封面格式

行政院及所屬各機關出國報告

（出國類別：~~其他活動 接收檢驗~~

考察）

經濟部「小型商務客機計畫」赴美MPC公司執行首件檢驗工作報告書

服務機關：中山科學研究院
第一研究所

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姓　名：張高健

出國地區：美國

出國期間：89.12.11-89.12.17

報告日期：90.03.15

目　錄

壹、出國目的及緣由

依據第一研究所執行經濟部科技專案『小型商務客機關鍵技術開發』計畫之奉核需求，委託美國 MPC 公司進行「商用機致動器研發及測試技術引進」案，奉核准派張建華中校領隊，率次系統組李啟泰少校及張高健上尉等三員赴美國伊利諾州史攸基市之 MPC 公司，執行委製件之首件檢驗及功能測試等相關工作，以確保雛型件能符合系統規格需求，並藉由實作以達技轉學習相關的組裝、測試、及檢驗等技術。

本案主要任務有：

1. 執行商用機致動器及其驅動控制器之首件檢驗（FAI）及相關技術套件資料查驗。
2. 進行商用機致動器及其驅動控制器之組裝、測試、及品質檢驗等相關研討。
3. 商用機致動器系統件含次組件之功能測試（ATP）及實作。
4. 與 MPC 公司洽談致動器認證及 OEM 事宜，並蒐集美洲地區之航空級電機致動器相關的伺服馬達與驅動器等關鍵技術資料，與瞭解國外先進的發展趨勢。

貳、公差心得

於執行商用機致動器及其驅動控制器之首件檢驗（FAI）及相關技術套件資料查驗，進行商用機致動器及其驅動控制器之組裝、測試、及品質檢驗等相關研討中，參觀了 MPC 公司內部的工作環境、使用設備、及人員的專業態度，令人印象深刻。

該公司從研發到測試緊密結合，製造廠區雖與設計分離，但僅有一路之隔。而且裝備齊全，雖非全為最新型的電子化產品，但是，設備齊全，足以讓設計人員，獨立操作，完成所有的驗證工作。且其所使用的裝備及安裝所須的零件均採用快拆式，並且廁底執行標準化，減少樣數，所以具備互換性，並降低零件成本。

在設計到測試能夠一貫到底的環境下，MPC 的設計人員相對的表現出對公司產品的信心。在檢測過程中，個人曾蓄意挑出已經執行過，而且比較困難且關鍵的測試項目，要求該公司再次展示其測試過程，結果設計人員立即調整裝備，設定測試條件，滿足我方臨時性的需求。由此可見其專業性、彈性。

另外使人印象深刻的一點是，全程接待我方人員的是一個僅三年經驗的年輕工程師，30 幾年工作經驗的總工程師則 on-call，這無可厚非。當我方人員提出問題，且深度超出其所能答覆者，他也能很迅速的獲得相關回覆，這表示，該公司內

部，支援情況良好，經驗傳承做得相當踏實。

本次任務主要目的在執行兩型商用機伺服製動器之首次檢驗及接收檢驗。分別為：

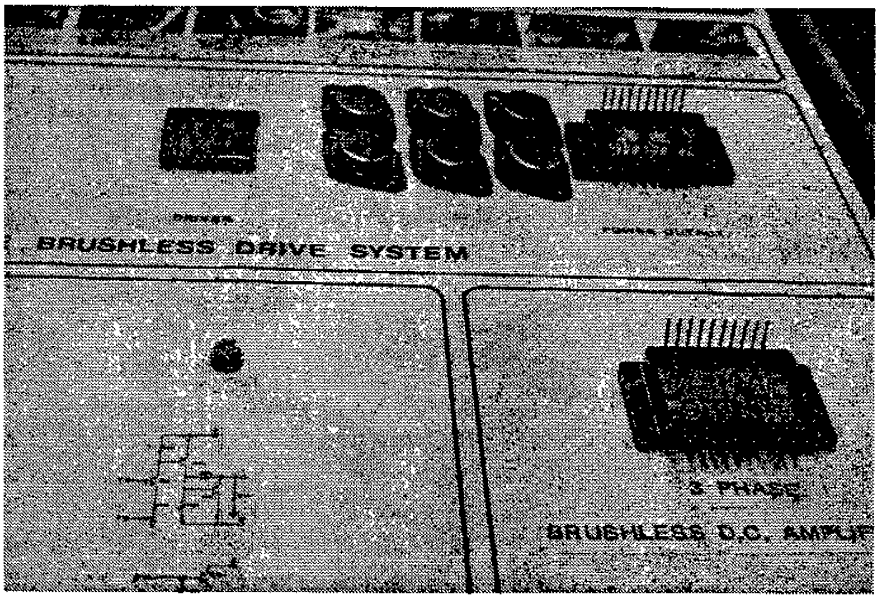
1. 2A7180Z210A：採用艾克姆螺紋之滾珠螺桿，應用於襟翼之驅動控制。
2. 2B7180Z219A：採用滾珠螺桿，應用於副翼、方向舵、升降舵之驅動控制。

測試項目包括：

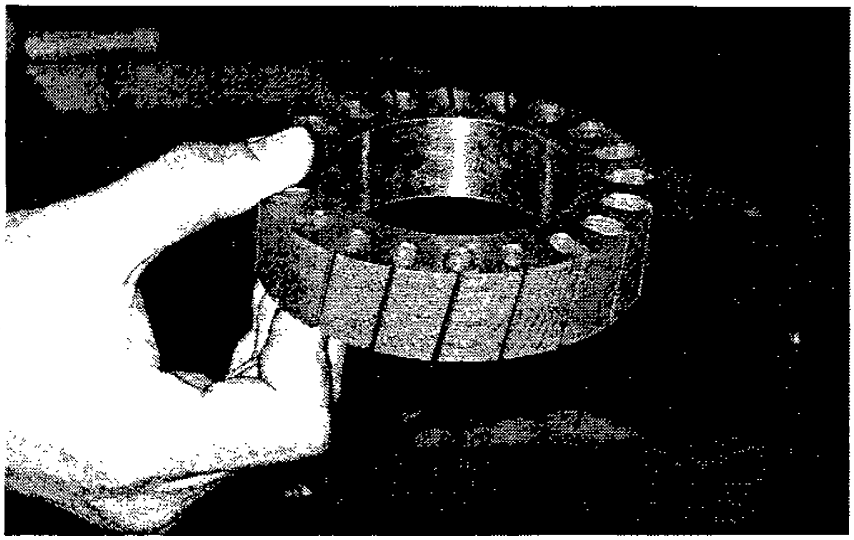
1. 重量量測。
2. 導電強度檢測。
3. 絕緣強度檢測。
4. 退隙檢測。
5. 操作速度檢測。
6. 煞車力量測試。
7. 機械行程測試。
8. 電動回程位置測試。
9. 定中測試。
10. 解角器角度測試。
11. 線性位置測試。
12. 位置重複度測試。
13. 接頭測試。
14. 長度量測。

藍圖及測試程序如附件。

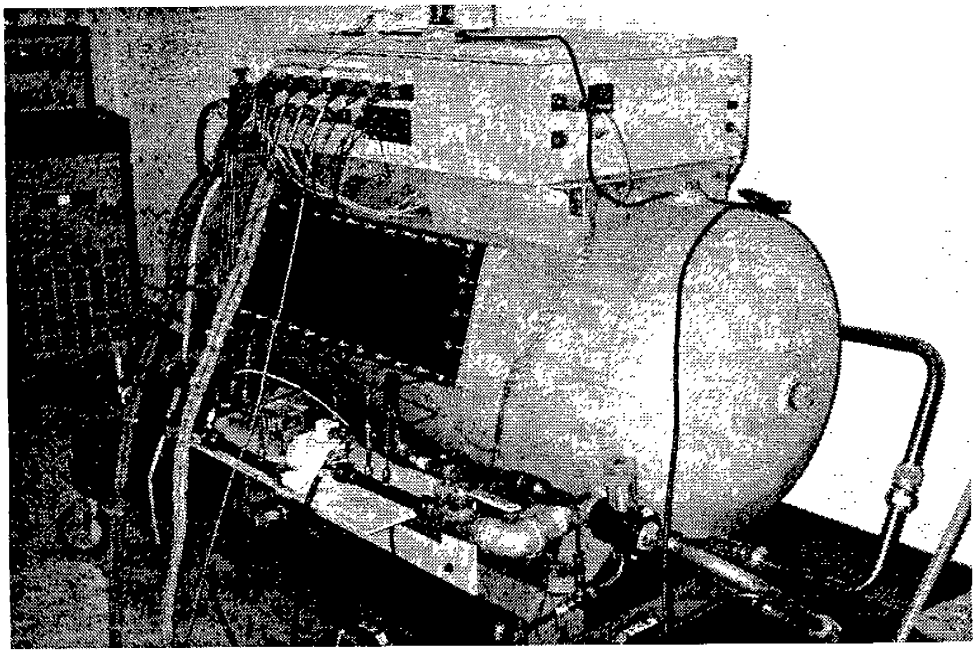
茲擇錄數張此次行程中所拍攝的照片如後附。



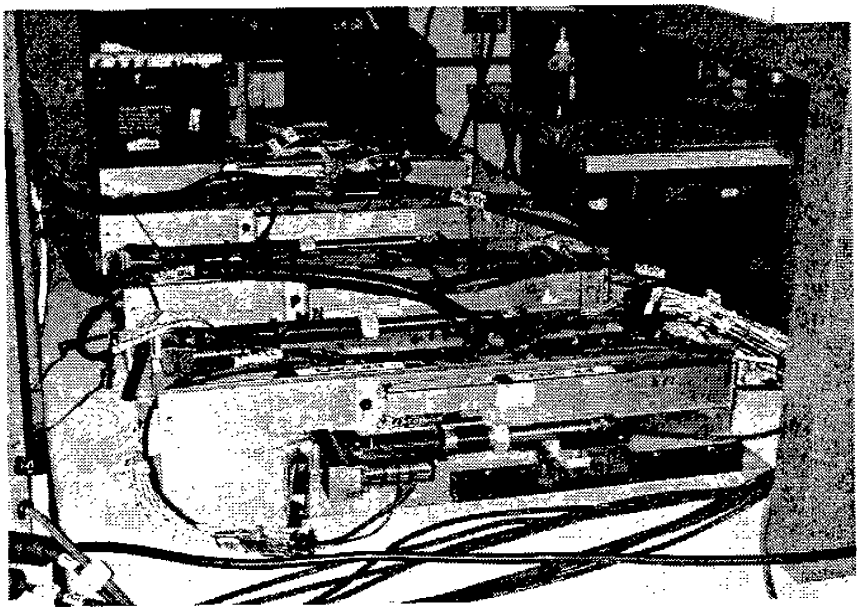
圖一：MPC 無刷馬達驅動器展示板



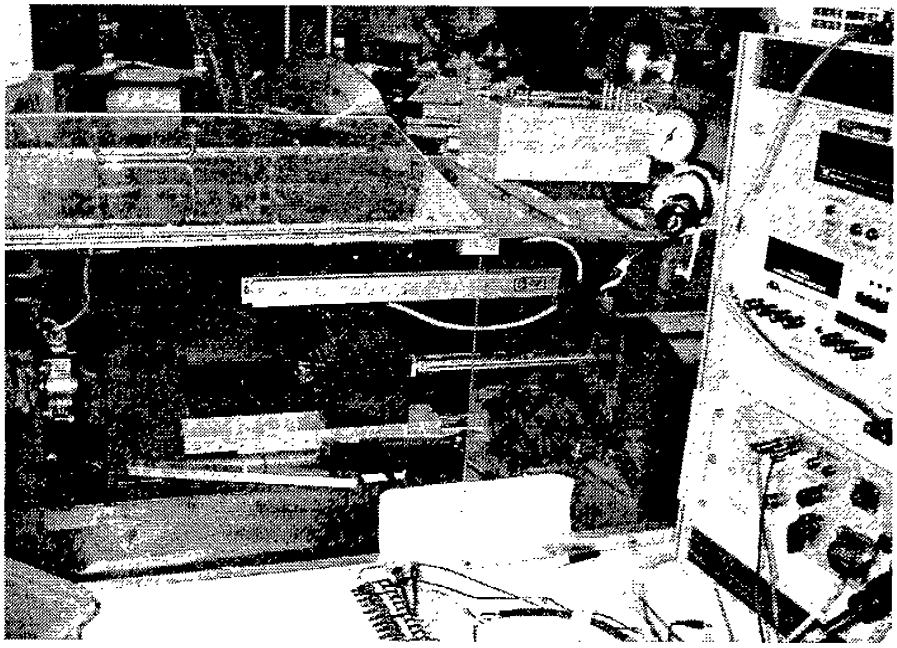
圖二：MPC 無刷馬達轉子樣品



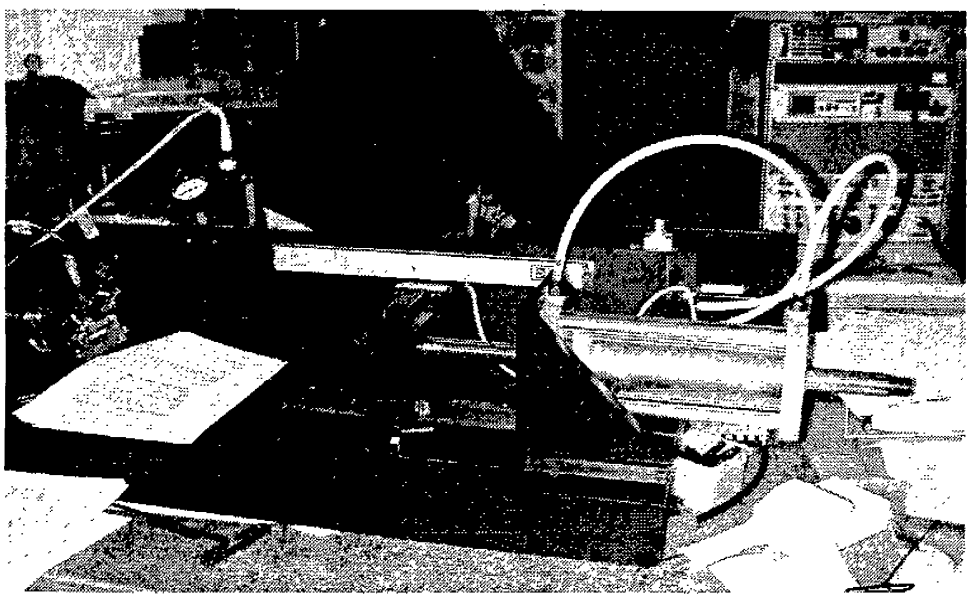
圖三：MPC 公司 高空試驗



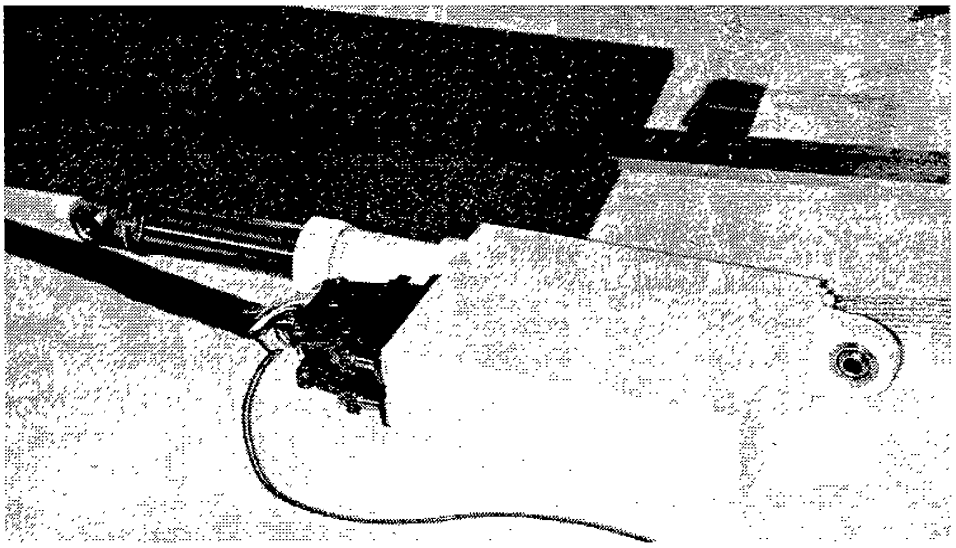
圖四：MPC 公司致動器耐久測試



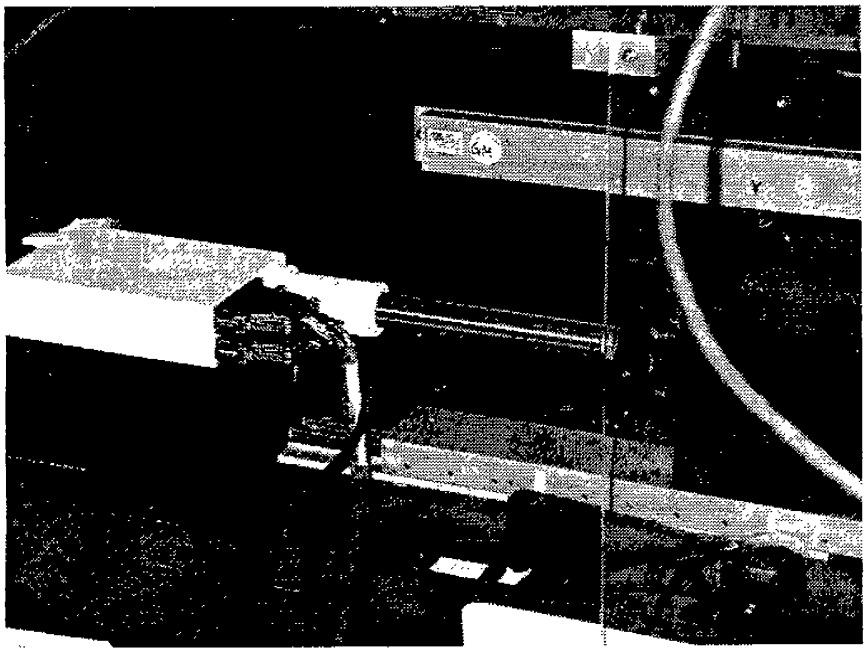
圖五：MPC 公司致動器接收檢驗測試台



圖六：MPC 公司致動器性能測試台



圖七：MPC 公司 線性致動器外觀



圖八：MPC 公司 線性致動器執行接收測試

參、效益分析

- 深入瞭解商用機線性致動器之設計概念，測試技術等關鍵技術。
- 觀摩並學習到 MPC 公司的規劃觀念，專業理念。
- 外購線性致動器價格昂貴，並且有輸出許可的問題，本次任務針對研發致動器之關鍵技術，多所助益，期能於爾後自我研發的過程中，有所助益。

肆、國外工作日程表

日期		89.12.11	89.12.12	89.12.13	89.12.14	89.12.15	89.12.16	89.12.17
行程	出發	台北	洛杉磯				芝加哥	洛杉磯
	抵達	洛杉磯	芝加哥				洛杉磯	台北
公差地點	國名		美國	美國	美國	美國		
	州省		伊利諾	伊利諾	伊利諾	伊利諾		
	城鎮		SKOKIE	SKOKIE	SKOKIE	SKOKIE		
工作項目		搭機。	轉機及廠商安排連繫&資料整理。	航空致動器藍圖、設計資料、測試程序等文件審查，及相關技術研討。（詳如次頁）	航空致動器首件檢驗（FAI）示範，含馬達、線性導螺桿與傳動機構等組件（詳如次頁）	航空致動器功能測試（ATP）實作，系統件含控制器等電子裝置。（詳如次頁）	整理參訪資料、回函及轉機準備。	返國飛行途中。
備考			夜宿芝加哥	夜宿芝加哥	夜宿芝加哥	夜宿芝加哥		

國外工作日程表（續）

日期 時間	89.12.13	89.12.14	89.12.15
08:00 ｜ 10:00	線性導螺桿組件(含滾珠螺桿與愛克姆螺桿等二型)之藍圖與設計規格審查	航空致動器系統之製造、組裝、測試程序等技術資料與指導文件審查	航空致動器零件組裝、測試、檢驗等試作示範
10:00 ｜ 12:00	直流馬達組件之藍圖與設計規格審查	驅動器與控制器之製造、組裝、測試程序及指導文件審查	驅動控制器之組件(包括底座基板、支架、界面線束與層間焊線等)接檢測試示範
13:00 ｜ 15:00	動力傳動機構(減速齒輪箱)之設計分析與技術文件研討	線性導螺桿組件之首件檢驗(FAI)示範。	馬達與傳動機構等零組件與次系統件之功能測試（ATP）見證
15:00 ｜ 17:00	馬達控制器之電路設計與PC板打樣設計等技術研討	直流馬達與減速齒輪箱組件之首件檢驗（FAI）示範。	航空致動器全系統件的功能測試（ATP）見證，含控制電子裝置在內。

伍、社交活動

本次行程過於匆促，故未安排任何社交活動。

陸、建議事項

航空級電機線性致動器是未來航空器上，執行各種控制的基本系統件，技術層次屬國內產業已可承製的單一系統件，市場需求量頗大，例如，本所進行中的計畫就有不小的需求量，應屬值得開發項目。因此，建議，納入國內航太產業發展重點項目，爭取經濟部科專經費，聯合業界、學界，共同投入本項系統件之研發任務。

柒、附件

附件一：Corporate and Technical Information of MPC

附件二：ACME 螺桿型致動器爆炸圖零件清單

附件三：滾珠螺桿型致動器爆炸圖零件清單

附件四：ACME 螺桿型致動器接收測試程序及結果

附件五：滾珠螺桿型致動器接收測試程序及結果

附件六：無刷直流馬達特性數據

附件七：印刷電路板組合圖

Corporate and Technical Information

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

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Section 1 MPC Products Corporate Information

1.1 Introduction to MPC Products

MPC Products Corporation, located in Skokie and Niles, Illinois, leads the industry in designing and producing electromechanical control components and subsystems. We are confident that we will fulfill the requirements of your program and will supply you with the highest quality hardware and program support in a cost-effective and timely manner.

MPC's operational philosophy consists of two integrated and vitally important principles:

- **Commitment to fully understanding the requirements of the task, and**
- **Commitment to fully conforming to those requirements.**

This historical commitment to building high-quality parts that fully meet customer specifications is reflected in our successful program management systems and our industry leadership.

