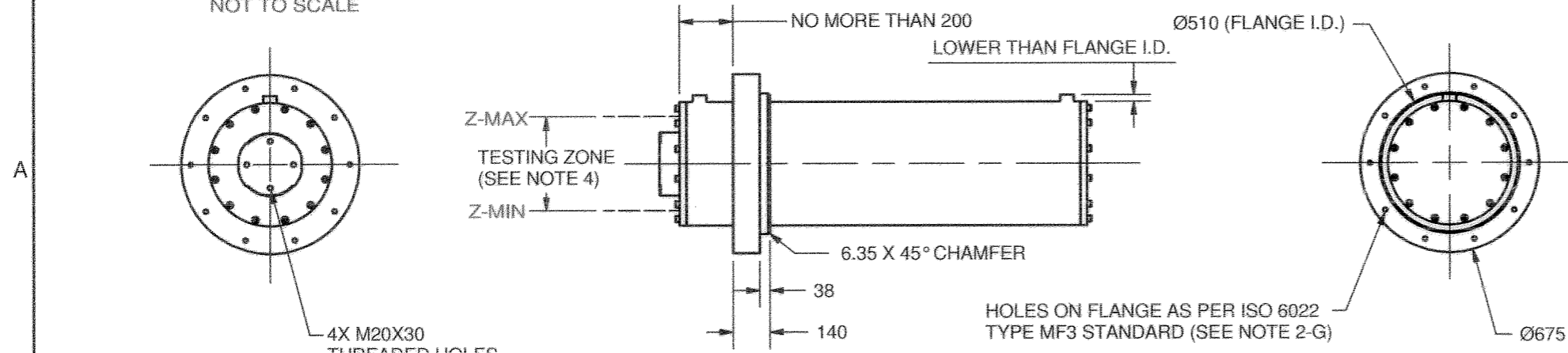
14.3 Notwithstanding Sub-clause 14.2, Data and Information as contemplated by Sub-clause 14.1 which relates either to modifications or to the Prototype to make it suitable for use at the Panama Canal or to make it in accordance to the requirements of the ACP may be used, modified, copied or communicated by the ACP for the purpose of procuring alternative products, including those supplied by other Contractors.

15. POINT OF CONTACT: Manufacturers requiring any clarification on this market research should contact Mrs. Dalida Lasso, e-mail: dlasso@pancanal.com; telephone (507) 272-4930 (central) and (507) 272-4937 (direct).

END OF DOCUMENT



HYDRAULIC CYLINDER TEST FACILITY SCHEMATIC
NOT TO SCALE



HYDRAULIC CYLINDER
SCALE 1/20

UNLESS OTHERWISE SPECIFIED, THE GENERAL DIMENSION TOLERANCES ARE:

0.5	A	3	+/-0.15
3	A	6	+/-0.2
6	A	30	+/-0.5
30	A	120	+/-0.8
120	A	400	+/-1.2
400	A	1000	+/-2.0
1000	A	2000	+/-3.0
2000	A	4000	+/-4.0

- GENERAL NOTES:**
- ALL THE DIMENSIONS ARE IN MILLIMETERS, UNLESS OTHERWISE SPECIFIED.
 - CYLINDER SPECIFICATIONS:
 - MODE OF OPERATING: DOUBLE ACTING (PULLING AND PUSHING).
 - BORE DIAMETER SHALL NOT BE MORE THAN 320 MM (12.60 IN), AND NOT LESS THAN 280MM(11 IN). PISTON ROD DIAMETER SHALL NOT BE LESS THAN 200 MM (7.87 IN). STROKE LENGTH SHALL NOT BE LESS THAN 1000 MM (39.27 IN).
 - DESIGN PRESSURE BOTTOM SIDE SHALL NOT BE LESS THAN 3000 PSI (20.6 MPA).
 - DESIGN PRESSURE ROD SIDE SHALL NOT BE LESS THAN 3000 PSI (20.6 MPA).
 - MAXIMUM SPEED: 4 IN/S (100 MM/S)
 - HYDRAULIC WORKING FLUID: MINERAL OIL (ISO-VG-68).
 - MOUNTING FLANGE SHALL BE OF THE MF3 TYPE (ROUND MOUNTING FLANGE), UNDER ISO 6022 STANDARD, AND SHALL BE MANUFACTURED AND INSTALLED ON CYLINDER BY THE CONTRACTOR. FLANGE DIMENSIONS SHOWN ON THE SKETCH ARE FOR REFERENCE PURPOSES ONLY.
 - POWER UNIT TO OPERATE THE CYLINDER WILL BE PROVIDED BY THE ACP (NOT SHOWN), NOMINAL POWER: 60 HP.
 - CYLINDER ROD WILL BE ABLE TO RESIST A SIDE LOAD OF NOT LESS THAN 1100 LB (500 KG).
 - THE EXTERNAL LOAD WILL BE SIMULATED BY MEANS OF A PRESSURE CONTROL VALVE.
 - CYLINDER WILL BE TESTED UNDER DIFFERENT WATER LEVEL CONDITIONS IN TESTING POOL, RANGING FROM A TOTALLY ABOVE WATER SETUP (WATER LEVEL AT Z-MIN), TO A TOTALLY SUBMERGED SCENARIO (WATER LEVEL AT Z-MAX).
 - CYLINDER CORROSION PROTECTION SHALL BE OF THE TYPE ICOSIT EG SYSTEM OR EQUIVALENT, WHICH CONSISTS, BUT IS NOT LIMITED, TO THE FOLLOWING:
 - TOTAL THICKNESS: 280 µM
 - NUMBER OF LAYERS: 3(THREE)
 - FIRST LAYER (UNDERCOATING): EPOXY RESIN, 80 µM
 - SECOND LAYER (INTERFACE LAYER): EPOXY RESIN, 120 µM
 - THIRD LAYER (TOP LAYER): POLYURETHANE BASED COAT, 80 µM

R I	15 JUL 2008	ADDED MINIMUM BORE DIAMETER	HAC	[Signature]
	REV.	FECHA	DESCRIPCIÓN	
			REVISADO	
AUTORIDAD DEL CANAL DE PANAMA EDIFICIO 721 COROZAL OESTE PROTOTYPE HYDRAULIC CYLINDER AND SCHEMATIC INSTALLATION GERENTE INTERINO DE INGENIERIA MECÁNICA Y ELÉCTRICA [Signature] VICEPRESIDENTE DE INGENIERIA ESCALA INDICADA FECHA 5/8/2008 DISEÑO L.I./R.R. DIBUJADO R. ROJAS REVISADO H.C./L.I. SK-412-308				