MPC Products offers the best of both worlds. We are the right size to provide attention to detail and exemplary service, while we also maintain excellent facilities and a staff able to support all types of programs. To manage these programs, we use a system tailored to our size and your needs.

1.1.1 MPC Products Background

The history of MPC Products Corporation began in the early 1930s with G.M. Laboratories, a leading supplier of rotary components manufactured in accordance with government drawings and specifications. In 1962, with the demand growing for higher performance servo components, G.M. Laboratories established a subsidiary company, McMaster Products Corporation, to develop and market advanced high-performance servo components. In 1964, McMaster Products acquired the manufacturing division of G.M. Laboratories and became a wholly independent company with a new name: **MPC Products Corporation.**

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1.1.2 MPC's Product Lines

MPC Products has continued to develop new components and expand its line of products. We offer state-of-the-art components and systems, including the following items:

- MPC electromechanical control systems are packaged in unique configurations, utilizing standard components:
  - Multiple motors with differential systems
  - Complimentary electronics (integral or discrete, open or closed loop)

- A full line of high-performance framed and frameless control motors—AC induction, synchronous, permanent magnet brush and Brushless DC, and stepper motors—all can be supplied with complementary drive electronics.

- Flight deck products, meaning all man-machine interface components. The simplest type of controller is a control lever, which activates a position sensor(s); the other end of the spectrum is a complete pedestal assembly, including primary and secondary Flight Command Controller modules.

- Electromechanical Control Systems including:
  - Rotary Actuators
  - Harmonic Drives
  - Solar Array Drives
  - Linear Actuators
    - Acme Screw
    - Ball Screw
    - Power Screw
  - Right-Angle Drives
  - Eddy Current Dampers
  - 2- and 3-Axis Gimbal Systems

- A complete family of mechanisms, including spur and planetary gear drives which feature long life, high capacity, and low backlash, along with a variety of clutches, brakes, and detenting devices.

- Position transducers, including RVDTs, micro LVDTs, and synchros. Multi-speed, high-accuracy resolvers are also offered. Several design options are available, including clustered or tandem-redundant configurations, frame and frameless designs.

- Electronic controllers such as DC-DC converters and amplifiers. Discrete, surface-mounted, and hybrid circuit modules are offered, as well as closed-loop servo systems, with analog or digital interfaces.

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Corporate and Technical Information

MPC is proud of the numerous applications of its products throughout the space, defense, and commercial aerospace industries. The list below provides a brief summary of a few of the varied applications which include MPC's hardware.

- **Space**
  - Orbus 21 Booster
  - IRIDIUM Satellite
  - P91 ARGOS Satellite
  - Mars Observer
  - Hubble
  - Solar Array Drives
  - Space Shuttle
  - Solar Observatory Satellite
  - Space Station
  - X-38 Crew Return Vehicle
  - X-33 X-34

- **Missiles**
  - IR/Radar/Fire Control/Target Acquisition
    ASQ-17 (Towed Array for Sub. Detection)
    C-NITE System IR
    Harpoon Missile
    JAVELIN Missile
    LANTIRN
    LONGBOW Fire Control Radar
    MMS - Mass-Mounted Sight
    Standard Missile
    TADS/PNVS
  - Flight Control
    GATS/GAM Tail Cone Assembly
    SLAT Missile
    THAAD Missile

- **Unmanned Air Vehicles and Drones**
  - BQM-34 Firebee
  - Cypher
  - Tier II+ Global Hawk
  - Tier III- DarkStar

- **Military Rotary Wing**
  - Apache AH-64
  - Comanche RAH-66
  - Osprey V-22
  - Seahawk SH-60A

- **Military Fixed Wing**
  - Attack Aircraft
    AV-8B F-111B
  - Bombers
    B-1B B-2
  - Cargo
    C-5B C-130
  - Fighters
    F-14 F-18
    F-16 F-22
  - Trainers
    JPATS T-45

- **Commercial**
  - Commercial Fixed Wing
    A300, A330, A340
    717, 737, 747, 757, 767, 777
    Canadair Regional Jet, RJ-700
    DC-9, MD-90, MD-11
    de Havilland Dash 8
    Fokker 100
    Galaxy
    Global Express
    Gulfstream IV and V
    Learjet Model 45 and 60
  - Commercial Rotary Wing
    B214ST MD-900
  - Commercial Tilt Wing
    BA609

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1.1.3 Employee Relations

As with any successful company, our people make the difference. MPC Products Corporation enjoys excellent employee relations between management and labor. The company has liberal medical insurance, life insurance, and incentive plans provided at no cost to employees. An activities committee encourages participation by employees in company-wide social and recreational events.

Company employees are represented by the MPC Employee Representative Union, a local union that is sanctioned by the U.S. Labor Board. MPC has never experienced a strike, slowdown, or work stoppage throughout its history. We are confident of continued good relations with all of our employees.

MPC's current four-year union contract expires September 14, 2001.

The following chart indicates the present number of employees in each major area.

Functional Area	Number
Engineering	211
Manufacturing	274
Quality Assurance	15
1) Inspection	21
2) Test	30
Other (Product support, administration, sales)	182
Total	**733**

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1.2 MPC's Commitment to Quality

MPC Products Corporation has been a supplier of high-quality hardware for military and commercial aerospace applications for 35 years. Our reputation has been established by time-proven methods of sound design and effective manufacturing practices.

Our traditional company commitment to quality has been reinforced by all corporate officers and management personnel having attended various quality-oriented seminars and training classes. These activities have included the Phil Crosby "Quality College" as well as Advanced Quality System (AQS) training and Total Quality Management (TQM) programs. These training sessions included significant instruction in Statistical Process Control and Evaluation techniques. MPC has embraced the DoD Total Quality Management concepts to ensure production and delivery of high-quality, reliable products that work. MPC Products produces hardware in compliance with Boeing D-1-9000, MIL-Q-9858, MIL-STD-45662, MIL-I-45208, MIL-STD-2000, Federal Aviation Regulation 21.303, and microelectronics certified to MIL-H-38534/MIL-STD-1772. ***In addition, MPC is certified for compliance to ISO 9001 quality procedures.***

MPC has a committed and experienced team for quality management, beginning with the company president, as shown in **Figure 1-1** on the next page. The quality director reports directly to the president.

Table 1-2, on page 7 on Section 1, highlights the various quality and military standards that MPC complies with in its operations. Following Table 1-2 is **Table 1-3**, which provides a partial list of the companies and/or agencies that have surveyed and approved MPC's present quality control system.

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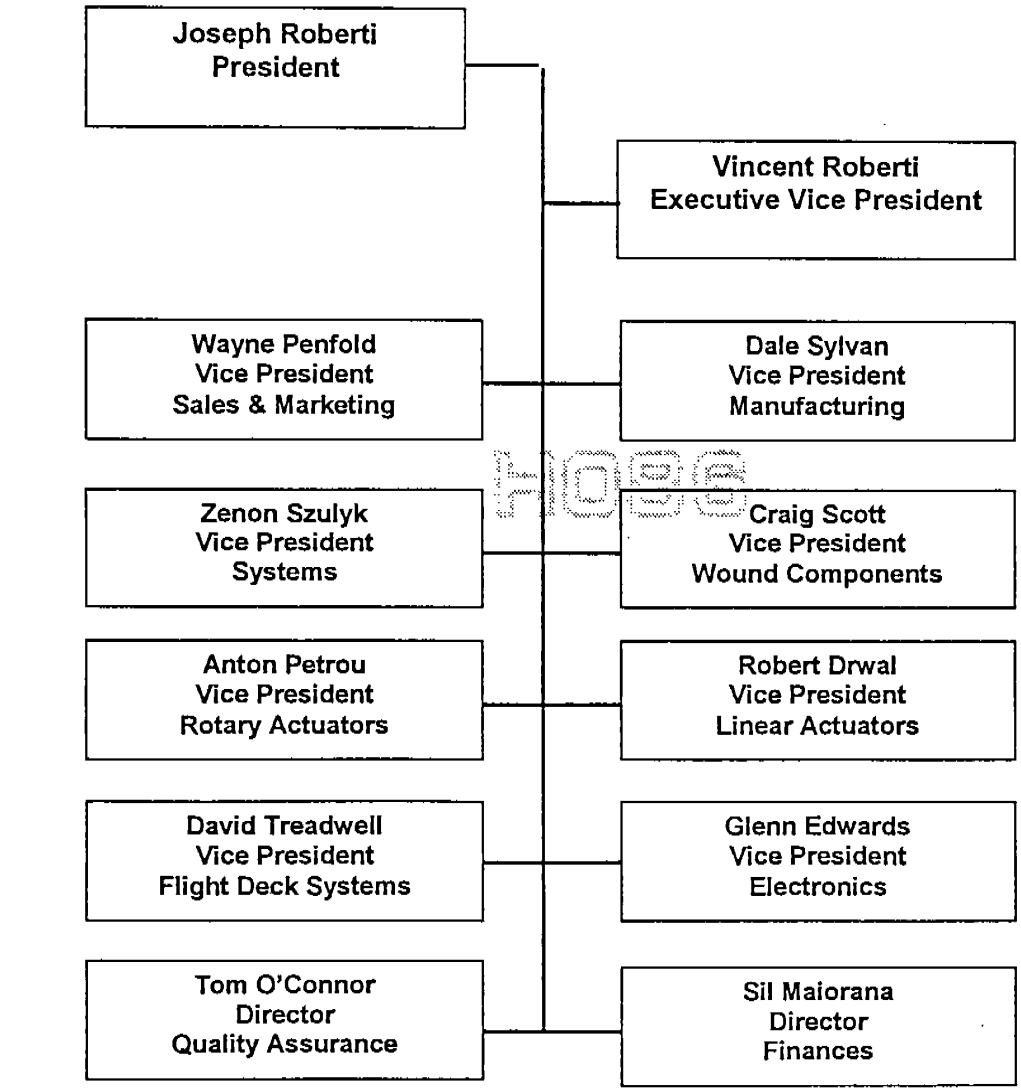

Figure 1-1 MPC's corporate organization chart shows top-level management involvement with programs, and independent reporting for quality matters.

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Major Functional Activity	Compliance Standard
Quality	
•Quality/Inspection System	**ISO 9001**, MIL-Q-9858, MIL-I-45208
•Instrument Calibration	MIL-STD-45662A
•Solder Systems	MIL-STD-2000, NASA NHB 5300.4
•Microelectronics Manufacturing	MIL-STD-1772, MIL-H-38534
Reliability	
•Reliability Programs	MIL-STD-785
•Failure Modes, Effects, and Criticality Analysis	MIL-STD-1629
•Failure Reporting, Analysis, and Corrective Action System	MIL-STD-785
•Reliability Design Qualifications and Production Acceptance	MIL-STD-781
•Reliability Acceptance Testing	MIL-STD-810
•Reliability Predictions	MIL-HDBK-217
•Reliability Definitions	MIL-HDBK-721
Configuration Management	
•Drawings	DoD-D-1000, DoD-STD-100
•Configuration Management	MIL-STD-973
•Changes, Deviations, and Waivers	MIL-STD-973
Program Management	
•Technical Reviews and Audits	MIL-STD-1521
Product Support	
•Maintainability	MIL-STD-470
•Overhaul Facility	Federal Aviation Regulation 21.303
Product Assurance	MIL-STD-750, MIL-STD-202
•Semiconductor Screening	MIL-STD-785, MIL-STD-965
•Parts Control	MIL-Q-9858, MIL-STD-1520
•Quality Program	DoD-STD-1679, MIL-STD-1535, MIL-I-45208, MIL-S-52779, Boeing D-1-8000
•***Advanced Quality System (AQS)***	***D-1-9000***
Design Engineering	
•Selection and Application of Electronics	MIL-E-5400

Table 1-2 MPC's Compliance To Quality Control and Military Standards

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

Company/Agency	Applicable Standards	Review Date
Allied Signal	MIL-Q-9858, MIL-I-45208	October 1995
Bell Aerospace	MIL-Q-9858	March 1991
Boeing - Washington	D-1-8000, D-1-9000	May 1996
Boeing - Vertol	D-1-8000	June 1992
British Aerospace	BAe/AG/QC/SCI	March 1996
Chandler Evans	MIL-I-45208	October 1993
Cubic Defense Systems	MIL-Q-9858	September 1996
DCMAO-Chicago Quality System Review (QSR) Audit	MIL-Q-9858	January 1993
Federal Aviation Admin.	Certified MMF 332-04	April 1993
FMC Corp.	MIL-I-45208	July 1993
Fokker-B.V.	ED-14A/DO160A	February 1989
Garrett - Phoenix	MIL-I-45208	August 1992
General Dynamics	MIL-I-45208	February 1992
General Electric, Evendale, OH	S-1000	March 1993
Grumman	MIL-Q-9858	January 1992
Hamilton Standard	MIL-I-45208, NBH5800	August 1996
Hughes	MIL-I-45208	October 1993
Litton-Canada	MIL-I-45208	April 1993
Lockheed / Martin	MIL-Q-9858, MIL-I-45208	August 1996
McDonnell Douglas	MIL-Q-9858	June 1991
McDonnell Douglas Helicopter Co.	MIL-Q-9858	August 1992
Northrop	MIL-I-45208	February 1996
Parker Hannafin	MIL-I-45208	March 1996
Rolls-Royce PLC	CQC 103, Issue 4	May 1991
SAAB-SCANIA	MIL-Q-9858, 80-P-7.6E	October 1996
Sterer (Vickers)	MIL-I-45208, MIL-STD-1535	June 1992
Sundstrand	MIL-I-45208	November 1993
Texas Instruments	MIL-Q-9858	June 1993
Textron Defense Systems	MIL-I-45208, MIL-STD-1686, DoD-HDBK-263	July 1996
Westinghouse	MIL-I-45208	February 1991
Woodward Governor	MIL-I-45208	June 1993

Table 1-3 MPC's Quality Control System: Surveyed and Approved by Companies and/or US Government Agencies

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1.2.1 Advanced Quality System: Statistical Process Control

In a constant effort to reduce "**cycle time**" and to stay on the leading edge of quality improvement, MPC has established a plant-wide system of **Statistical Process Control (SPC)**. We have a solid foundation, due to the corporate-wide training and implementation of Philip Crosby's approach to the fundamentals of quality improvement. SPC builds on this foundation.

The first step in incorporating SPC was for MPC's top management to pledge its support to Advanced Quality System (AQS); this commitment has been made and a statement of that commitment was formulated. Following a corporate-wide dedication to the practice of SPC, an implementation team was formed, and an implementation procedure was established. MPC document number 999-5903-380, **Advanced Quality System Procedure for MPC Products Corporation** (dated 7/31/98) is available for your review.

A comprehensive SPC education effort is underway. All managers, directors, and some strategic MPC suppliers have attended a two-day seminar which presented the fundamentals of SPC and its applications. We have also started in-house education for manufacturing personnel; operators are being educated on data collection, presentation, and interpretation.

MPC has been working with many of its customers in identifying "key" or dominant characteristics. The principles of SPC are applied to each characteristic when that product enters production.

As a parallel effort to the key characteristics effort, we are looking at processes that we know are causing problems in our production flow. Through the application of SPC tools, we have been very successful at identifying and improving some of the processes that are common to the manufacture of many of our products.

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1.3 MPC Facilities

As previously discussed, MPC Products Corporation is a fully integrated engineering and manufacturing company capable of performing full-scale design and development work in addition to follow-on production and manufacturing of its own components.

Our facilities are housed in seven modern buildings, all within a five-minute walking distance of each other, in a technology corridor located in the near-north suburbs of Chicago. The seven plants have undergone extensive remodeling and expansion in recent years. MPC's plants provide facilities for research, engineering, manufacturing, final assembly, environmental testing, product support, administration, and marketing. MPC's facilities total 337,000 sq. feet.

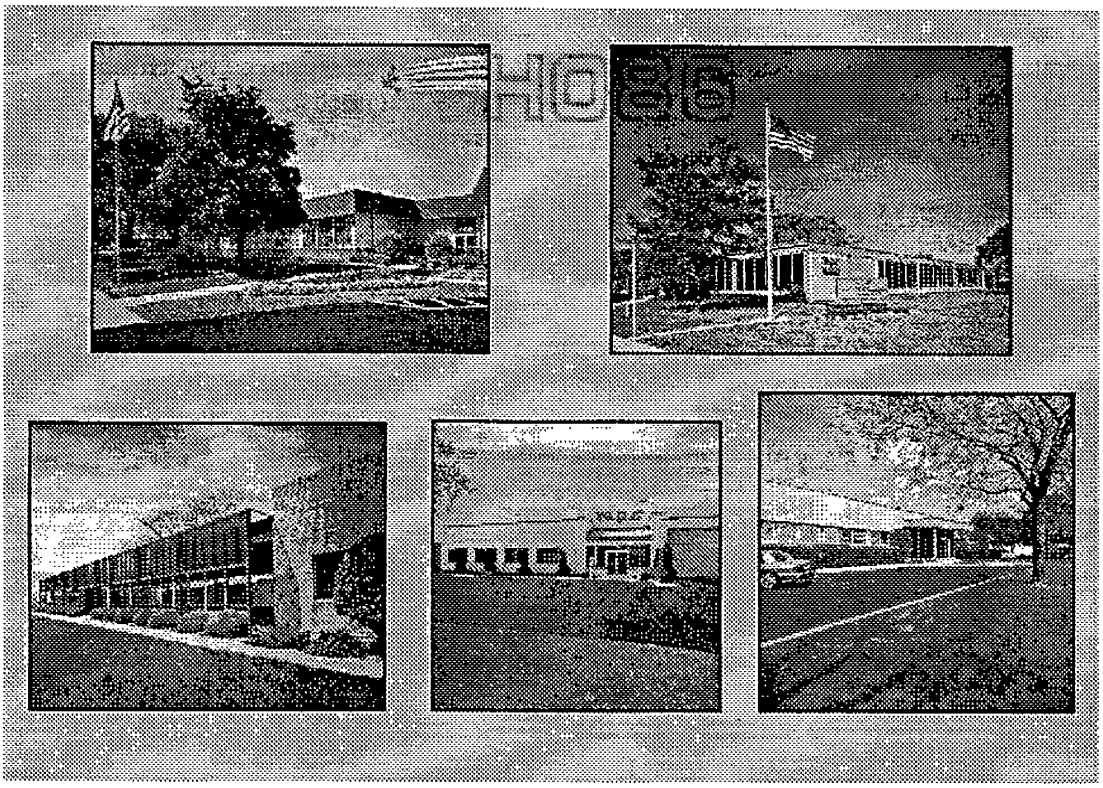

Figure 1-4 **MPC's plants provide facilities for research, engineering, manufacturing, final assembly, environmental testing, product support, administration, and marketing.**

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Corporate and Technical Information

Our testing facilities are well-equipped to handle a majority of our customers' program testing requirements. The following is a list of outside test facilities that MPC occasionally uses to conduct portions of test programs; these facilities are proven vendors who routinely support MPC testing efforts. All of these vendors have been accepted by MPC's customers and prime contractors, including the U.S. Government and commercial aviation buyers.

Proven Vendors Who Routinely Support MPC Testing Programs

- Dayton T. Brown
  Church Street
  Bohemia, NY 11716
- DLS Electronic Systems
  10350 Dearlove Road
  Glenview, IL 60025
- Dynamic Controls, Inc.
  7060 Cliffwood Place
  Dayton, OH 45424
- Elite Electronic Engineering Co.
  1516 Centre Circle
  Downers Grove, IL 60515
- Environ Laboratories
  9725 Girard Ave.
  Minneapolis, MN 55431
- Gaynes Testing Labs.
  1642-52 W. Fulton St.
  Chicago, IL 60612
- Magnetic Inspection Labs
  1401 Greenleaf Ave.
  Elk Grove Village, IL 60007
- Radiometrics Midwest
  2200 S. Main St.
  Lombard, IL 60148
- Trace Laboratories
  4611 N. Olcott St.
  Chicago, IL 60656
- Wyle Laboratories
  7800 Governors Dr. West
  Huntsville, AL 35807

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1.3.1 MPC's Computer-Aided Engineering (CAE) Facilities and Capabilities

MPC has very comprehensive computer-aided engineering (CAE) facilities and equipment. The highlight of our CAE is our ability to conduct basic and in-depth product analyses. MPC uses ANSYS 5.5 software run on an Intergraph TDZ-410 Workstation which is comprised of dual 200 MHz Pentium Pro processors, 512 MB RAM, 11 GB hard drive, and an Intense 3D Graphics Accelerator Card. This equipment is capable of complex vibration analysis (random and sine), linear and non-linear stress analysis, steady-state and transient-heat transfer with radiation and convection effects, and magnetism analysis. All of MPC's workstation hardware is maintained and upgraded on a regular basis to ensure peak efficiency and minimum down time. All software is upgraded to the latest version, as it becomes available. MPC's workstation configurations range from 133 MHz processors, 64 MB RAM, and 4.3 GB hard drives to 500 MHz processors, 1 GB RAM, and 10 GB hard drives. A majority of MPC's workstations have 200 MHz processors, 128 MB RAM, and 4.3 GB hard drives. A list of our computer equipment is listed below as **Table 1-5**. MPC is EDI capable.

Equipment Description	Quantity
Hardware	
Intergraph TDZ-410 Workstation	1
Desktop Workstations	472
Macintosh Computers	3
Software	
Manufacturing/Statistical Process Control (SPC) Software	
GageTalker SPC software	
SmartCAM manufacturing software	
Engineering Software	
AutoCAD	
ANSYS:	
• Linear Plus	
• Mechanical	
• MultiPhysics	
Mechanical Desktop	
Design Space	
SDRC-IDEAS	
Cypress Warp2 Design Tools	
MathCAD	
OrCAD/ PSPICE	
Visual SPC	
CimWorks DNC	
Magneto	
Relex	
MatLAB	
MPC Gear Analysis Programs	
• Mesh	
• Life	
• Error	

Table 1-5 MPC's Computer-Aided Engineering Equipment

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1.3.2 Plant Availability and Capacity

MPC is confident that all of the human resources necessary to perform the subcontract effort for this program are now present at MPC. MPC has been providing hardware to the aerospace industry for over 35 years. This system will be designed and produced using MPC's modular configuration. All of these components are designed, manufactured, and tested here at MPC, using basic building-block inventory, proven materials, and established manufacturing techniques.

Therefore, all of the management, staff, and technically skilled people are currently in place. MPC does not foresee a need for any additional personnel being required for this effort. All of the people involved in this proposal will have a role in the program.

MPC typically ships over 25,000 units to 300 customers per year—representing more than 100 programs. During this subcontract effort, many other programs will be underway. There will be no influence from other programs which would cause any negative effect on this program. This subcontract will not require an exclusive effort from any program team member, with the exception of the program coordinator in certain situations. Due to the design (which includes MPC standard items) and the extremely low associated risk, it is not anticipated that there will be any major problems. If there are any problems, the entire manpower resources and talent of the company will be available to solve them. Constant monitoring by MPC's technical director/vice president for the product line(s) and the program coordinator will ensure that the required attention is given to any potential problem.

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1.4 Achieving Quality, Value, and Delivery Through Total In-House Capabilities

Our mission is to supply products that best satisfy our customer's needs in terms of performance, reliability, price, and delivery. To routinely meet these objectives, MPC has established totally integrated, in-house capabilities to design, develop, and produce the products we supply.

To meet customer needs for the highest available performance, MPC has developed proprietary lines of the following products that represent the state-of-the-art in electromechanical motion control:

- **motors** (AC synchronous and control motors, DC and Brushless DC permanent magnet motors);
- **sensors** (rotary and linear position and velocity);
- **gearing** (spur, planetary, right angle, and linear screw modules);
- **amplifiers and control electronics** (discrete, surface mounted, and hybrids);
- **brakes and tachometers** (AC, DC, brush, brushless, and PM alternator).

MPC modules provide the highest torques and power densities, and highest accuracies at the lowest weights available in the industry.

In terms of reliability, MPC modules have been proven in numerous applications to yield unsurpassed reliability and life. The designs of our components, selections of materials, and methods of manufacture have been developed to assure uncompromising reliability in service under the most demanding conditions.

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Corporate and Technical Information

Each new item that we supply is unique in that it must comply with the particular requirements of the development specification. However, for most items that consist of several components, we are able to combine our existing product modules into a configured assembly that meets form, fit, and functional requirements. Through the use of our own products as components, we control design and manufacturing quality so that we are confident in the integrity of the end item. Often, only minor modifications to our proven modules and a minimum of original design are involved in producing a new end item. In most cases, technical and producibility risks in meeting the specification are thereby reduced to low levels.

All critical operations entailed in manufacturing the item are performed at MPC. To perform these operations, MPC purchases basic materials—electronic piece parts, steel stock, bearings, wire and other items—from qualified sources. Our suppliers have been cultivated to provide dependable quality and delivery of materials. MPC then strictly controls fabrication, processing, and subassembly of all components and final assembly of the end item—all within its own facilities.

MPC's plants in suburban Chicago have complete manufacturing capabilities for components and end items including wound and permanent magnet motors and velocity and position sensors. Machining operations, heat treating, and welding for motors and sensors, and all gear manufacturing (e.g., hobbing and shaping) are carried out within our completely equipped shops. Also, manufacturing and assembly of hybrid electronics circuits and soldering of discrete circuits (in accordance with the most demanding weapons specifications) are performed in our plants.

Our in-house manufacture of standard, modular components also supports the objectives of low price and dependable, quicker deliveries. Through optimum economical use of standard motors, gear modules, sensors, and electronics, virtually every item we supply benefits from the economics of standardization. Procurement and production costs are reduced, which results in lower unit prices. In addition, availability and confidence in common inventory parts are high. Design, procurement, and quality risks to the schedule are reduced to a lowest achievable level because we do not have to depend on outside suppliers to design or supply critical subassemblies that may jeopardize the schedule.

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Section 2 Technical Information

2.1 Technical Executive Summary

✈ Technical Challenges

Our proposal objective was to design an actuation system that not only met ASRD's requirements, but also exhibited a high level of reliability while minimizing weight, cost, and program risk. We feel that we have achieved our goals with these linear actuator design approaches. The remainder of this summary highlights the key elements of our designs for the Flight Control Actuators.

✈ Standardization and Modular Design

MPC has utilized a modular concept by incorporating standard power drive and transmission modules which are identical or similar to the following applications:

- MPC P/Ns 2A8206, 2A8207, 2A8208, 2A8209, and 2A8210, Raytheon, Premier I Flap Actuators
- MPC P/N 2B7206, Lucas, IPTN N250 Q Feel Actuators
- MPC P/N 2B5-202, Zeppelin, Prop Pitch Actuators
- MPC P/Ns 2A4204 and 2A4-205, McDonnell, MD-11, Aileron Deflection Actuators

✈ Make/Buy Plan

Approximately 97% of the basic piece parts will be taken from MPC stock to support the aggressive nature of the first delivery. The balance of the parts will be fabricated within MPC's in-house machine shops. MPC does have the facilities to produce 90-95% of the parts, if required. The only parts outside our capability are industry-standard commodities such as bearings, diodes, resistors, lead wire, connectors, etc.

MPC has drawn from existing production hardware to create a design that maintains a high degree of commonality for MPC — ultimately keeping both recurring and non-recurring costs down.

✈ Environmental Testing

MPC has the in-house capability to perform virtually all types of temperature and vibration testing. Although we currently do not see the need in this effort to utilize this facility, as the program progresses some additional testing might become necessary for certification.

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Corporate and Technical Information

- **Staffing/Analysis**
  Each of the components utilized in our design approach presents very low design risk since the components have been utilized in many qualified actuation systems in the past. However, should any problems and/or design challenges arise, MPC has sufficient engineering and manufacturing manpower as well as the appropriate design software (e.g., AutoCAD, Mechanical Desktop, Inventor, Mathcad, Matlab-Similink, ANSYS, Ideas) to ensure that an accurate, timely solution will be achieved.

- **Manufacturing Capacity**
  No additional manpower and/or manufacturing equipment will be required to produce the quantity c actuation systems being discussed for this Program. However, the timeframe for the delivery of th initial development hardware necessitates a contract award as soon as possible, so there is sufficient time to finalize the design and fabricate the necessary hardware.

- **Cost-Reduction Methods**
  MPC incorporates several methods for providing cost-effective designs for its customers. Design for Manufacture and Assembly (DFMA) techniques are employed to reduce the parts counts as much as possible. In addition, MPC utilizes many standard parts and modules within its designs s that the maximum number of quantity price breaks can be obtained, even on lower-quantity orders. In addition, our commonality approach allows us to reduce the development costs typically associated with custom system designs.

- **Risk-Reduction Methods**
  MPC incorporates several methods and philosophies designed to reduce program risk for its customers. Some key aspects of our risk-reduction techniques include:

  - Use of field proven modules wherever possible
  - Employing diverse engineering design teams with a wealth of differentiated experience
  - Implementation of internal design critique meetings
  - In-house ability to manufacture 95% of the components reduces delivery risk
  - Utilizing solid modeling and finite element analysis tools to electronically prove out the design
  - The use of system modeling tools for design substantiation

MPC is proud of its extensive capability and has exhibited an exceptionally high level of support throughout the years on all of its commercial and military applications. We hope that our past efforts demonstrate our corporate commitment to excellence.

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2.2 Related Experience

MPC has included Sales Drawings for the following similar applications in **Appendix A.**

- Predator B Aileron and Tail Actuators, General Atomics
  MPC P/Ns 2B7214 through 2B7218

- Predator B Flaps Actuators, General Atomics
  MPC P/Ns 2A7208 & 2A7208

- Premier I Flaps Actuation System, Raytheon Aircraft
  MPC P/Ns E6D207, 2A8206A through 2A8210A

- MD-11 Aileron Deflection Actuators, Honeywell
  MPC P/Ns 2A4204A and 2A4205A

- Propeller Pitch, Zeppelin
  MPC P/N 2B5202A

- F-18 Aileron Actuator NASA, Navy, Air Force
  MPC P/N 2B7204A

- IPTN N250 "Q" Feel Actuator, Lucas Aerospace
  MPC P/N 2B7206A

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2.3 Technical Requirements

This section presents MPC's technical approach regarding the design, development, and implementation of linear electromechanical actuators (EMA). MPC uses a modular approach in the design of actuators. This modular concept will allow this EMA to have similar components to previously tested and qualified hardware, thus reducing cost, development time, and risk.

This actuator will consist of an MPC-standard Brushless DC (BDC) motor with associated field director commutation sensors and tachometer driving a 3/8-8 ball screw is driven via a 14.8:1 ratio. Integral anti-rotation within the screw module results in the required linear movement. The amount of linear travel provided by the screw module is restricted by the internal mechanical hard stops. A single-channel resolver will be used in this actuator; this is a brushless sensing device with a high level of reliability and an extremely low failure rate.

MPC believes that this design approach offers minimum weight, low cost, high reliability, and reduced risk based on the commonality of the actuator to existing MPC products.

2.4 MPC's Sales Drawings

MPC's Sales Drawing have been provided in **Appendix A.**

Our drawing is comprised of the following:

- Sheet #1 reflects the space claim of the actuator
- Sheet #2 represents the top-level architecture and a basic performance graph

In the event that these space claims are not adequate, MPC is willing to work jointly with the ASRD team to achieve a mutually acceptable space claim.

2.4.1 Performance Graph

We have included a performance graph on the second sheet of the proposal drawing. This graph shows the capability of the motor to provide speed and torque well beyond the load and rate requirements for this program. The motor has been sized to provide ample open-loop headroom above the closed-position-loop performance requirements, and it is functional at the extreme requirements of the MIL-STD-704 power specification.

The two vertical axes on the left of the graph show the open-loop speed of the motor and the corresponding axial ram speed. The open-loop speed of the linear actuator is directly

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proportional to the speed of the motor, and depends on the power train gear ratio and the lead of the acme (ball)-screw assembly.

The two horizontal axes shown on the graph portray the load performance of the motor and linear actuator. These axes are also directly dependent upon the gear ratio and lead of the screw assembly. Also included in the calculations are mechanical inefficiencies, which reduce the theoretical capability of the system. These inefficiencies include friction in the actuator's gear train support bearings and screw assembly. Based upon previous experience, MPC knows the average actuator efficiency is 75% for the ball screw version. This efficiency is based upon practical experience with this frame size and screw configuration and correlates quite nicely with past test data.

The "SPEED" line on the graph represents the maximum open-loop performance of the motor for the specified voltage. As with all DC motors, this speed linearly decreases as applied load increases; thus, this line is sloped downward. In this particular case, we have wound the motor to approach a horizontal speed, as opposed to a DCR-limited approach. This technique offers maximum closed-loop headroom. The operating region of the motor can be thought of as the area under the open-loop "SPEED" line.

The vertical axis on the right-hand side of the graph plots current draw in amperes. The upward sloping line on the graph represents current draw of the motor. This current draw is directly proportional to the amount of torque that the motor will produce.

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2.5 EMA Component Descriptions

2.5.1 Linear Module Description

MPC's linear module is comprised of:

- An ball (ACME) screw assembly
- A statically sealed ball (ACME)-screw support system
- An anti-rotation guide for the dynamically sealed translating output shaft
- The interface to the power-transmission gearbox
- Environmental enclosure

2.5.1.1 Ball Screw/Nut

MPC's ball screw assembly consists of a 0.375-inch-diameter acme screw with a .125-inch-per-turn lead. The ball screw rotates and the ball nut is prevented from rotating, thereby causing translation. Thrust compression and tension loads are reacted by high-capacity stainless steel thrust-roller bearings. Radial loads (separating forces) caused by the gear mesh are reacted by high-quality ABEC 5 stainless steel ball bearings for volume minimization and high design margin.

The drive screw and ball nut are manufactured from materials that are thermally matched, which eliminates the concerns regarding screw wedging at the temperature extremes. From experience, this combination of materials also offers exceptional life and wear characteristics. MPC continually conducts a full array of acme- and ball-screw life testing. We are always researching the best materials and lubricants for specific applications.

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2.5.1.2 Anti-Rotation

The ball nut is prevented from rotating by the linear housing and, therefore, translates along the screw length. The linear housing prevents ball-nut rotation through the use of mating internal and external hexagons.

The anti-rotation housing is constructed from high-strength 6061-T651 or 7075-T651 aluminum, in order to minimize weight. Areas of the housing that have the potential for wear are synergistically coated using a traditional hardcoat anodize.

The ball nut is then coated with Nedox™ SF-2. This synergistic coating offers the following key advantages:

- The coating offers high hardness (R_c 70), which is excellent for abrasion resistance.
- The equilibrium wear rate is 24.5 times less than that of traditional heat-treated electroless nickel. Traditional electroless nickel wears at a rate of 73.5 mg every 10,000 cycles using a Tabor-abrasion method, CS-10 Wheel, 1,000 gm load. Nedox™ SF-2 wears at only 3 mg given the same test criteria.
- The coating does not chip or flake due to the process. The coating transforms the surface of the material and becomes part of the base metal.
- The coating provides a secondary boundary layer of lubrication. Basically, the coating levels off surface asperities with a polymer, hence drastically reducing surface tension and increasing permanent lubricity. Therefore, over time, as the boundary layer of liquid lubrication begins to break down, the additional benefits of the solid secondary boundary layer are realized.
- Lastly, the fluorocarbon-impregnated surface is hydrophobic — meaning that it resists wetting, primarily due to the low surface tension. Hence, in the event of a breached seal, this property reduces the effect of moisture accumulation at the screw/nut interface.

The coating of the Nedox™ SF-2 on the external housing, coupled with the TUFRAM™ L-4 on the acme nut, provides maximum surface protection at the sliding interface. This, coupled with the impregnated polymer, produces a coefficient of friction of .06. The low coefficient of friction has proven itself to increase life and improve efficiency.

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2.5.1.3 Dynamic Sealing

The ball nut is mechanically attached to a stainless steel output ram that translates and provides the required motion at the output. Special care is taken during the fabrication of the output ram to ensure survivability in adverse environments. The ram itself is constructed out of 17-4PH or 15-5PH stainless steel, condition H1150, which has superior corrosion-protection properties. Then, the smooth outer cylinder of the ram is coated with thin dense chrome. This provides the following functions:

- The chrome provides an excellent sealing surface for the actuator's internal spring-energized dynamic seals. The seal jackets are comprised of 85% Virgin Teflon and 15% Graphite. The springs are made of corrosion-resistant steel.
- It provides an excellent wear surface for the nickel-aluminum-bronze outboard support bushing which guides the ram.
- It provides an exceptionally hard surface (R_c 70) for abrasion resistance during routine maintenance activities on the aircraft.

Lastly, the shaft is lapped and polished to a maximum of 16 microfinish to provide for maximum seal integrity and life. This sealing arrangement is common for MPC and has been utilized on the vast majority of MPC's actuators. It has proven the test of time in many adverse environments and has performed well on all of MPC's commercial and military applications.

2.5.1.4 Static Sealing

The actuator incorporates significant environmental protection that is essential to success in this application. To that end, either Flourosilicone O-rings and/or Polysulfide sealant will protect all static interfaces. We selected flourosilicone due to a wide operating temperature range (-55°C to +150°C) as well as exceptionally good chemical resistance. Polysulfide has been selected due to its long service history in adverse environmental applications; it has performed exceptionally well in applications where the sealing surface is small, static, and unloaded.

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2.5.1.5 Lubrication

MPC has selected Braycote 601 as the lubricant for this application. Our reasons for selecting this lubricant are twofold:

- The lubricant has acceptable cold-temperature performance capabilities. There is a slight change in the viscosity of this lubricant at cold temperature; however, it operates well down to -55°C. This is important in this application due to the relatively low power requirement. A substantial viscosity change could make the system seem sluggish.

- This lubricant can be used for all the gears, bearings, and ball screw and nut. The chemical composition of the lubricant is also compatible with both the static and dynamic sealing elements. Hence, the O-rings will not swell or break down from coming in contact with the lubricant.

HOBB

2.5.2 Power-Transmission Gearbox Description

The power-transmission gearbox houses the interface between the linear module and the Brushless DC motor, as well as the resolver. The overall gear ratio between the motor and the linear module is 14.8:1. The overall ratio between the ball screw and the resolver is 1:174.07.

2.5.2.1 Spur Gearing

All hobbed gears used in the transmission box are AGMA Quality 12 and are hobbed at our facility to precision gear data. All gears that require shaping in the gearbox are AGMA Quality 10 and are shaped at our facility. The gears are 100% inspected in-house to ensure consistent and accurate gearing throughout our product lines. All bearings used in this box are ABEC Class 5 bearings or higher, providing uncompromised life and performance for the transmission box. High-quality gears and bearings, coupled with precision jig-boring of the gearbox, ensure accurate gear center distances which, in turn, provide the module with tight backlash control. All loaded gears are made of high-quality stainless steel and case-hardened to a Rockwell "C" of 60 minimum. The gearbox itself is made of high-quality aluminum (7075 or 6061) in order to minimize actuator weight.

All gearing located in the position feedback path also utilizes the same high-quality gears and bearings previously mentioned. Additionally, anti-backlash gearing is used to minimize position feedback errors.

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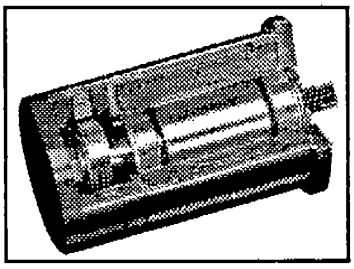
2.5.3 MPC's Power Drive Module



2.5.3.1 Motor Selection

The motor chosen for this application is a standard MPC Brushless DC motor with field director commutation. The following paragraphs provide a description of this standard MPC Brushless DC (BDC) motor. Please note that all the commutation and control logic functions are integral to the controller electronics system.

MPC has approached the preliminary design from a conservative perspective. This architecture and motor have been used successfully on numerous applications and have qualified to stringent commercial transport and military requirements.

2.5.3.2 Brushless DC Motor Description

The motor assembly consists of a permanent magnet rotor concentrically mounted within a wound-field stator. The housing and other related steel parts of the MPC BDC motor will be constructed of the same series, corrosion-resistant stainless steel in order to match coefficients of thermal expansion. The stator is a laminated magnetic structure wound with polyimide-insulated magnet wire used in conjunction with high-performance films and sheet insulators between the structure and each isolated phase.

The rotor is a four-pole, samarium cobalt 2-17, 28 MgOe permanent magnet assembly contained by a continuous stainless steel sleeve as secondary retention for greater reliability and ruggedness. High accelerations are achieved from the high-torque-to-low-inertia ratio resulting from the mechanical arrangement of wound stator and permanent magnet rotor.

Initial alignment during assembly relates the mechanical position of the motor stator to the commutation sensor.

Design Considerations

Use of the most efficient motor design minimizes power loss for a given torque output. The remaining necessary power loss must be transferred out of the motor with a minimum internal temperature rise. Various design techniques are utilized to minimize thermal gradients, including choice of materials and the geometric proportions of heat paths. The magnetic materials in this motor are used substantially below their rated temperature.

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High-temperature operation severely tests the integrity of the design, materials, and processes that comprise a finished motor. In the design stages, thermally induced stresses and strains are evaluated to guarantee freedom from racking, binding, and parts shifting. The effects of electrochemical decomposition are most severe at high temperatures. The use of appropriate materials minimizes these effects. Controls on incoming and in-process materials assure conformity to rigid design specifications. Thorough testing is conducted on prototype and production units to demonstrate conformity to design requirements.

It should be noted that the design and materials utilized in these motors are standard on MPC's entire line of sophisticated control components and, therefore, do not represent an unproven or radical departure from standard production.

Winding and Termination

Superior performance and reliability are a direct result of the stator assembly design and manufacturing processes. The laminations are stacked in specially designed fixtures and are bonded with a high-temperature epoxy cement. Individual wire coils are separated from the stator by film-type insulation and are inserted into the slots by a skilled operator. The polyimide magnet-wire insulation is the most reliable insulation available in the industry. Fluoropolymer-insulated leads are securely attached and soldered to the magnet wires. These terminations and lead wire are then formed and laced around the perimeter of the end turns, in order to provide strain relief. The winding is then impregnated and tested.

The finished stator is press-fit into the component housing such that low thermal resistance is obtained, minimizing internal temperature rise. The end turns of the stator are insulated from the housing by a formed-film insulator and/or epoxy coating. These assemblies are then subjected to an extreme temperature-vacuum cycling process.

This effectively removes any minute residues of volatile material, which reduces subsequent outgassing. The polyimide-insulated magnet wire and fluoropolymer-insulated lead wires, together with the other insulating materials, comprise a MIL-STD-454, requirement 11 insulation system that performs up to +225°C. The solder used to terminate the lead wires melts above +285°C.

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

2.5.3.3 Field Director Commutator

The motor position will be sensed by a field director commutation sensor which is attached directly to the BDC motor.

The field director is a three-phase, four-pole rotary variable transformer (RVT) used to sense rotor position. The field director requires a high-frequency (20 kHz) AC excitation input provided by the control electronics. The output of the field director is three position-modulated amplitudes on the high-frequency carrier whose phase reverses with respect to the excitation at each zero crossing. Although the outputs resemble that of a brushless synchro, only the phasing information is utilized by the MPC controller. An initial alignment during assembly relates the mechanical position of the motor stator to the field director. The insulation system, materials, and construction are the same as in the motor, which allows the combination to perform reliably at very high case temperatures from -54°C to +225°C.

2.5.4 Brushless DC Tachometer

The Brushless DC tachometer is a three-phase permanent magnet alternator whose output is synchronously demodulated. A permanent magnet alternator produces an AC voltage proportional to shaft speed. The BDC tachometer is a modular component that can be mounted as an integral part of a motor-field director assembly or, less commonly, supplied as a stand-alone unit. Combined with the positional information of the rotor, supplied by the field director outputs, the PMA output is synchronously demodulated, providing speed and direction-of-rotation information on the motor.

2.5.4.1 Tachometer Construction

The alternator winding is inserted in a multi-slot laminated stator assembly like that of all MPC motors. The internal diameter of the stator forms a closed cylinder which prevents contamination in the bore that could contact the moving rotor assembly. The stator assembly is press-fit and bonded into a stainless steel housing which also functions as the magnetic return path. An initial alignment during final assembly relates the alternator emf to the field director outputs.

All lead wires are PTFE-insulated, conforming to MIL-W-16878/6. The rotor consists of a stainless-steel-sleeved four-pole, samarium cobalt magnet assembly.

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

2.5.4.2 Tachometer Theory of Operation

The alternator produces an AC voltage (emf) for each of three legs in a wye termination whose amplitude is proportional to speed. The electrical displacement for each of these voltages is nominally 120°. A 60° displacement is realized by electrically inverting any one of the outputs, which results in minimum ripple for the commutated final output.

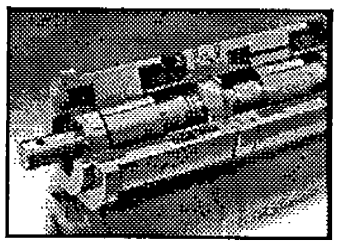
The field director produces position signals for each of the alternator emfs. The field director states (in- or out-of-phase) are a function of only rotor position as represented by the presence of the field director rotor lamination assembly.

The logical combination of each of the field director outputs is used to select (demodulate) either the positive or inverse of each alternator emf which, when parallel summed, yields a DC average level with an amplitude proportional to speed and a polarity (+ or -) dependent on direction.

At any time the shaft direction is reversed, the field director signals will remain the same and the alternator emf's will invert, thereby producing a DC signal of opposite polarity. The change is instantaneous because there is no lag due to complex processing or filtering.

The field director signals are not only used for demodulation of the alternator, but can also be used by the motor controller for required commutation of the motor current. The tachometer provides outer loop damping and stabilization.

2.5.5 Brushless Resolver Design Approach



A resolver is a rotary variable transformer designed to produce two outputs that have a sine-cosine relationship as a function of rotor position. The tangent of the two voltages represents the exact rotor position within several arc minutes — in larger devices, within arc seconds. Usually, both the stator and rotor have two windings each, located precisely at 90° with respect to each other. With the rotor as primary (coil), power transfer to the rotor is accomplished using a rotary transformer which is isolated from the primary and stator coils.

One of the more important features of MPC's standard resolvers is a Class "H" insulation system which uses double-insulated polyimide, good to 220°C continuously. This magnet-wire insulation is the most reliable insulation available in the industry. Both stator and rotor will feature fully distributed windings in order to achieve the lowest possible error or the highest accuracy.

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

Where soldering is required (for example, between lead wire and magnet wire), MPC uses solder that melts above 285°C. Both rotor and stator combinations are constructed with specially designed fixtures. The bonding agent necessary to both hold the laminations tightly to one another and insulate for proper electrical characteristics is a high-temperature epoxy varnish.

2.6 Qualification

The reader is referred to proposal **Table 2-1** (next two pages) for a Qualification Listing of the baseline actuator. MPC strongly recommends that qualification-by-similarity be attempted, in order to defer any additional non-recurring costs.

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

Table 2-1 Qualification Test Levels of the Premier I Flap Actuators

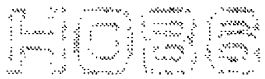
Test Description	Level	Publication
Temperature/Temperature Variation	Category 2 -55°C and +85°C 10°C/minute	RTCA DO-160C Section 4 & 5
Altitude	Category D2	RTCA DO-160C Section 4.6.1
Humidity	Category C 55°C and 95%.	RTCA DO-160C Section 6
Operational Shock, and Crash Safety Shock		
Operational Shock (In each direction of each axis)	18 shocks at 11±2ms - half sine wave at 6 g	RTCA DO-160C Section 7
Crash Safety (In each direction of each axis)	1 shock at 11±2ms - half sine wave shape at 15 g	RTCA DO-160C Section 7
Vibration	Category E	RTCA DO-160C Section 8
Explosion Proofness	Category E1	RTCA DO-160C Section 9
Waterproofness	Category S Continuous stream of water on all sides for five minutes	RTCA DO-160C Section 10
Fluid Susceptibility		
Spray Test	Category F Aviation Jet A Fuel, Silicate Ester-based Hydraulic oil, Isopropyl Alcohol, and Ethylene Glycol	RTCA DO-160C Section 11
Immersion Test	Category F Aviation Jet A Fuel, Silicate Ester-based Hydraulic oil, Isopropyl Alcohol, and Ethylene Glycol	RTCA DO-160C Section 11
Sand and Dust	Category D	RTCA DO-160C Section 12
Fungus Resistance	Qualification by Similarity/ Analysis Report	RTCA DO-160C Section 12
Salt Spray	Category S	RTCA DO-160C Section 14
Magnetic Effects	Category Z The distance that causes a deflection of 1° shall not be less than 0.3 meters	RTCA DO-160C Section 15

Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

Power Input	Category Z	RTCA DO-160C Section 16.5.2 & 16.5.4
Icing	Category A	RTCA DO-160C Section 24
Limit Structural Load	700 pounds in compression	MPC QTP
Endurance Total = 29160 cycles	9720 cycles, 50 lbs. full stroke spring load 9720 cycles, 350 lbs. nominal spring force to peak 9720 cycles, 400 lbs. nominal spring force to peak	MPC QTP
Ultimate Structural Load	1050 pounds in compression and tension	MPC QTP

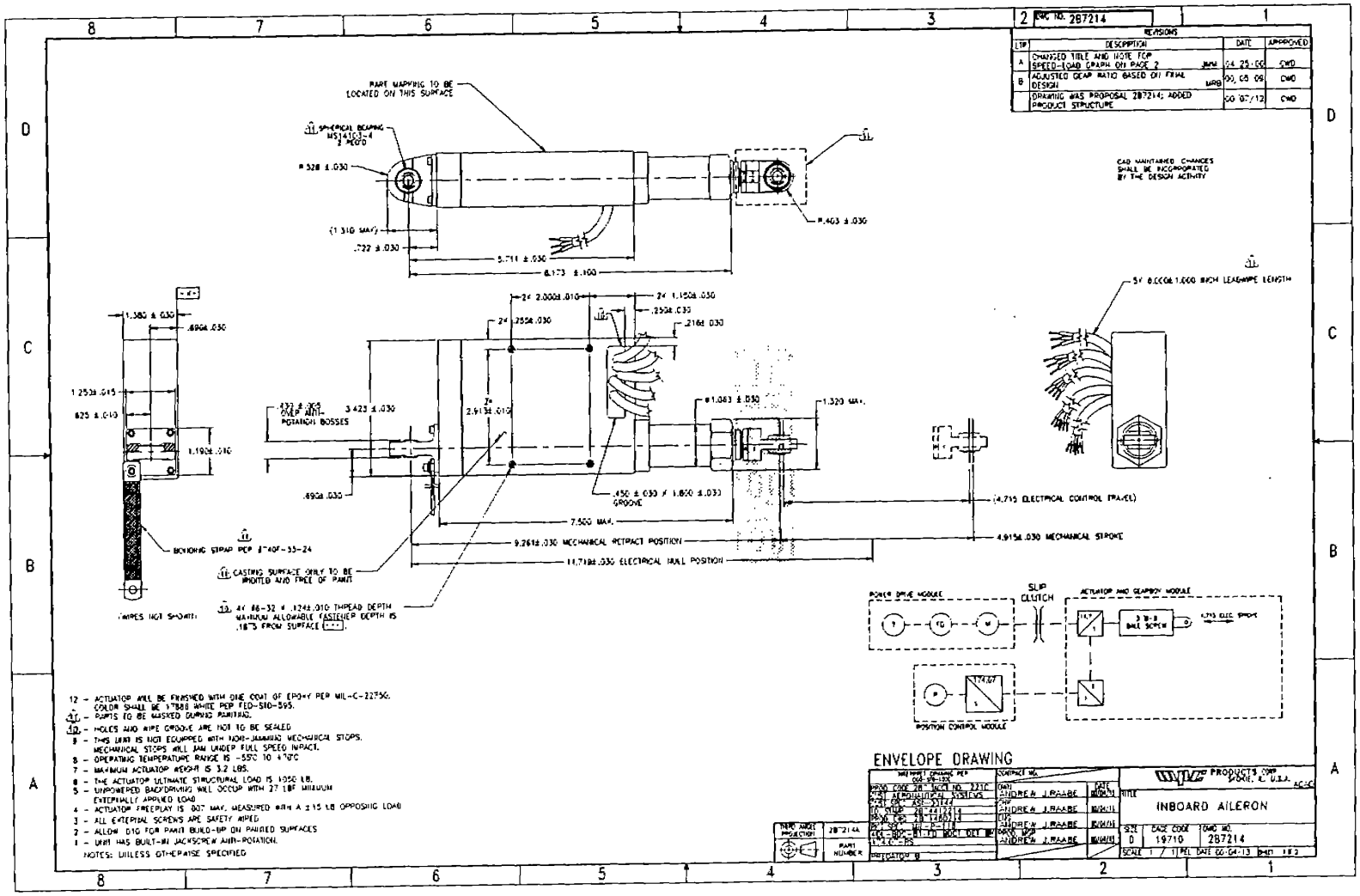
Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

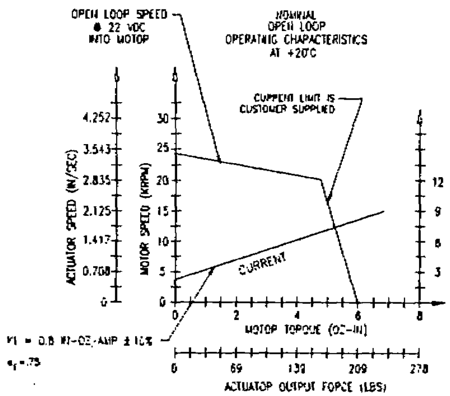
Appendix A Proposal Drawings



Use or disclosure of proposal data is governed by the nondisclosure statement on the Cover Page of this proposal.

Appendix A MPC Sales Drawings

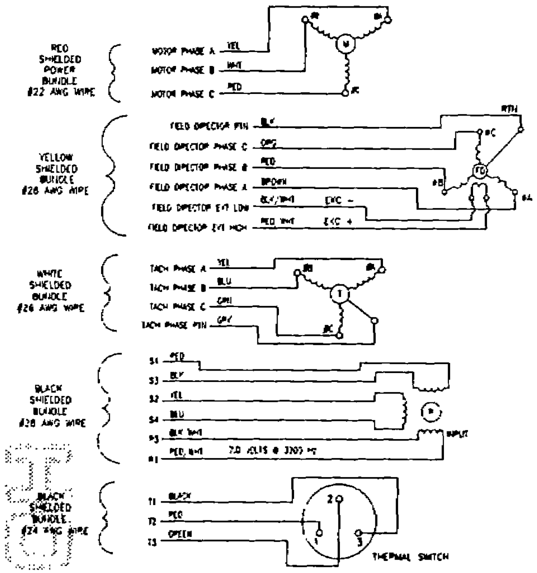




SPEED - LOAD GRAPH*

*SYSTEM RATED FOR 45 WATTS OF CONTINUOUS DUTY OUT OF THE ACTUATOR

NOTE: SLIP CLUTCH IS SET TO 440 LBF ± 20% EQUIVALENT



ELECTRICAL WIRING DIAGRAM

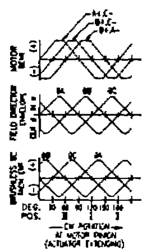
FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C		
EXCITATION FREQUENCY	(KHZ)	[illegible]
EXCITATION VOLTAGE	(VRMS)	3.0
INPUT CURRENT	(ARMS)	0.040
OUTPUT TRANSFORMATION RATIO	(L-N)	[illegible]

3φ TACHOMETER ELECTRICAL CHARACTERISTICS			
PARAMETERS			UNITS
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]
PHASING CW ROTATION	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

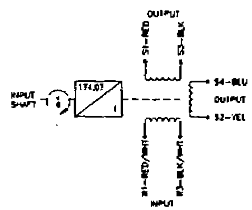
FIELD DIRECTOR ALIGNMENT						
SHAFT POSITION	MOTOR CURRENT			FIELD DIRECTOR OUTPUT		
	A	B	C	A	B	C
I	[illegible]	+	−	OUT	IN	NULL
II	−	0	+	NULL	OUT	IN
III	+	−	0	IN	NULL	OUT

WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR NULLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.

CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END.



RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C ±5°C			
ROTOR AS PRIMARY	INPUT VOLTAGE @ 3300HZ	(VOLTS)	7.0
	INPUT CURRENT	(AMPS)	.035 MAX.
	INPUT POWER	(WATTS)	.178 MAX.
	OUTPUT VOLTAGE	(VOLTS)	7.0 ± 10%
	PHASE SHIFT	DEG. (LEAD)	10 MAX.
D.C. RESISTANCE	ROTOR	(OHMS)	14 NOM.
	STATOR	(OHMS)	13 NOM.
IMPEDANCE	[illegible]	(OHMS)	[illegible] + J230 NOM.
	[illegible]	(OHMS)	125 + J290 NOM.
NULL VOLTAGE		(MV)	53.3 MAX.
ACCURACY MAX. ERROR FROM [illegible]		[illegible]	±0.24°
ACCURACY MAX. ERROR FROM [illegible]		[illegible]	±5.020
TRANSFORMATION RATIO			1.000 ± 10%



WIRING DIAGRAM

PHASING EQUATIONS

$E(S1S3) = K \times E(R1R3) \times \cos(\ldots)$

$E(S2S4) = K \times E(R1R3) \times \sin(\ldots)$

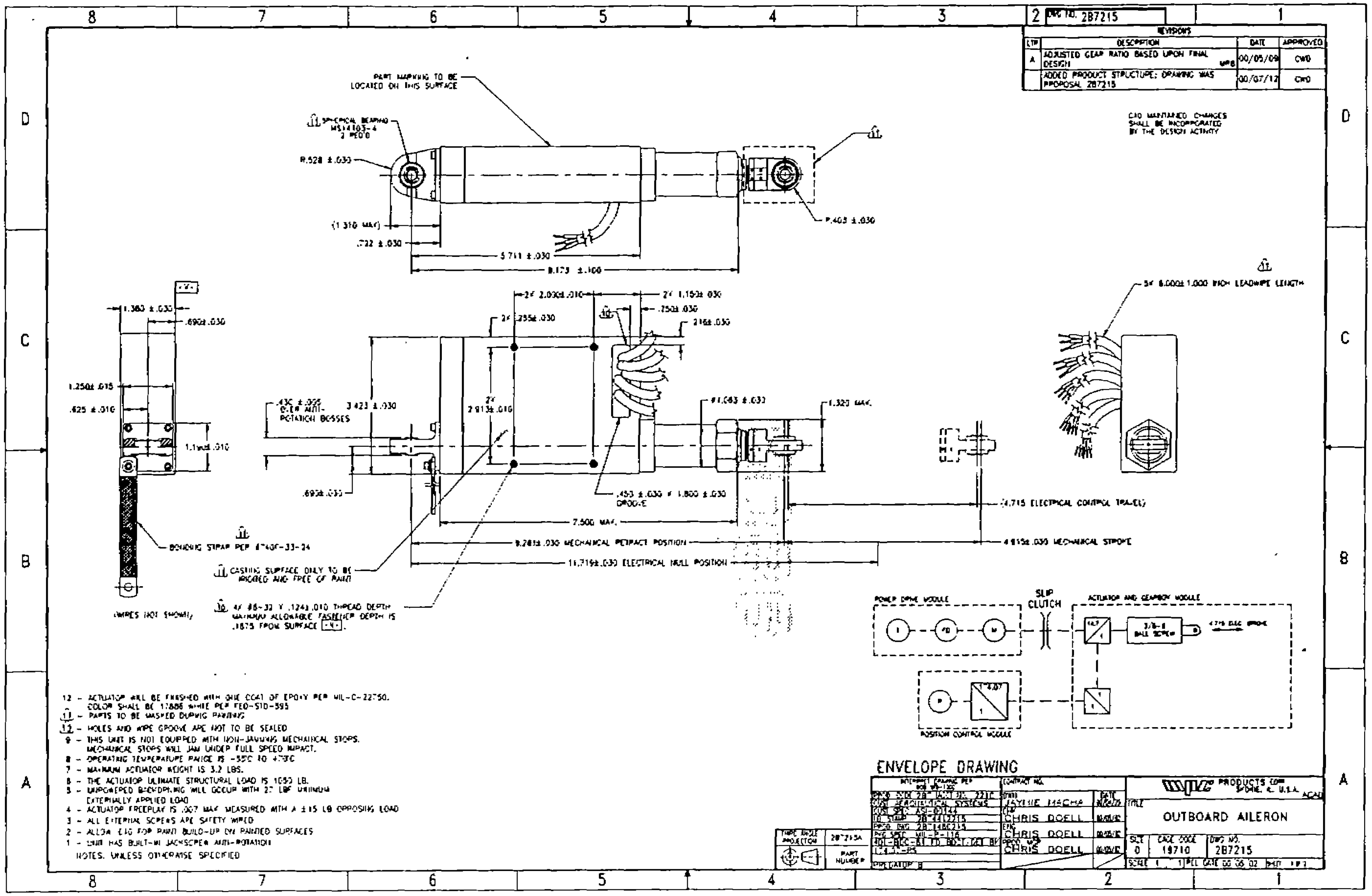
CW IS INCREASING ANGLE WHEN VIEWED FROM SHAFT END.

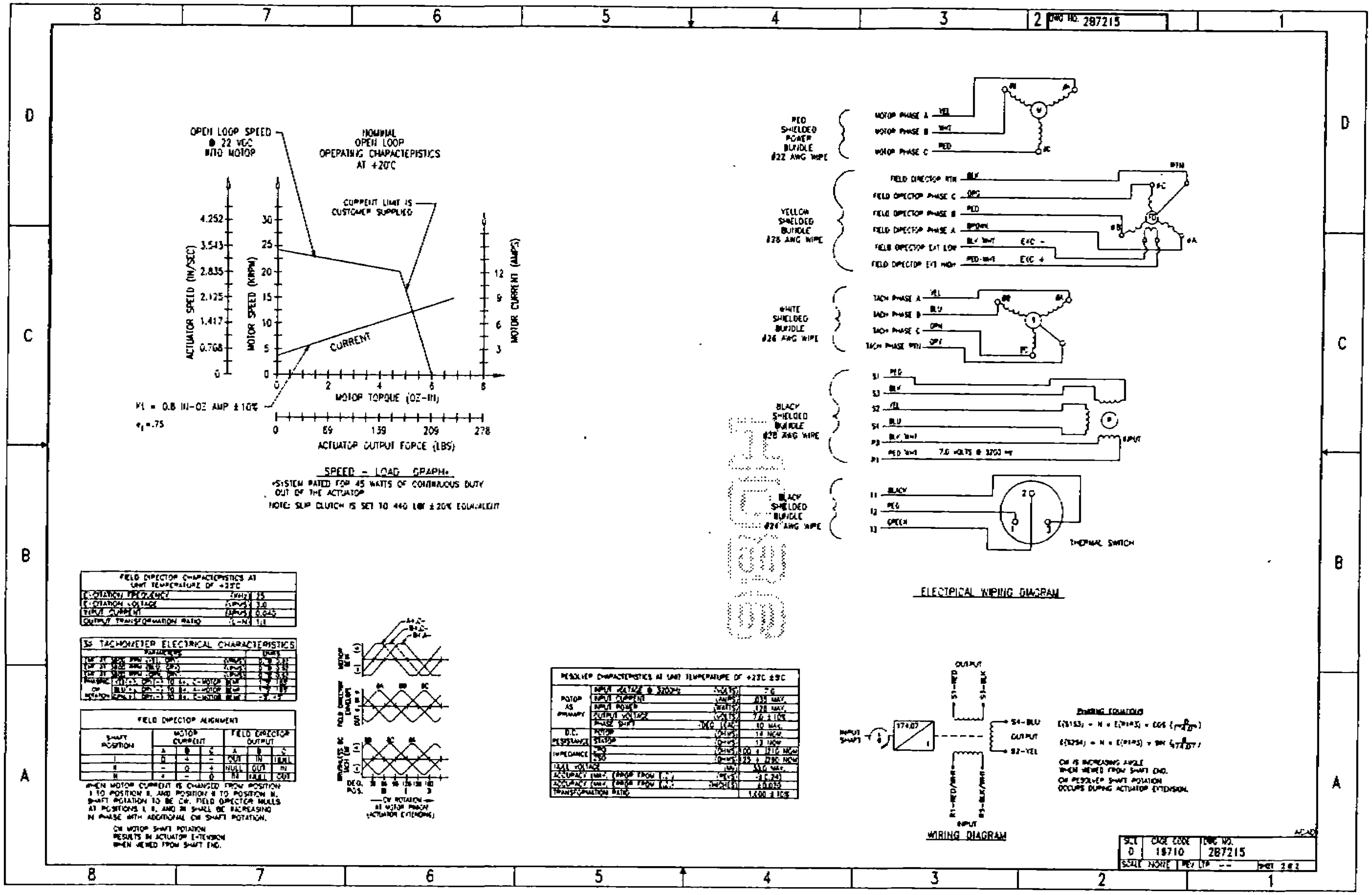
CW RESOLVER SHAFT ROTATION OCCURS DURING ACTUATOR EXTENSION.

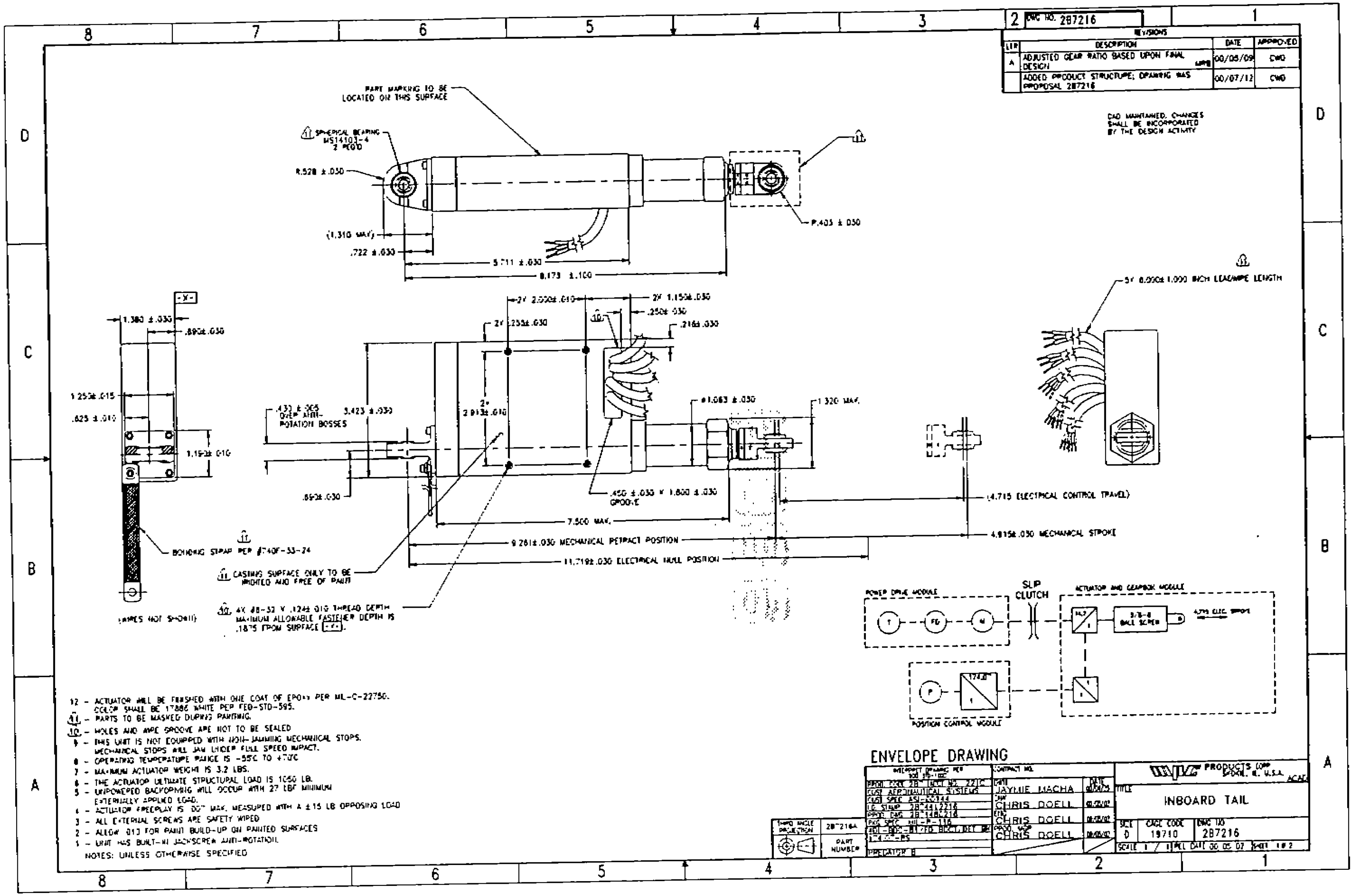
SIZE	CAGE CODE	DWG NO.
D	19710	287214
SCALE NONE	REV ITP --	SHT 2 OF 2

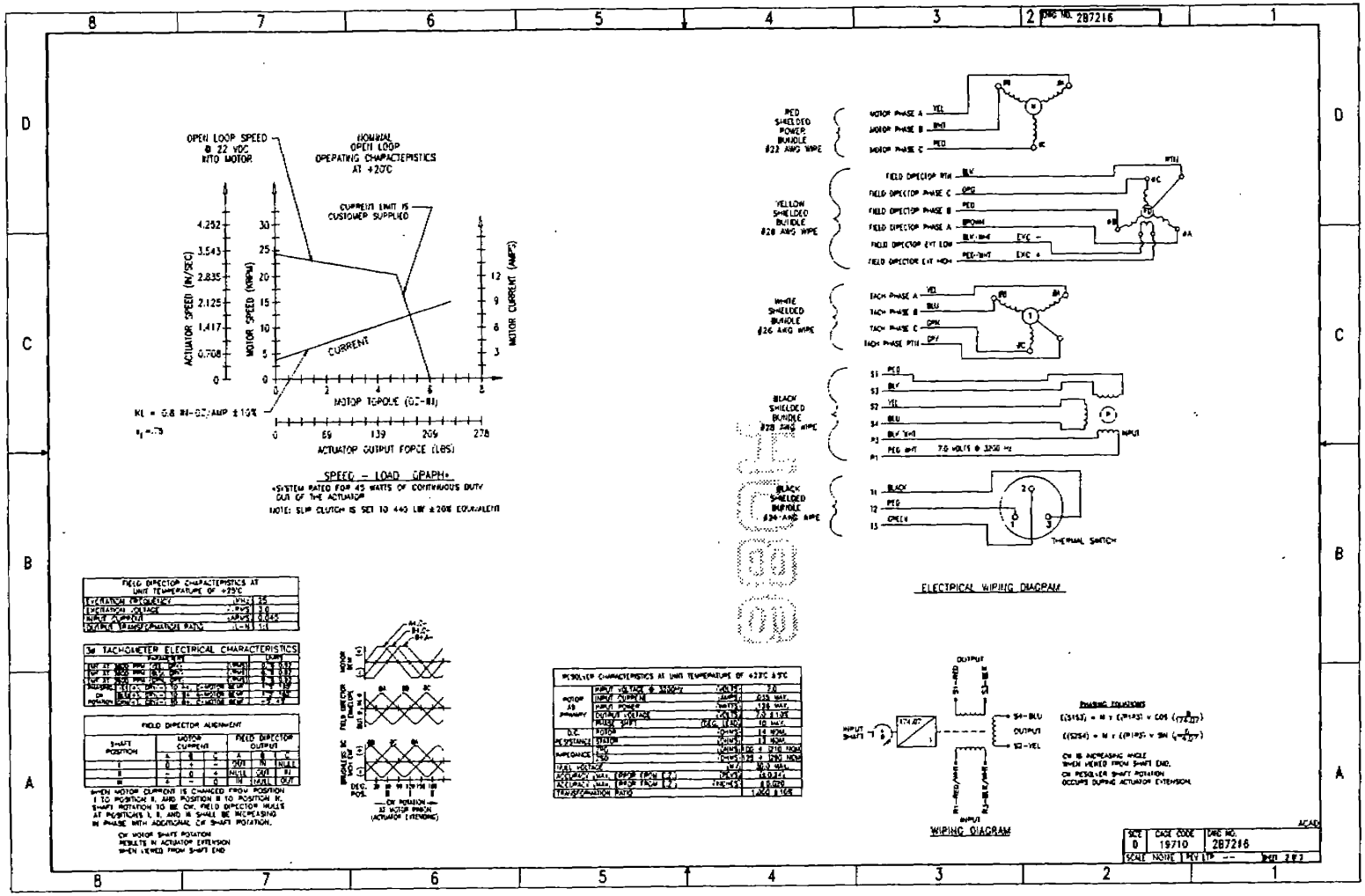
ACAD

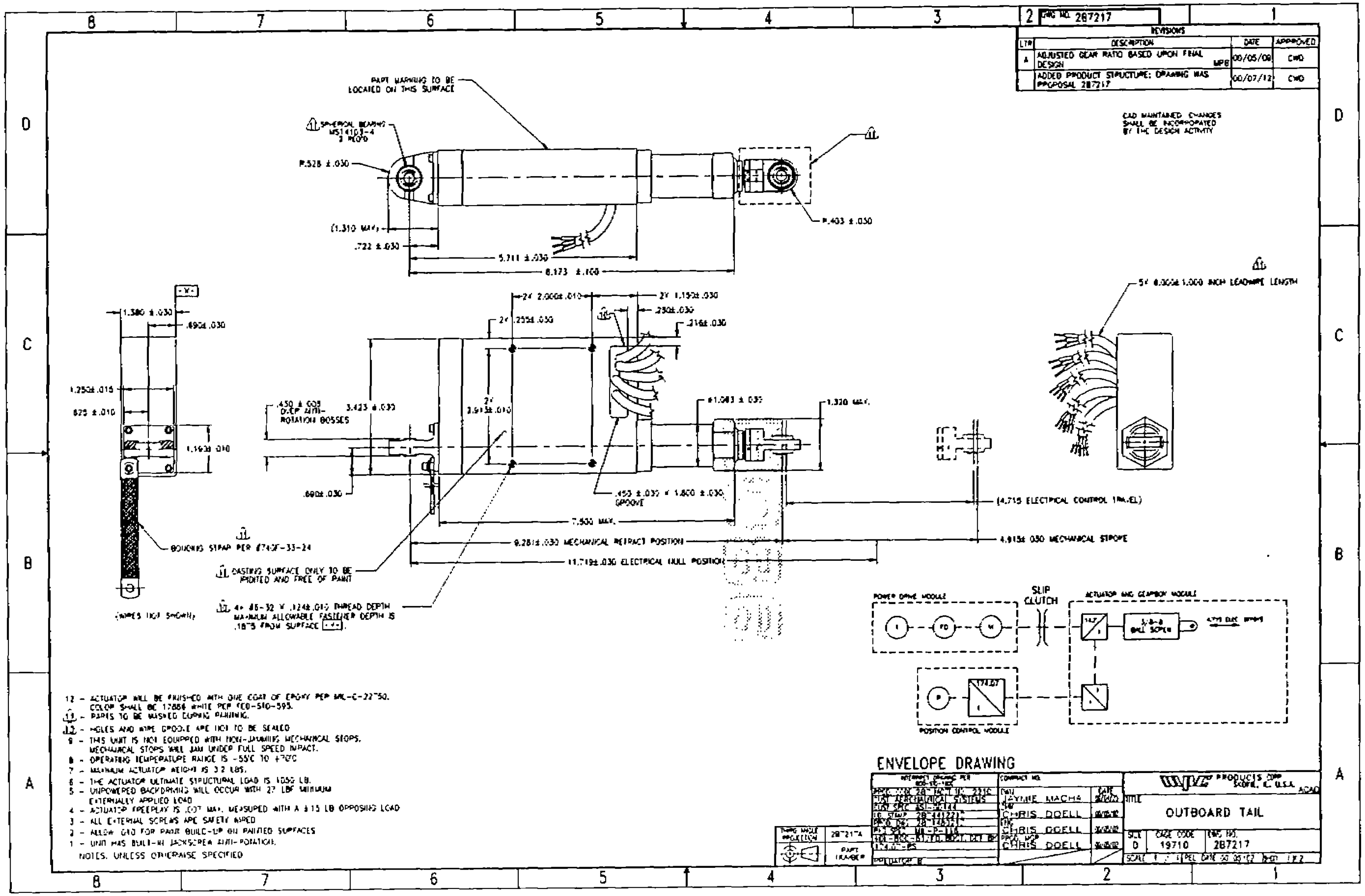
DWG NO. 287214

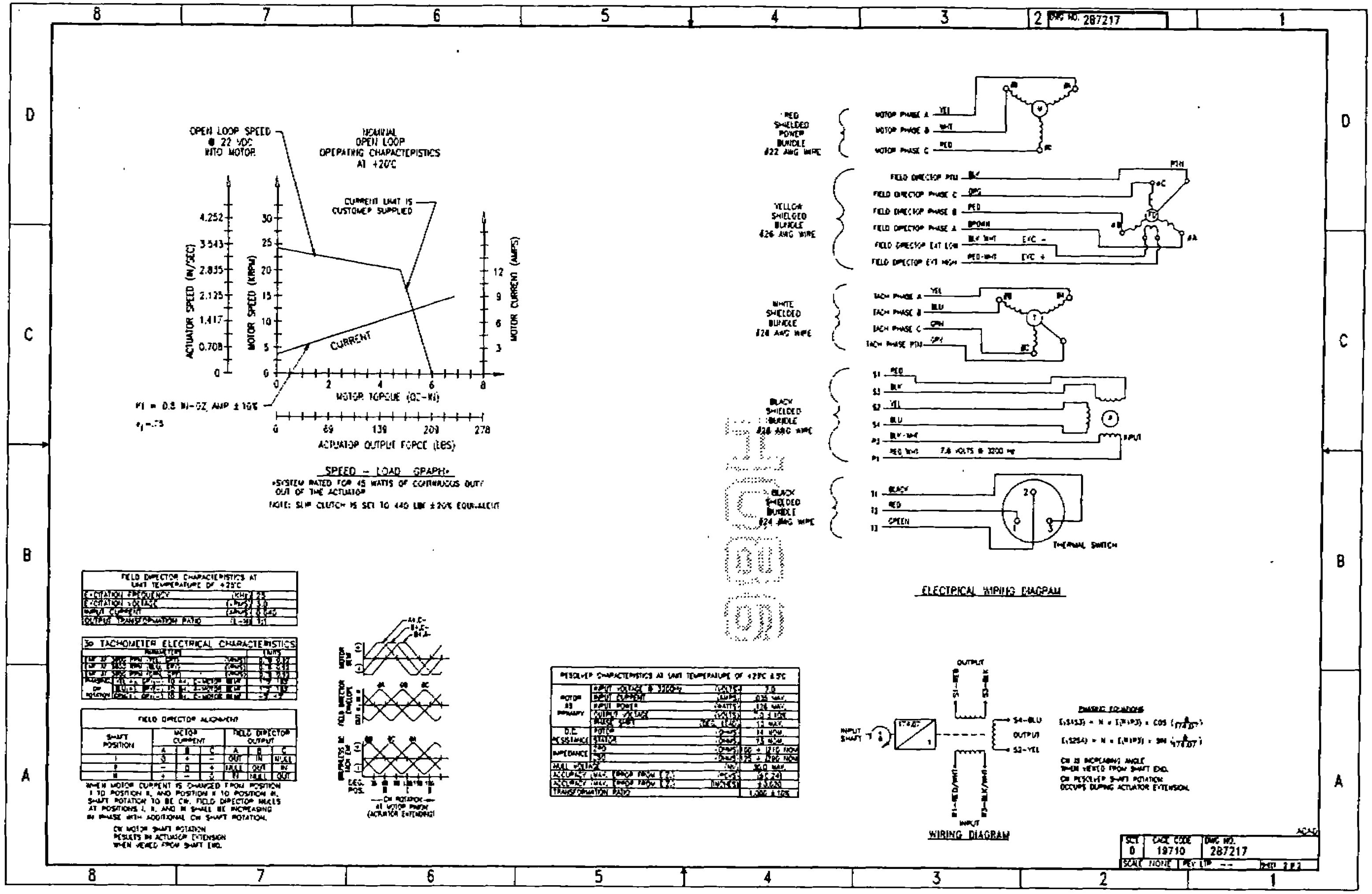

DWG NO. 2B7215
REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A | ADJUSTED GEAR RATIO BASED UPON FINAL DESIGN | 00/05/09 | CWD
ADDED PRODUCT STRUCTURE; DRAWING WAS PROPOSAL 2B7215 | 00/07/12 | CWD
CID MAINTAINED CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING
R.528 ± .030
R.403 ± .030
(1.310 MAX)
.732 ± .030
5.711 ± .030
8.173 ± .100
1.380 ± .030
.690± .030
1.250± .015
.625 ± .010
1.1± .010
2X 2.030± .010
2X 1.150± .030
2X .255± .030
.250± .030
.216± .030
2X 2.913± .010
3.423 ± .030
.690± .030
Ø1.063 ± .030
1.320 MAX
.453 ± .030 X 1.800 ± .030 GROOVE
7.500 MAX
9.281± .030 MECHANICAL RETRACT POSITION
11.716± .030 ELECTRICAL NULL POSITION
4.715 ELECTRICAL CONTROL TRAVEL
4.815± .030 MECHANICAL STROKE
BONDING STRAP PER 4740F-33-24
CASTING SURFACE ONLY TO BE ... AND FREE OF PAINT
.1875 FROM SURFACE
WIRES NOT SHOWN
5X 8.000± 1.000 INCH LEADWIRE LENGTH
POWER DRIVE MODULE
SLIP CLUTCH
ACTUATOR AND GEARBOX MODULE
3/8-8 BALL SCREW
POSITION CONTROL MODULE
12 - ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595
11 - PARTS TO BE MASKED DURING PAINTING
10 - HOLES AND WIPE GROOVE ARE NOT TO BE SEALED
9 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
8 - OPERATING TEMPERATURE RANGE IS -55°C TO +75°C
7 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
6 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB.
5 - UNPOWERED BACKDRIVING WILL OCCUR WITH 27 LBF MINIMUM EXTERNALLY APPLIED LOAD
4 - ACTUATOR FREEPLAY IS .007 MAX MEASURED WITH A ±15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .CIG FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION
NOTES. UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
THIRD ANGLE PROJECTION
2B7215A
PART NUMBER
CONTRACT NO.
CHRIS DOELL
CHRIS DOELL
CHRIS DOELL
PRODUCTS CORP
TITLE
OUTBOARD AILERON
SIZE D
CAGE CODE 19710
DWG NO. 2B7215
SCALE 1 : 1


DWG NO. 287215
OPEN LOOP SPEED @ 22 VDC INTO MOTOR
NOMINAL OPEN LOOP OPERATING CHARACTERISTICS AT +20°C
CURRENT LIMIT IS CUSTOMER SUPPLIED
ACTUATOR SPEED (IN/SEC)
MOTOR SPEED (KRPM)
MOTOR CURRENT (AMPS)
CURRENT
MOTOR TORQUE (OZ-IN)
ACTUATOR OUTPUT FORCE (LBS)
KT = 0.8 IN-OZ AMP ± 10%
SPEED - LOAD GRAPH*
*SYSTEM RATED FOR 45 WATTS OF CONTINUOUS DUTY OUT OF THE ACTUATOR
NOTE: SLIP CLUTCH IS SET TO 440 LBF ± 20% EQUIVALENT
FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C
TACHOMETER ELECTRICAL CHARACTERISTICS
FIELD DIRECTOR ALIGNMENT
WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR NULLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.
CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END.
CW ROTATION AT MOTOR PINION (ACTUATOR EXTENDING)
RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C ±5°C
RED SHIELDED POWER BUNDLE #22 AWG WIRE
MOTOR PHASE A
MOTOR PHASE B
MOTOR PHASE C
YELLOW SHIELDED BUNDLE #28 AWG WIRE
FIELD DIRECTOR RTN
FIELD DIRECTOR PHASE C
FIELD DIRECTOR PHASE B
FIELD DIRECTOR PHASE A
FIELD DIRECTOR EXT LOW
FIELD DIRECTOR EXT HIGH
EXC -
EXC +
WHITE SHIELDED BUNDLE #26 AWG WIRE
TACH PHASE A
TACH PHASE B
TACH PHASE C
TACH PHASE RTN
BLACK SHIELDED BUNDLE #28 AWG WIRE
7.0 VOLTS @ 3200 Hz
BLACK SHIELDED BUNDLE #26 AWG WIRE
THERMAL SWITCH
ELECTRICAL WIRING DIAGRAM
INPUT SHAFT
OUTPUT
INPUT
S1-RED
S3-BLK
S4-BLU
S2-YEL
R1-RED/WHT
R3-BLK/WHT
WIRING DIAGRAM
CW IS INCREASING ANGLE WHEN VIEWED FROM SHAFT END.
CW RESOLVER SHAFT ROTATION OCCURS DURING ACTUATOR EXTENSION.
SIZE D
CAGE CODE 18710
DWG NO. 287215
SCALE NONE
SHEET 2 OF 2

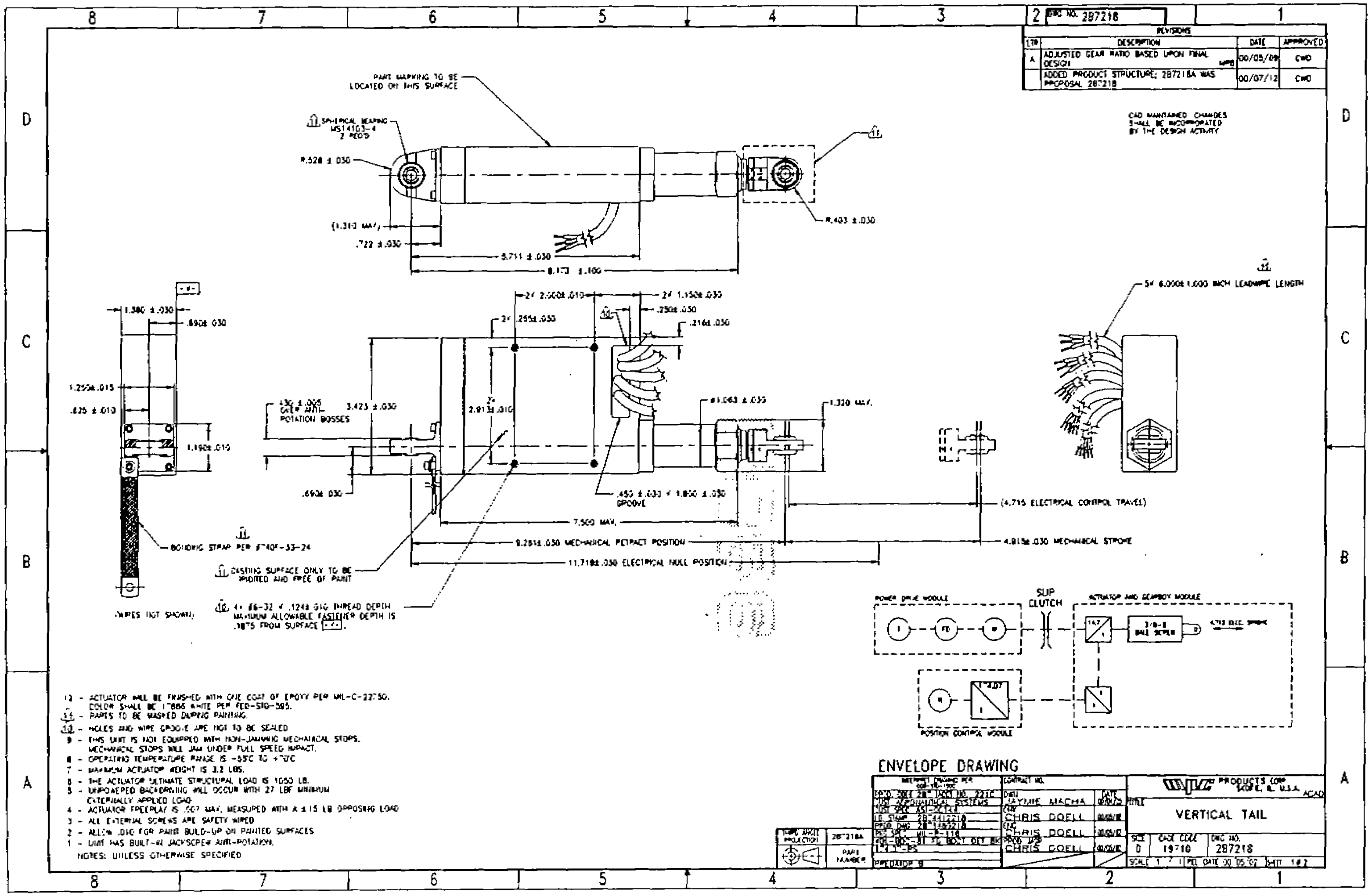

DWG NO. 287216
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
A
ADJUSTED GEAR RATIO BASED UPON FINAL DESIGN
00/05/09
CWD
ADDED PRODUCT STRUCTURE; DRAWING WAS PROPOSAL 287216
00/07/12
CWD
CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING MS14103-4
R.528 ± .030
(1.310 MAX)
.722 ± .030
5.711 ± .030
8.173 ± .100
R.403 ± .030
1.380 ± .030
.890± .030
1.250± .015
.625 ± .010
1.19± .010
BONDING STRAP PER #740F-33-24
(WIRES NOT SHOWN)
.432 ± .005 DEEP ANTI-ROTATION BOSSES
3.423 ± .030
.850± .030
2X 2.000± .010
2X 1.155± .030
.250± .030
.218± .030
2X .255± .030
2.913± .010
ø1.063 ± .030
1.320 MAX.
.450 ± .030 X 1.800 ± .030 GROOVE
7.500 MAX.
9.261± .030 MECHANICAL RETRACT POSITION
11.719± .030 ELECTRICAL NULL POSITION
(4.715 ELECTRICAL CONTROL TRAVEL)
4.815± .030 MECHANICAL STROKE
CASING SURFACE ONLY TO BE IRIDITED AND FREE OF PAINT
4X #8-32 X .124± .010 THREAD DEPTH MAXIMUM ALLOWABLE FASTENER DEPTH IS .1875 FROM SURFACE
5X 8.000± 1.000 INCH LEADWIRE LENGTH
POWER DRIVE MODULE
SLIP CLUTCH
ACTUATOR AND GEARBOX MODULE
POSITION CONTROL MODULE
12 - ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595.
11 - PARTS TO BE MASKED DURING PAINTING.
10 - HOLES AND WIRE GROOVE ARE NOT TO BE SEALED
9 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
8 - OPERATING TEMPERATURE RANGE IS -55°C TO +70°C
7 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
6 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB.
5 - UNPOWERED BACKDRIVING WILL OCCUR WITH 27 LBF MINIMUM EXTERNALLY APPLIED LOAD.
4 - ACTUATOR FREEPLAY IS .007 MAX. MEASURED WITH A ± 15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .013 FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION
NOTES: UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
CUST AERONAUTICAL SYSTEMS
CUST SPEC ASI-55344
PKG SPEC MIL-P-116
PREDATOR B
CONTRACT NO.
JAYLIIE MACHA
CHRIS DOELL
CHRIS DOELL
CHRIS DOELL
PRODUCTS CORP
TITLE
INBOARD TAIL
SIZE D
CAGE CODE 19710
DWG NO 287216
SCALE 1 / 1
SHEET 1 of 2
THIRD ANGLE PROJECTION
287216A
PART NUMBER

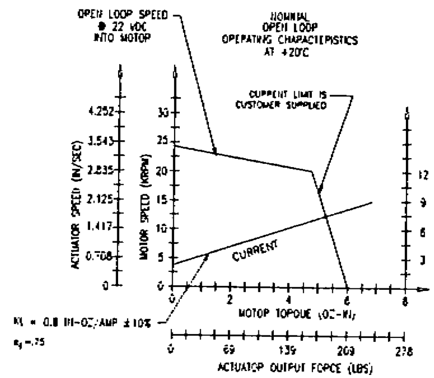

DWG NO. 2B7216
OPEN LOOP SPEED @ 22 VDC INTO MOTOR
NOMINAL OPEN LOOP OPERATING CHARACTERISTICS AT +20°C
CURRENT LIMIT IS CUSTOMER SUPPLIED
CURRENT
ACTUATOR SPEED (IN/SEC)
MOTOR SPEED (KRPM)
MOTOR CURRENT (AMPS)
MOTOR TORQUE (OZ-IN)
ACTUATOR OUTPUT FORCE (LBS)
SPEED – LOAD GRAPH*
*SYSTEM RATED FOR 45 WATTS OF CONTINUOUS DUTY OUT OF THE ACTUATOR
NOTE: SLIP CLUTCH IS SET TO 440 LBF ±20% EQUIVALENT
RED SHIELDED POWER BUNDLE #22 AWG WIRE
MOTOR PHASE A
MOTOR PHASE B
MOTOR PHASE C
YELLOW SHIELDED BUNDLE #26 AWG WIRE
FIELD DIRECTOR PTH
FIELD DIRECTOR PHASE C
FIELD DIRECTOR PHASE B
FIELD DIRECTOR PHASE A
FIELD DIRECTOR EXT LOW
FIELD DIRECTOR EXT HIGH
EXC –
EXC +
WHITE SHIELDED BUNDLE #26 AWG WIRE
TACH PHASE A
TACH PHASE B
TACH PHASE C
TACH PHASE PTH
BLACK SHIELDED BUNDLE #28 AWG WIRE
7.0 VOLTS @ 3200 Hz
INPUT
BLACK SHIELDED BUNDLE #24 AWG WIRE
THERMAL SWITCH
ELECTRICAL WIRING DIAGRAM
FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C
3m TACHOMETER ELECTRICAL CHARACTERISTICS
FIELD DIRECTOR ALIGNMENT
SHAFT POSITION
MOTOR CURRENT
FIELD DIRECTOR OUTPUT
WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR HALLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.
CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END
FIELD DIRECTOR ALIGNMENT
CW ROTATION AT MOTOR PINION (ACTUATOR EXTENDING)
RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C ±3°C
WIRING DIAGRAM
S1–RED
S3–BLK
S4–BLU
S2–YEL
R1–RED/WHT
R2–BLK/WHT
INPUT
OUTPUT
ACAD
SIZE 0
CAGE CODE 19710
DWG NO. 2B7216
SCALE NONE
REV LTR --
SHT 2 OF 2


DWG NO. 287217
REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A | ADJUSTED GEAR RATIO BASED UPON FINAL DESIGN | 00/05/08 | CWD
ADDED PRODUCT STRUCTURE; DRAWING WAS PROPOSAL 287217 | 00/07/12 | CWD
CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING MS14103-4 2 PLC'D
R.528 ± .030
R.403 ± .030
(1.310 MAX)
.722 ± .030
5.711 ± .030
8.173 ± .100
5X 8.00± 1.000 INCH LEADWIRE LENGTH
2X 2.000± .010
2X 1.150± .030
2X .255± .030
.250± .030
.316± .030
.450 ± .005 DEEP ANTI-ROTATION BOSSES
3.423 ± .030
2X 3.913± .010
Ø1.083 ± .030
1.320 MAX.
.690± .030
.450 ± .030 X 1.800 ± .030 GROOVE
7.500 MAX.
9.281±.030 MECHANICAL RETRACT POSITION
11.719±.030 ELECTRICAL NULL POSITION
(4.715 ELECTRICAL CONTROL TRAVEL)
4.915± .030 MECHANICAL STROKE
1.380 ± .030
.690± .030
1.250± .015
.875 ± .010
1.150± .010
BONDING STRAP PER 8740F-33-24
(WIRES NOT SHOWN)
CASTING SURFACE ONLY TO BE IRIDITED AND FREE OF PAINT
4X #8-32 X .1248.010 THREAD DEPTH MAXIMUM ALLOWABLE FASTENER DEPTH IS .1875 FROM SURFACE
POWER DRIVE MODULE
SLIP CLUTCH
ACTUATOR AND GEARBOX MODULE
BALL SCREW
POSITION CONTROL MODULE
12 - ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595.
11 - PARTS TO BE MASKED DURING PAINTING.
10 - HOLES AND WIRE GROOVE ARE NOT TO BE SEALED
9 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
8 - OPERATING TEMPERATURE RANGE IS -55°C TO +70°C
7 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
6 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB.
5 - UNPOWERED BACKDRIVING WILL OCCUR WITH 27 LBF MINIMUM EXTERNALLY APPLIED LOAD
4 - ACTUATOR FREEPLAY IS .007 MAX. MEASURED WITH A ± 15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .010 FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION.
NOTES, UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
CONTRACT NO.
JAYNIE MACHA
CHRIS DOELL
CHRIS DOELL
CHRIS DOELL
PRODUCTS CORP
OUTBOARD TAIL
SIZE D
CAGE CODE 19710
DWG NO. 287217
THIRD ANGLE PROJECTION
287217A
PART NUMBER



NOMINAL OPEN LOOP OPERATING CHARACTERISTICS AT +20°C
OPEN LOOP SPEED @ 22 VDC INTO MOTOR
CURRENT LIMIT IS CUSTOMER SUPPLIED
ACTUATOR SPEED (IN/SEC)
MOTOR SPEED (KRPM)
MOTOR CURRENT (AMPS)
CURRENT
MOTOR TORQUE (OZ-IN)
ACTUATOR OUTPUT FORCE (LBS)
SPEED - LOAD GRAPH*
*SYSTEM RATED FOR 45 WATTS OF CONTINUOUS OUT/ OUT OF THE ACTUATOR
NOTE: SLIP CLUTCH IS SET TO 440 LBF ±20% EQUIVALENT
FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +22°C
3φ TACHOMETER ELECTRICAL CHARACTERISTICS
FIELD DIRECTOR ALIGNMENT
RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +22°C ±3°C
RED SHIELDED POWER BUNDLE #22 AWG WIRE
YELLOW SHIELDED BUNDLE #26 AWG WIRE
WHITE SHIELDED BUNDLE #28 AWG WIRE
BLACK SHIELDED BUNDLE #28 AWG WIRE
BLACK SHIELDED BUNDLE #24 AWG WIRE
MOTOR PHASE A
MOTOR PHASE B
MOTOR PHASE C
FIELD DIRECTOR PHASE C
FIELD DIRECTOR PHASE B
FIELD DIRECTOR PHASE A
TACH PHASE A
TACH PHASE B
TACH PHASE C
7.8 VOLTS @ 3200 Hz
THERMAL SWITCH
ELECTRICAL WIRING DIAGRAM
INPUT SHAFT
OUTPUT
INPUT
WIRING DIAGRAM
PHASING EQUATIONS
CW IS INCREASING ANGLE WHEN VIEWED FROM SHAFT END.
CW RESOLVER SHAFT ROTATION OCCURS DURING ACTUATOR EXTENSION.
CAGE CODE 19710
DWG NO. 287217
SCALE NONE

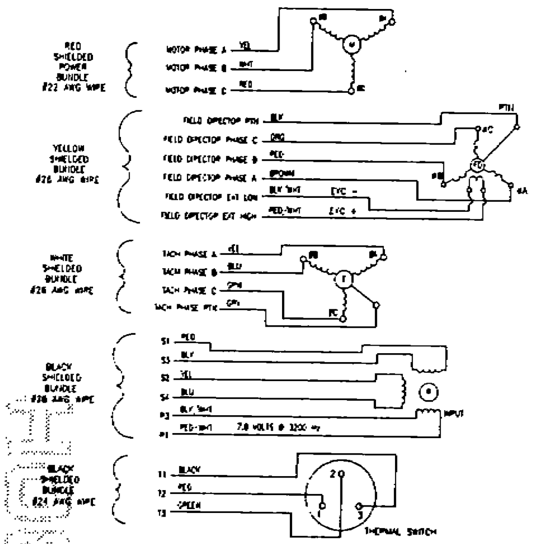

DWG NO. 2B7218
REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A | ADJUSTED GEAR RATIO BASED UPON FINAL DESIGN | 00/05/09 | CWD
ADDED PRODUCT STRUCTURE; 2B7218A WAS PROPOSAL 2B7218 | 00/07/12 | CWD
CAD MAINTAINED CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING MS14103-4 2 REQ'D
R.528 ± .030
R.403 ± .030
(1.310 MAX)
.722 ± .030
5.711 ± .030
8.173 ± .100
5X 6.000± 1.000 INCH LEADWIRE LENGTH
1.380 ± .030
.890± .030
1.250± .015
.625 ± .010
1.190± .010
BONDING STRAP PER F740F-33-24
WIRES NOT SHOWN
2X 2.500± .010
2X 1.150± .030
2X .255± .030
.250± .030
.216± .030
3.423 ± .030
2X 2.913± .010
Ø1.063 ± .030
1.320 MAX.
.455 ± .030 X 1.800 ± .030 GROOVE
.690± .030
7.500 MAX.
(4.715 ELECTRICAL CONTROL TRAVEL)
9.281± .030 MECHANICAL RETRACT POSITION
4.815± .030 MECHANICAL STROKE
11.718± .030 ELECTRICAL NULL POSITION
CASTING SURFACE ONLY TO BE PRIMED AND FREE OF PAINT
4X #6-32 X .124± DIG THREAD DEPTH MAXIMUM ALLOWABLE FASTENER DEPTH IS .1875 FROM SURFACE
POWER DRIVE MODULE
SLIP CLUTCH
ACTUATOR AND GEARBOX MODULE
3/8-8 BALL SCREW
POSITION CONTROL MODULE
12 - ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595.
11 - PARTS TO BE MASKED DURING PAINTING.
10 - HOLES AND WIRE GROOVE ARE NOT TO BE SEALED
9 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
8 - OPERATING TEMPERATURE RANGE IS -55C TO +70C
7 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
6 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB.
5 - UNPOWERED BACKDRIVING WILL OCCUR WITH 27 LBF MINIMUM EXTERNALLY APPLIED LOAD
4 - ACTUATOR FREEPLAY IS .007 MAX. MEASURED WITH A ± 15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .010 FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION.
NOTES: UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
THIRD ANGLE PROJECTION
2B7218A
PART NUMBER
CONTRACT NO.
DRN JAYNE MACHA
CHK CHRIS DOELL
ENG CHRIS DOELL
PROD APP CHRIS DOELL
PRODUCTS CORP
ACAD
TITLE VERTICAL TAIL
SIZE D
CAGE CODE 19710
DWG NO. 2B7218
SCALE 1 : 1
SHT 1 OF 2



SPEED -- LOAD GRAPH*

*SYSTEM RATED FOR 45 WATTS OF CONTINUOUS DUTY OUT OF THE ACTUATOR

NOTE: SLIP CLUTCH IS SET TO 440 LBF ±25% EQUIVALENT



ELECTRICAL WIRING DIAGRAM

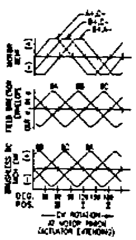
FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C		
EXCITATION FREQUENCY	(KHZ)	25
EXCITATION VOLTAGE	(VRMS)	3.0
INPUT CURRENT	(ARMS)	0.04
OUTPUT TRANSFORMATION RATIO	(L-N)	1:1

3φ TACHOMETER ELECTRICAL CHARACTERISTICS			
PARAMETERS			LIMITS
EMF AT [illegible] RPM	[illegible]	[illegible]	[illegible]
EMF AT [illegible] RPM	[illegible]	[illegible]	[illegible]
EMF AT [illegible] RPM	[illegible]	[illegible]	[illegible]
PHASING CW ROTATION	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

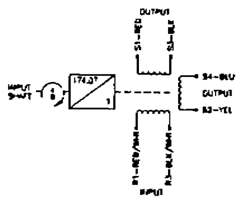
FIELD DIRECTOR ALIGNMENT						
SHAFT POSITION	MOTOR CURRENT			FIELD DIRECTOR OUTPUT		
	A	B	C	A	B	C
I	0	+	-	OUT	IN	NULL
II	-	0	+	NULL	OUT	IN
III	+	-	0	IN	NULL	OUT

WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR NULLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.

CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END.



RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C ±5°C			
ROTOR AS PRIMARY	INPUT VOLTAGE @ 3200Hz	(VOLTS)	7.0
	INPUT CURRENT	(AMPS)	.035 MAX.
	INPUT POWER	(WATTS)	.120 MAX.
	OUTPUT VOLTAGE	(VOLTS)	7.0 ±10%
	PHASE SHIFT	(DEG. LEAD)	10 MAX.
D.C. RESISTANCE	ROTOR	(OHMS)	14 NOM.
	STATOR	(OHMS)	13 NOM.
IMPEDANCE	ZRO	(OHMS)	150 + j210 NOM.
	ZSO	(OHMS)	135 + j190 NOM.
NULL VOLTAGE		(MV)	30.0 MAX.
ACCURACY (MAX. ERROR FROM E.Z.)		(DEG.)	±0.25
ACCURACY (MAX. ERROR FROM E.Z.)		(INCHES)	±0.003
TRANSFORMATION RATIO			1.000 ±10%



WIRING DIAGRAM

PHASING EQUATIONS

E(S1S3) = N × E(R1R3) × COS (...)

E(S2S4) = N × E(R1R3) × SIN (...)

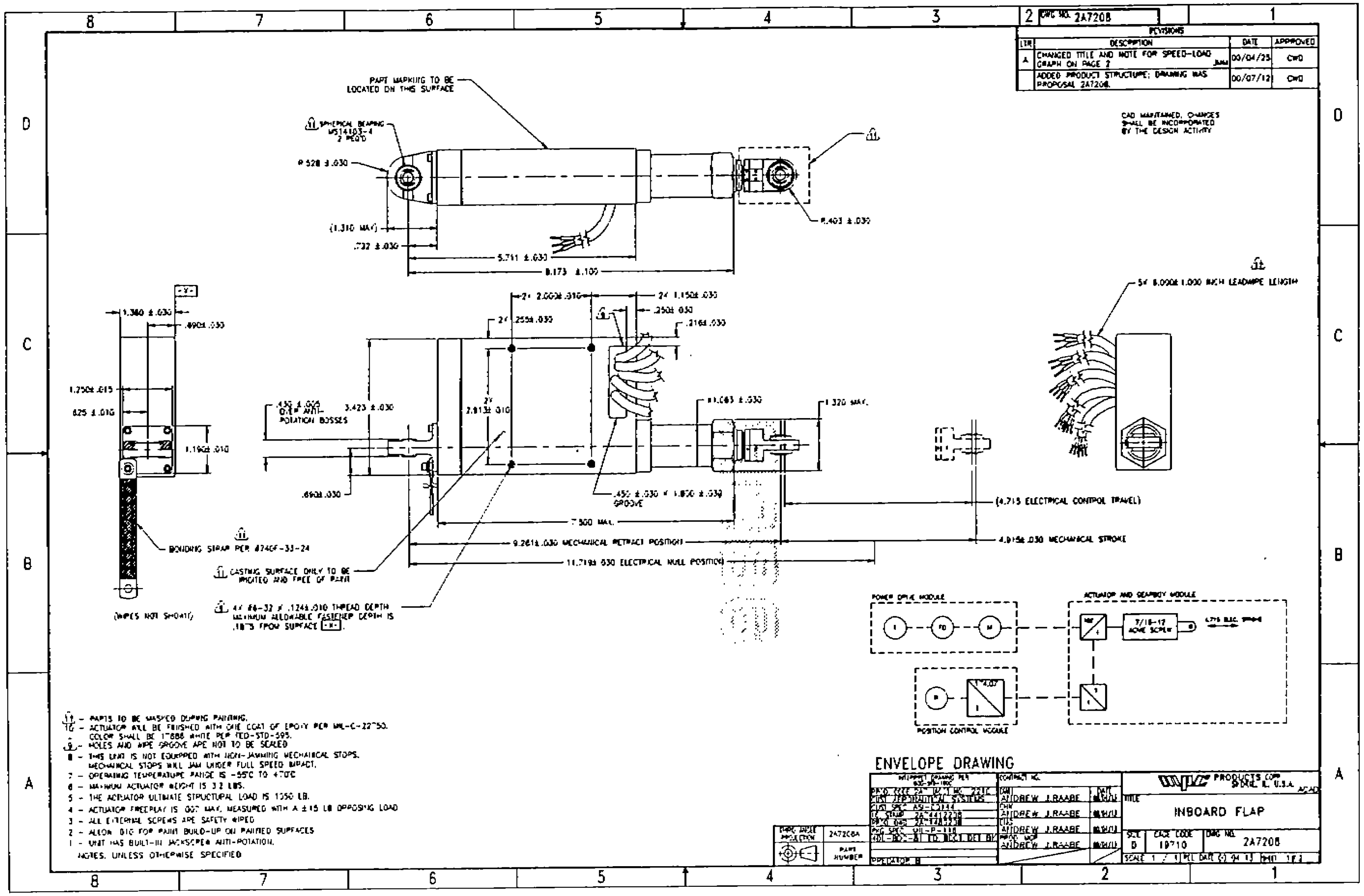
CW IS INCREASING ANGLE WHEN VIEWED FROM SHAFT END.

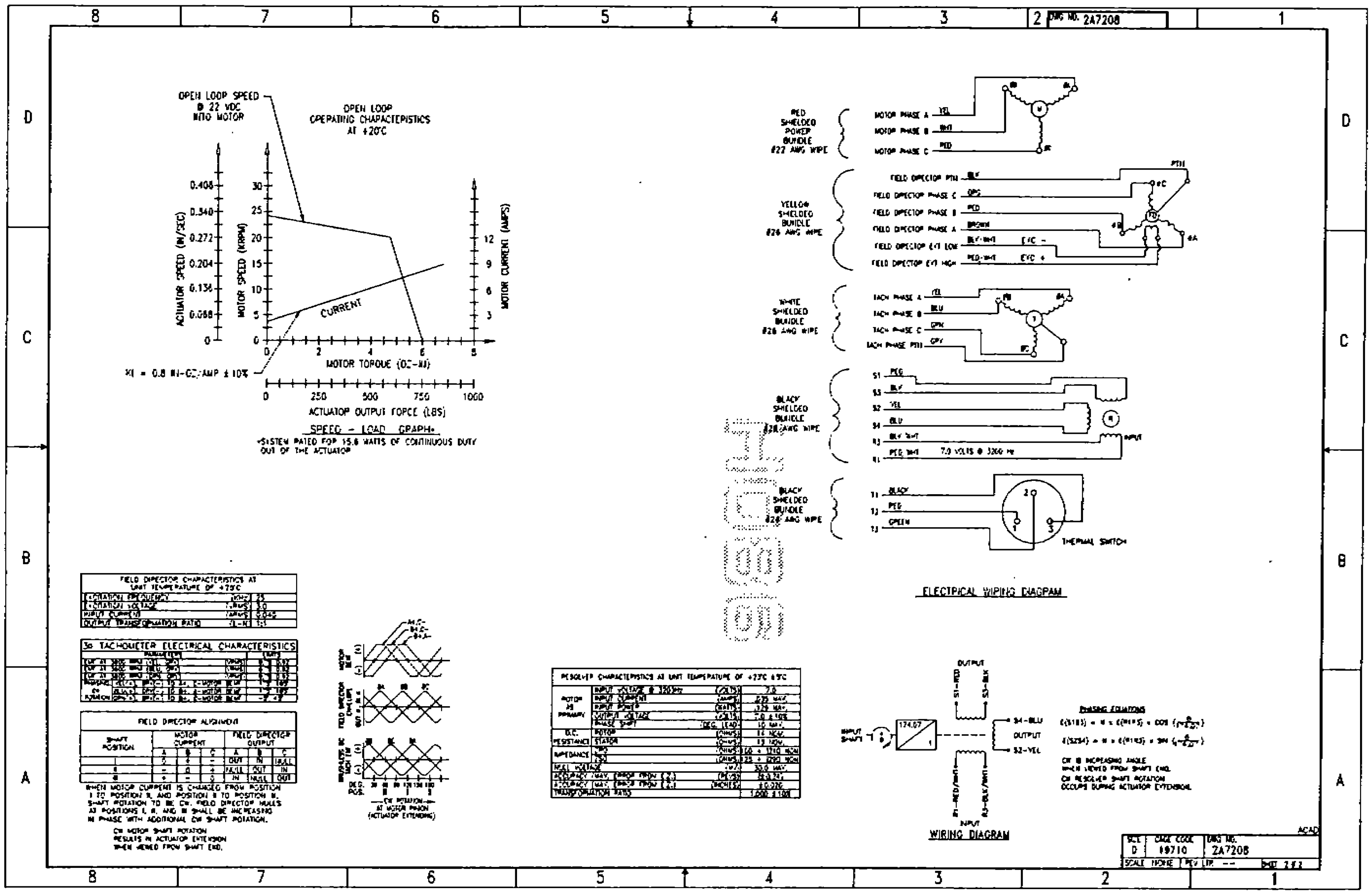
CW RESOLVER SHAFT ROTATION OCCURS DURING ACTUATOR EXTENSION.

SIZE	CAGE CODE	DWG NO.	
D	19710	287218	
SCALE NONE	REV LTR --		SHEET 2 OF 2

DWG NO. 287218

ACAD


DWG NO. 2A7208
REVISIONS
LTR | DESCRIPTION | DATE | APPROVED
A | CHANGED TITLE AND NOTE FOR SPEED-LOAD GRAPH ON PAGE 2 | 00/04/25 | CWD
ADDED PRODUCT STRUCTURE; DRAWING WAS PROPOSAL 2A7208. | 00/07/12 | CWD
CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING MS14103-4 2 REQ'D
Ø.528 ±.030
Ø.403 ±.030
(1.310 MAX)
.732 ±.030
5.711 ±.030
8.173 ±.100
5X 6.000±1.000 INCH LEADWIRE LENGTH
1.360 ±.030
.890±.030
1.250±.015
.625 ±.010
1.190±.010
BONDING STRAP PER #240F-33-24
(WIRES NOT SHOWN)
2X 2.000±.010
2X 1.150±.030
2X .255±.030
.250±.030
.216±.030
2X 2.813±.010
.450 ±.050 DEEP ANTI-ROTATION BOSSES
3.423 ±.030
.690±.030
1.063 ±.030
1.320 MAX.
.450 ±.030 X 1.800 ±.030 GROOVE
7.500 MAX.
9.261±.030 MECHANICAL RETRACT POSITION
11.719±.030 ELECTRICAL NULL POSITION
(4.715 ELECTRICAL CONTROL TRAVEL)
4.915±.030 MECHANICAL STROKE
CASTING SURFACE ONLY TO BE PAINTED AND FREE OF PAINT
4X #8-32 X .124±.010 THREAD DEPTH MAXIMUM ALLOWABLE FASTENER DEPTH IS .187 FROM SURFACE
POWER DRIVE MODULE
ACTUATOR AND GEARBOX MODULE
7/16-12 ACME SCREW
4.715 ELEC. STROKE
POSITION CONTROL MODULE
- PARTS TO BE MASKED DURING PAINTING.
- ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595.
- HOLES AND WIRE GROOVE ARE NOT TO BE SCALED
8 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
7 - OPERATING TEMPERATURE RANGE IS -55°C TO +70°C
6 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
5 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB.
4 - ACTUATOR FREEPLAY IS .007 MAX. MEASURED WITH A ±15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .010 FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION.
NOTES, UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
THIRD ANGLE PROJECTION
2A7208A
PART NUMBER
CONTRACT NO.
ANDREW J.RAABE
TITLE
INBOARD FLAP
SIZE D
CAGE CODE 19710
DWG NO. 2A7208
SCALE 1 / 1
ACAD



FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C		
EXCITATION FREQUENCY	(KHZ)	25
EXCITATION VOLTAGE	(VRMS)	5.0
INPUT CURRENT	(ARMS)	0.045
OUTPUT TRANSFORMATION RATIO	(L-N)	1:1

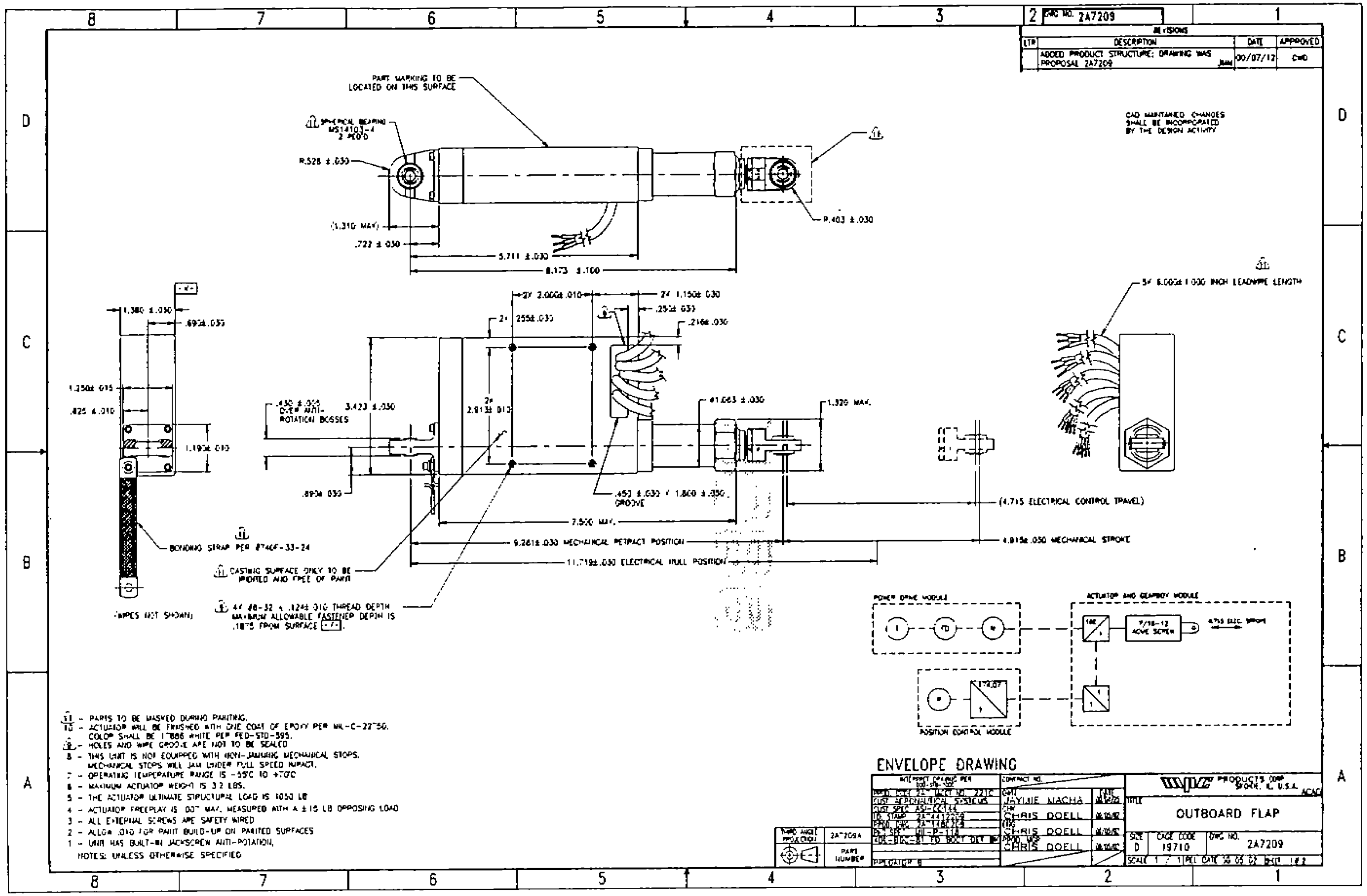
3φ TACHOMETER ELECTRICAL CHARACTERISTICS			
PARAMETERS		LIMITS	
[illegible]	(VRMS)	[illegible]	0.52
[illegible]	(VRMS)	[illegible]	0.52
[illegible]	(VRMS)	[illegible]	0.52
PHASING CW ROTATION [illegible]		[illegible]	109
[illegible]		[illegible]	109
[illegible]		[illegible]	[illegible]

FIELD DIRECTOR ALIGNMENT						
SHAFT POSITION	MOTOR CURRENT			FIELD DIRECTOR OUTPUT		
	A	B	C	A	B	C
I	0	+	-	OUT	IN	NULL
II	-	0	+	NULL	OUT	IN
III	+	-	0	IN	NULL	OUT

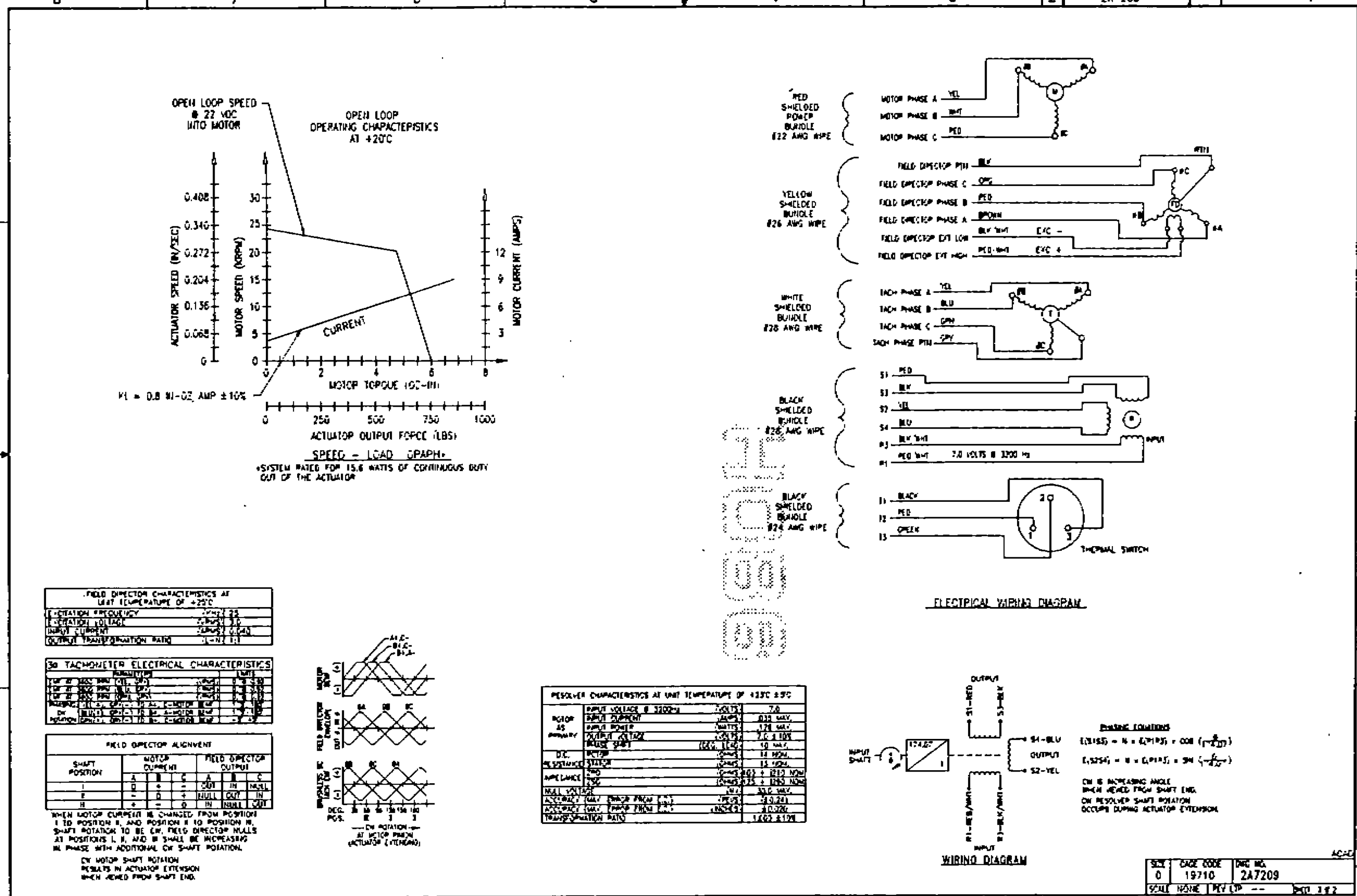
WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR NULLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.

CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END.

RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C ±5°C			
ROTOR AS PRIMARY	INPUT VOLTAGE @ 3200Hz	(VOLTS)	7.0
	INPUT CURRENT	(AMPS)	.035 MAX.
	INPUT POWER	(WATTS)	.125 MAX.
	OUTPUT VOLTAGE	(VOLTS)	7.0 ± 10%
	PHASE SHIFT	(DEG. LEAD)	10 MAX.
D.C. RESISTANCE	ROTOR	(OHMS)	14 NOM.
	STATOR	(OHMS)	13 NOM.
IMPEDANCE	ZRO	(OHMS)	160 + J710 NOM
	ZSS	(OHMS)	125 + J290 NOM
NULL VOLTAGE		(mV)	30.0 MAX.
ACCURACY (MAX. ERROR FROM E.Z.)		(DEG)	±0.24
ACCURACY (MAX. ERROR FROM E.Z.)		(INCHES)	±0.020
TRANSFORMATION RATIO			1.000 ± 10%



DWG NO. 2A7209
REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
ADDED PRODUCT STRUCTURE; DRAWING WAS PROPOSAL 2A7209
00/07/12
CMD
CAD MAINTAINED CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY
PART MARKING TO BE LOCATED ON THIS SURFACE
SPHERICAL BEARING MS14103-4 2 REQ'D
R.528 ±.030
R.403 ±.030
(1.310 MAX)
.722 ±.030
5.711 ±.030
8.173 ±.100
5X 8.000±1.000 INCH LEADWIRE LENGTH
2X 2.000±.010
2X 1.150±.030
2X .255±.030
.255±.030
.216±.030
1.380 ±.030
.693±.030
1.250±.015
.825 ±.010
1.193±.010
.430 ±.005 OVER ANTI-ROTATION BOSSES
3.423 ±.030
2X 2.813±.010
⌀1.063 ±.030
1.320 MAX.
.893±.030
.453 ±.030 X 1.800 ±.030 GROOVE
7.500 MAX.
(4.715 ELECTRICAL CONTROL TRAVEL)
4.815±.050 MECHANICAL STROKE
9.261±.030 MECHANICAL RETRACT POSITION
11.719±.030 ELECTRICAL NULL POSITION
BONDING STRAP PER 8746F-33-24
CASTING SURFACE ONLY TO BE PRIMED AND FREE OF PAINT
4X #8-32 x .124±.010 THREAD DEPTH MAXIMUM ALLOWABLE FASTENER DEPTH IS .1875 FROM SURFACE
(WIRES NOT SHOWN)
POWER DRIVE MODULE
ACTUATOR AND GEARBOX MODULE
7/16-12 ACME SCREW
4.715 ELEC. STROKE
POSITION CONTROL MODULE
11 - PARTS TO BE MASKED DURING PAINTING.
10 - ACTUATOR WILL BE FINISHED WITH ONE COAT OF EPOXY PER MIL-C-22750. COLOR SHALL BE 17886 WHITE PER FED-STD-595.
9 - HOLES AND WIRE GROOVE ARE NOT TO BE SEALED
8 - THIS UNIT IS NOT EQUIPPED WITH NON-JAMMING MECHANICAL STOPS. MECHANICAL STOPS WILL JAM UNDER FULL SPEED IMPACT.
7 - OPERATING TEMPERATURE RANGE IS -55°C TO +70°C
6 - MAXIMUM ACTUATOR WEIGHT IS 3.2 LBS.
5 - THE ACTUATOR ULTIMATE STRUCTURAL LOAD IS 1050 LB
4 - ACTUATOR FREEPLAY IS .007 MAX, MEASURED WITH A ±15 LB OPPOSING LOAD
3 - ALL EXTERNAL SCREWS ARE SAFETY WIRED
2 - ALLOW .010 FOR PAINT BUILD-UP ON PAINTED SURFACES
1 - UNIT HAS BUILT-IN JACKSCREW ANTI-ROTATION.
NOTES: UNLESS OTHERWISE SPECIFIED
ENVELOPE DRAWING
THIRD ANGLE PROJECTION
2A7209A
PART NUMBER
CONTRACT NO.
JAYNIE NACHA
CHRIS DOELL
CHRIS DOELL
CHRIS DOELL
PRODUCTS CORP
OUTBOARD FLAP
SIZE D
CAGE CODE 19710
DWG NO. 2A7209



FIELD DIRECTOR CHARACTERISTICS AT UNIT TEMPERATURE OF +25°C

EXCITATION FREQUENCY	(KHZ)	25
EXCITATION VOLTAGE	(VRMS)	3.0
INPUT CURRENT	(AMPS)	0.043
OUTPUT TRANSFORMATION RATIO	(L-N)	1:1

3Ø TACHOMETER ELECTRICAL CHARACTERISTICS

PARAMETERS		LIMITS
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
CW ROTATION [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

FIELD DIRECTOR ALIGNMENT

SHAFT POSITION	MOTOR CURRENT			FIELD DIRECTOR OUTPUT		
	A	B	C	A	B	C
I	0	+	–	OUT	IN	NULL
II	–	0	+	NULL	OUT	IN
III	+	–	0	IN	NULL	OUT

WHEN MOTOR CURRENT IS CHANGED FROM POSITION I TO POSITION II, AND POSITION II TO POSITION III, SHAFT ROTATION TO BE CW. FIELD DIRECTOR NULLS AT POSITIONS I, II, AND III SHALL BE INCREASING IN PHASE WITH ADDITIONAL CW SHAFT ROTATION.

CW MOTOR SHAFT ROTATION RESULTS IN ACTUATOR EXTENSION WHEN VIEWED FROM SHAFT END.

RESOLVER CHARACTERISTICS AT UNIT TEMPERATURE OF +23°C ±5°C

ROTOR AS PRIMARY	INPUT VOLTAGE @ 3200Hz	(VOLTS)	7.0
	INPUT CURRENT	(AMPS)	.035 MAX.
	INPUT POWER	(WATTS)	.178 MAX.
	OUTPUT VOLTAGE	(VOLTS)	7.0 ±10%
	PHASE SHIFT	(DEG. LEAD)	10 MAX.
D.C. RESISTANCE	ROTOR	(OHMS)	14 NOM.
	STATOR	(OHMS)	13 NOM.
IMPEDANCE	ZRO	(OHMS)	603 + j1212 NOM
	ZSS	(OHMS)	375 + j1265 NOM
NULL VOLTAGE		(MV)	33.6 MAX.
ACCURACY (MAX. ERROR FROM E.Z.)		(MIN)	±10.24
ACCURACY (MAX. ERROR FROM E.Z.)		(INCHES)	±0.070
TRANSFORMATION RATIO			1.000 ±10%

SIZE	CAGE CODE	DWG NO.
D	19710	2A7209
SCALE NONE	REV LTR --	SHEET 2 OF 2

DWG NO. 2A7209

MPC Products

BOM EXPLOSION REPORT

Part Number 2A7180Z210A
Part Revision -
Part Description LINEAR ACTUATOR

PRODUCTION RELEASED

Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
0	Sales P/N	2A7180Z210A		LINEAR ACTUATOR				
.1	Document	2A7210	-	LINEAR ACTUATOR	0	REF		
.1	Part	2A71480210-1	--	LINEAR ACTUATOR	1	1		
..2	Part	2A72480210-1	--	FINAL ASSEMBLY	1	1		
...3	Part	2A83512001-1	--	PLATE, MOUNTING, FEEDBACK ASSEMBLY	1	1.000		
....4	Part	2A84512001-3	A	PLATE, MOUNTING, FEEDBACK	1	1.000		
.....5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
....4	Part	MS21209C0215	--	INSERT, SCREW THREAD, HELI-COIL .086-56 X .129 (1.5 D)	2	3.000		
....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	0.050		
...3	Part	2A83401006-6	A	HOUSING, SLIDER, ASSEMBLY	2	1.000		
....4	Document	2A83401006	A	HOUSING, SLIDER ASSEMBLY	0	REF		
....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	0	REF		
....4	Part	2A84401002-13	E	HOUSING, SLIDER	1	1.000		
.....5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
.....5	Document	2A84401002	--	HOUSING, SLIDER CO#39455 REV.	0	REF		
.....5	Document	2A85902005-1	--	ENGINEERING INSTRUCTIONS 1.0930-40 UNJS-3B THDS	0	REF		
.....5	Document	9999951800-5	A	XTRSN, 6.500 LONG ALUM. 6061-T651, QQ-A-200/8	0	REF		
......6	Document	9999951800	--	XTRSN, 9.125 LONG CO#39823 REV.	0	REF		
....4	Part	MS21209C0425	--	INSERT, SCREW THREAD, HELI-COIL .112-40 X 2.5 DIA.	2	4.000		
...4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	1.000		
...3	Part	2A84422002-3	C	SLIDER, POSITION 5	3	1.000		
...3	Part	2A83486005-3	A	COVER ASSEMBLY, HELI-COIL, POSITION 5L & 5R	4	1.000		
....4	Part	2A84486008-5	C	COVER CASTING REWORK POSITION 5L & 5R	1	1.000		
.....5	Part	2A84486007-3	D	COVER INVESTMENT CASTING	0	1.000		
...4	Part	MS21209C0610	--	INSERT, SCREW THREAD, HELI-COIL 6-32, .138L	2	4.000		

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...3	Screw	2A84568001-2	B	SCREW, ACME 7/16-12	5	1.000		
....4	Document	2A84568001	B	SCREW, ACME, 7/16-12	0	REF		
....4	Document	2A85902004-1	A	ENGINEERING INSTRUCTIONS STUB ACME THREADS 7/16-12-6C	0	REF		
....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
...3	Part	2A84567001-1	A	NUT, ACME, 7/16-12	6	1.000		
.....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
...3	Bearing	2A84575002-2	--	BEARING, 3/4 LINEAR	7	1.000		
....4	Document	2A84575002	--	BEARING, LINEAR, 3/4"	0	REF		
...3	Part	2A83401008-3	A	HOUSING, JIG-BORED ASSEMBLY	8	1.000		
....4	Document	9995902224A	F	HELI-COIL INSERTION INSTRUCTION	0	REF		
....4	Part	2A83401005-3	B	HOUSING, JIG-BORED	1	1.000		
....4	Part	MS21209C0320	--	NUT, HELI-COIL INSERT #3-48, .198	2	2.000		
....4	Part	MS21209C0320	--	NUT, HELI-COIL INSERT #3-48, .198	3	2.000		
....4	Part	MS21209C0220	--	INSERT, SCREW THREAD, HELI-COIL .086-56 X 2.0 DIA.	4	4.000		

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....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	5	0.050		
...3	Part	2A83532002-1	--	CLEVIS ASSEMBLY	9	1.000		
....4	Part	2A84532002-1	A	CLEVIS FOR MS14103-4	1	1.000		
.....5	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....4	Part	MS14103-4	–	BEARING, PLAIN, SELF-LUBRICATINGSELF-ALIGNING, LOW SPEED	2	1.000		
...3	Part	2A84567002-1	A	NUT, RETAINER	10	1.000		
....4	Document	9995902004A	J	INSTRUCTIONS, ENGINEERING ANODIZING OF ALUMINUM PARTS	0	REF		
...3	Part	2A44413003A	–	ADAPTER, THREADED	11	1.000		
....4	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
...3	Hobbed/Shaped	2A84514001-3	B	GEAR, PRESS-ON, 68T / 64DP	12	1.000		
....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
...3	Part	2A44560001A	B	WASHER, PLAIN	13	1.000		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...3	Part	2994556370A	–	SPACER	14	1.000		
...3	Part	2994557380-3	--	SEAL, O-RING, FLUOROSILICONE, 2.614 ID X .070 W	15	1.000		
...3	Part	2A84560001-1	–	WASHER, PLAIN	16	1.000		

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....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...3	Part	2994557107-6	--	SEAL ASSEMBLY, SPRING LOADED 1/16" CROSS SECTION	17	2.000		
....4	Document	2994557107	--	SEAL ASSEMBLY, SHAFT, SPRING LOADED - 1/16" NOMINAL CROSS-SE	0	REF		
...3	Hobbed/Shaped	2A83513004-1	--	GEAR ASSY, PINION 12T/72DP - 39T/96DP	18	1.000		
....4	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
....4	Hobbed/Shaped	2A84513004-1	--	GEAR, PINION 12T/72DP	1	1.000		
....4	Hobbed/Shaped	2A84524001-1	--	GEAR, BLANK	2	1.000		
...3	Hobbed/Shaped	2A83513005-1	--	GEAR ASSY, PINION 12T/72DP - 40T/72DP	19	1.000		
....4	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		

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....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
....4	Hobbed/Shaped	2A84513005-1	--	GEAR, PINION 12T / 72DP	1	1.000		
....4	Hobbed/Shaped	2A84524004-1	--	GEAR, BLANK	2	1.000		
...3	Hobbed/Shaped	2A83513006-3	A	GEAR ASSY, PINION 40T/64DP - 72T/72DP	20	1.000		
....4	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
....4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
....4	Hobbed/Shaped	2A84513003-3	A	GEAR, PINION 40T / 64DP	1	1.000		
....4	Hobbed/Shaped	2A84524005-1	--	GEAR, BLANK	2	1.000		
...3	Bearing	9994575428D	AM	BEARING, BALL, ANNULAR, FLANGED	21	4.000		
....4	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
....4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
...3	Bearing	9994575449B	AM	BEARING, BALL, ANNULAR, FLANGED	22	2.000		
....4	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
....4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
...3	Hobbed/Shaped	2994511007-1	B	ANTI-BACKLASH GEAR 68T/64DP 25 DEG PA	23	1.000		
...3	Bearing	9994575863A	N	BEARING P13-P15	24	2.000		
....4	Document	9994575831/870	L	BEARING 36524 INA. CO#	0	REF		

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....4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
...3	Part	1ED1200005-1	--	BLDC MOTOR / F.D. TACH / BRAKE	25	1.000		
....4	Part	1ED2200005-1	A	FINAL ASSEMBLY, BLDC MOTOR / FD TACH / BRAKE	0	1.000		
.....5	Document	1995902027A	C	INSTRUCTIONS, ENGINEERING FINAL ASSEMBLY, CAPS, MOTORS, MOTOR-TACHS & MTR ALTERNATORS	0	REF		
.....5	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....5	Document	9995902021A	J	INSTRUCTIONS, ENGINEERING USE AND APPLICATION OF "LOCTITE" SEALANT	0	REF		
.....5	Part	1BD3405010-1	C	STATOR & HOUSING ASSY, SIZE D BLDC MOTOR, SIDE LEAD EXIT	2	1.000		
.....6	Document	1BD3405010	C	STATOR & HOUSING ASSY, SIZE D BLDC MOTOR, SIDE LEAD EXIT	0	REF		
.....6	Part	9995400003A	B	INSTRUCTIONS, ENGINEERING ASSEMBLY, STATOR AND HOUSING (MOTOR AND MOTOR TACHOMETER)	0	REF		
.....6	Document	9995412001A	F	INSTRUCTIONS, ENGINEERING IDENTIFICATION MARKING OF SERVO COMPONENTS	0	REF		
.....6	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....6	Part	1BD3404032-1	C	WINDING ASSY, BLDC MOTOR, 4 POLE, THREE PHASE, OPEN BORE	49	1.000		
.....7	Document	1995902007A	B	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF MOTOR STATOR WINDING ASSEMBLY	0	REF		
.....7	Document	1BD3404032	C	WINDING ASSY, BLDC MOTOR, 4 POLE, THREE PHASE, OPEN BORE	0	REF		

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.....7	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
.....7	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....7	Document	9995906002A	5	INSTRUCTION, INSPECTION	0	REF		
.....7	Part	11D3406005-1	A	STACK, TYPE, 12 SLOT, OPEN BORE MODIFIED D MOTOR	68	1.000		
.....8	Document	11D3406005	A	STACK, TYPE, 12 SLOT, OPEN BORE MODIFIED D MOTOR	0	REF		
.....8	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....8	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....8	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....8	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....8	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	REF		
.....8	Part	11D4406023-1	--	LAMINATION, TYPE, STATOR, SIZE D, 12 SLOT, OPEN BORE, M-19	91	37.000		
.....8	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	92	0.020		
.....8	Part	9999957002A	C	VARNISH, EPOXY	95	0.200		
.....7	Part	M16878/6BFB9	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND WHT	73	24.000		
.....7	Part	M16878/6BFB2	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND RED	76	24.000		

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.....7	Part	M16878/6BFB4	--	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND YEL	77	24.000		
.....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	80	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	81	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	82	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999952091-2	--	MOLDING 3/8 IN. POLYIMIDE TAPE	86	1.000		
.....7	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)	87	0.050		
.....7	Part	722HNAT	--	LACING TAPE NOMEX, .055W X.010THK (MIL-T-43435, SZ4, FIN. C)	88	0.300		
.....7	Part	9999957002A	C	VARNISH, EPOXY	91	0.200		
.....7	Part	9994543081A	C	SLOT WEDGE	92	12.000		
.....8	Document	9994543081/099	C	SLOT WEDGE	0	REF		
.....7	Part	9994542120A	F	INSULATOR, SLOT .810 X .002 THK	93	4.000		
.....8	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....6	Part	11D4401006-3	D	HOUSING, D MOTOR, .700 STACK HEIGHT, SQUARE FLANGE	50	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Part	11D4402004-1	C	BELL, END, FOR PRESS-IN FIELD DIRECTOR	51	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	52	0.001		
.....6	Part	1254544001A	A	GROMMET	54	1.000		
.....7	Document	1254544001/006	A	GROMMET	0	REF		

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.....6	Part	9994565002L	--	RING, RETAINING, REWORK	56	1.000		
.....7	Part	9994565106A	C	RETAINING RING, BORE .500DX.035T	0	1.000		
.....8	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....6	Part	9999957002A	C	VARNISH, EPOXY	63	0.200		
.....6	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	65	1.500		
...6	Part	9999957029A	D	PRIMER, SILICONE	66	1.500		
.....5	Part	1ED3433004-1	--	ROTOR ASSY, D BLDC MOTOR-11 FD, DC TACH, 11 BRAKE	3	1.000		
.....6	Hobbed/Shaped	1ED4A12005-1	A	SHAFT, ROTOR, D BLDC MOTOR-FD, DC TACH, BRAKE	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....7	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....8	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Part	1B94462056A	H	MAGNET, FOUR POLE, FULL SECTORNEO 35, NORTH	2	2.000		
.....7	Document	1B94462052/069	H	MAGNET, FOUR POLE, FULL SECTOR, NEO 35	0	REF		
.....6	Part	1B94462074A	H	MAGNET, FOUR POLE, FULL SECTORNEO 35, SOUTH	3	2.000		
.....7	Document	1B94462070/087	H	MAGNET, FOUR POLE, FULL SECTOR, NEO 35	0	REF		
.....6	Part	1B94422005A	AA	SLEEVE, ROTOR, BDC MOTOR D-L-BDC	4	2.000		
.....7	Document	1B94422001/024	AA	SLEEVE, ROTOR, BRUSHLESS DC MOTOR	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		

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.....6	Part	9999957253A	C	EPOXY ADHESIVE, 2 PART DOLPH'S CR-1056B & CC-1056A	5	0.050		
.....5	Part	1B53405127-1	–	STATOR & HOUSING ASSEMBLY, FD, PRESS-IN	4	1.000		
.....6	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....6	Part	1B54401011-1	A	HOUSING, FIELD DIRECTOR & TACH, PRESS-IN	1	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....7	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....7	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	0	0.500		
.....6	Part	1B53404804A	N	WINDING ASSY F.D. 3 PHASE CMF202/203	2	1.000		
.....7	Document	1995902009A	E	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF ADJUSTMENT STUD & WINDING ASSY	0	REF		
.....7	Document	1B53404800/805	N	WINDING ASSEMBLY, 4 POLE, 30, 12 SLOT, FIELD DIRECTOR	0	REF		
.....7	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
.....7	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....7	Document	9995902228A	A	INSTRUCTIONS, ENGINEERING INSPECT.INSTRUCT.F/TERM & FORM FIELD DIR. WINDGS & ASSY STATR	0	REF		
.....7	Part	719C406002A	A	TYPE STACK 6PDCMTR	68	1.000		
.....8	Document	719C406001/200	A	STACK, TYPE	0	REF		
.....8	Part	715D406002A	C	LAMINATION (12 SLOT)	91	10.000		

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.....8	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	92	0.001		
.....8	Part	9999957002A	C	VARNISH, EPOXY	93	0.200		
.....7	Part	9994543079A	U	SLOT WEDGES F.D.	69	12.000		
.....8	Document	9994543051/080	U	SLOT WEDGE	0	REF		
.....7	Part	9994542102A	F	INSULATOR, SLOT, ROLL	70	12.000		
.....8	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....7	Part	M16878/6BDB29	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND RED/WHT	71	40.000		
.....7	Part	M16878/6BDB09	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND BLK/WHT	72	40.000		
.....7	Part	M16878/6BDB1	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BROWN	73	40.000		
.....7	Part	M16878/6BDB2	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, RED	75	40.000		
.....7	Part	M16878/6BDB0	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BLACK	76	40.000		
.....7	Part	M16878/6BDB3	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND ORG	77	40.000		
.....7	Part	9999581036A	B	WIRE, MAGNET W-1177/15 36 AWG J-	79	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG J-	80	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG J-	81	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG J-	82	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	86	1.000		
.....7	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)	87	0.050		
.....7	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	88	0.300		

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.....7	Part	9999957002A	C	VARNISH, EPOXY	89	1.000		
.....6	Part	1454544001A	A	GROMMET	3	1.000		
.....6	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	4	0.001		
.....6	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	6	1.500		
.....6	Part	9999957029A	D	PRIMER, SILICONE	7	1.500		
.....6	Part	9999957002A	C	VARNISH, EPOXY	8	0.200		
.....5	Part	9994559500-112	AK	SHIM, WASHER .494 X .376 X .002 THK	5	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-113	AK	SHIM, WASHER .494 X .376 X .003 THK	6	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-116	AK	SHIM, WASHER .494 X .376 X .010 THK	7	2.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-114	AK	SHIM, WASHER .494 X .376 X .006 THK	8	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-115	AK	SHIM, WASHER .494 X .376 X .008 THK	9	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-110	AK	SHIM, WASHER .494 X .270 X .010 THK	10	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994562103C	D	WASHER, SPRING WASH WAVE S	11	1.000		
.....6	Document	9994562101/111	D	WASHER, WAVE SPRING	0	REF		
.....5	Part	MS16625-4050	—	RING, RETAINING, INTERNAL, BASIC CORRES. STL, .035W .500 BORE	13	1.000		
.....5	Bearing	1994575030B	AA	BEARING, BALL, ANNULAR, 15 18 D R2	15	2.000		
.....6	Document	1994575001/061	AA	BEARING, BALL, ANNULAR	0	REF		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
.....5	Part	7194556040A	--	SPACER	17	1.000		

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.....6	Document	9999950310A	00	RND/PG .3126/.3124 416, COND T, RC24-30, ASTM-A582	0	0.400		
.....5	Part	715C424701L	A	ASSEMBLY, LAMINATION	18	1.000		
.....6	Part	715C424021A	B	LAMINATION ASSEMBLY (4 POLE)	0	1.000		
.....7	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....7	Part	9995406007A	3	ENGINEERING INSTRUCATIONS	0	REF		
.....7	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....7	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....7	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....7	Part	715D424007A	–	ROTOR LAMINATION (4 POLE)	1	14.000		
.....7	Part	9999957002A	C	VARNISH, EPOXY	2	0.200		
.....5	Part	1C94556002-1	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	19	2.000		
.....6	Document	1C94556002	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....6	Part	1C94556002-3	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....7	Document	1C94556002	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Part	9994567831B	1	SPECIAL NUT	21	2.000		

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.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Part	8S53404021A	K	WINDING ASSY BDC TACH 3 PHASE WITH "SPIDER"STACK 2A8206	23	1.000		
.....6	Document	1995902009A	E	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF ADJUSTMENT STUD & WINDING ASSY	0	REF		
.....6	Document	8S53404019/024	B	WINDING ASSY BDC TACH 3 PHASE CO30612 REV.	0	REF		
.....6	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
.....6	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....6	Document	9995906002A	5	INSTRUCTION, INSPECTION	0	REF		
.....6	Part	119C410054A	G	SPIDER STACK .925O.D/.625BORE.100 LONG (BDC TACH)	68	1.000		
.....7	Document	119C410050/079	G	SPIDER STACK "D" O.D./"E" BORECO30106 REV.	0	REF		
.....7	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....7	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....7	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....7	Document	9995906008A	C	INSTRUCTIONS, INSPECTION FOR STUD & INNNER STATOR ASSEMBLIES	0	REF		
.....7	Part	11DD410010A	B	LAMINATION, SPIDER, 12 SLOT	91	7.000		
.....6	Part	9994543079A	U	SLOT WEDGES F.D.	69	12.000		

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.....7	Document	9994543051/080	U	SLOT WEDGE	0	REF		
.....6	Part	9994542133B	F	INSULATOR, SLOT 75E-M80	70	10.000		
.....7	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....6	Part	M16878/6BDB4	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, YELLOW	73	24.000		
.....6	Part	M16878/6BDB8	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND GRY	74	24.000		
.....6	Part	M16878/6BDB6	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BLUE	75	24.000		
.....6	Part	M16878/6BDB5	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, GREEN	76	24.000		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	80	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	81	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	82	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	86	1.000		
.....6	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)	87	0.050		
.....6	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	88	0.600		
.....6	Part	9999957002A	C	VARNISH, EPOXY	89	0.200		
.....5	Part	10D4544004-1	A	GROMMET, TEFLON, SNAP-IN	24	1.000		
.....5	Part	1B53461001A	D	MAGNET ASSEMBLY BRUSHLESS D.C. COMMUTATOR, 4 POLE	25	2.000		
.....6	Document	7195902002A	D	INSTRUCTIONS, ENGINEERING CEMENTING OF MAGNET ASSEMBLIES	0	REF		
.....6	Part	1B54556001A	A	SPACER, MAGNET, FOUR POLE BDC TACH	1	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		

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.....6	Part	1B54462001A	–	MAGNET, BDC COMMUTATOR	2	2.000		
.....7	Document	1B54462001/002	–	MAGNET, BDC COMMUTATOR	0	REF		
.....7	Document	9995902157A	A	POLARITY DESIGNATION AND MEASUREMENT OF PERMANENT MAGNET STRENGTH	0	REF		
.....7	Document	9995902206A	B	SPECIFICATION, MATERIAL, MAGNETIC, SAMARIUM COBALT 28 MGOE	0	REF		
.....7	Document	9995902207A	B	INSTRUCTIONS, ENGINEERING PROCEDURE, MAGNETIC TESTING (MAGNETIC COMPARATOR)	0	REF		
.....6	Part	1B54462002A	–	MAGNET, BDC COMMUTATOR 11-BDC COMM-S	3	2.000		
.....7	Document	1B54462001/002	–	MAGNET, BDC COMMUTATOR	0	REF		
.....7	Document	9995902157A	A	POLARITY DESIGNATION AND MEASUREMENT OF PERMANENT MAGNET STRENGTH	0	REF		
.....7	Document	9995902206A	B	SPECIFICATION, MATERIAL, MAGNETIC, SAMARIUM COBALT 28 MGOE	0	REF		
.....7	Document	9995902207A	B	INSTRUCTIONS, ENGINEERING PROCEDURE, MAGNETIC TESTING (MAGNETIC COMPARATOR)	0	REF		
.....6	Part	1B54422004A	–	SLEEVE, MAGNET ASSEMBLY, BDC COMMUTATOR	4	2.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....7	Document	9999950039A	10	RND .750 416, COND T, RC24-32, ASTM-A582	0	0.300		
.....8	Document	9999950031/060	10	STAINLESS STEEL - TYPE 416	0	REF		
.....6	Part	9999957267-1	–	HIGH TEMPERATURE EPOXY TRA-BOND 223F01	5	0.050		
.....6	Part	2994569845L	W	PIN, SPRING .062D-.110L	7	1.000		

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.....7	Part	2994569234A	G	PIN .062D-.188L	0	1.000		
.....8	Document	2994569200/234	G	PIN, SPIROL	0	REF		
.....7	Document	2994569835/864	W	PIN, SPRING	0	REF		
.....5	Part	9994560001-85	AG	WASHER, FLAT .375 X .254 X .025 THK	26	1.000		
.....6	Document	9994560001	AG	WASHER, FLAT	0	REF		
.....5	Part	1R53450001-1	A	BRAKE ASSEMBLY, HYSTERESIS	27	1.000		
.....6	Document	9995902021A	J	INSTRUCTIONS, ENGINEERING USE AND APPLICATION OF "LOCTITE" SEALANT	0	REF		
.....6	Part	1R54401001-1	B	HOUSING, BRAKE, PRESS-IN	1	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Part	1R94462001-2	A	MAGNET, HYSTERESIS BRAKE, CIRCUMFERENTIAL, 0.100 L	2	1.000		
.....7	Document	1R94462001	A	MAGNET, HYSTERESIS BRAKE, CIRCUMFERENTIAL ORIENTATION	0	REF		
.....6	Part	9999957004A	G	RETAINING COMPOUND	3	0.200		
.....5	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	44	1.500		
.....5	Part	9999957029A	D	PRIMER, SILICONE	45	1.500		
.....5	Part	9999957004A	G	RETAINING COMPOUND	46	0.500		
.....5	Part	1ED6412004-1	--	STAMP, IDENTIFICATION, OFFSET	50	0.010		
....4	Document	1ED5906002	B	TEST SHEET, BLDC MOTOR, FD/TACH/BRAKE	0	1.000		
....4	Document	1ED5918002	--	DESIGN HIGHLIGHT REVIEW	0	1.000		
...3	Part	3E31200120-1	A	RESOLVER, BRUSHLESS, SIZE 8, GEARED	26	1.000		
....4	Part	3E32200120-1	C	FINAL ASSEMBLY, BRUSHLESS, GEARED SIZE: 8	0	1.000		
.....5	Part	2995521001B	A	ASSEMBLY AND INSPECTION OF ANTI- BACKLASH GEAR ASSB.	0	REF		

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.....5	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....5	Document	3E35906120	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	1.000		
.....5	Document	9995412007A	A	INSTRUCTIONS, ENGINEERING IDENTIFICATION MARKING FOR COMPONENTS WITH AIR CURE INK	0	REF		
.....5	Document	9995902021A	J	INSTRUCTIONS, ENGINEERING USE AND APPLICATION OF "LOCTITE" SEALANT	0	REF		
.....5	Document	9995902145A	A	INSTRUCTIONS, ENGINEERING PROCEDURE F/AUTOMATING METER'G OF LUBRICANT TO GEARHEAD ASSYS	0	REF		
.....5	Part	3E31200122-1	A	BRUSHLESS, SIZE: 8 SINGLE	1	1.000		
.....6	Part	3E32200122-1	B	FINAL ASSEMBLY, SINGLE, SIZE 9 GHD INPUT	0	1.000		
.....7	Document	3E35902001A	--	ENG INSTRUCTIONS	0	REF		
.....7	Document	3E35906119	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	REF		
.....7	Document	3E35906120	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	REF		
.....7	Document	3E35906122	A	TEST REPORT, BRUSHLESS, SIZE: 8 SINGLE	0	1.000		
.....7	Part	3E3C405122-1	--	STATOR & HOUSING ASSY SIZE 8, BRUSHLESS	1	1.000		
.....8	Document	9995902232A	D	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF SYNCHRO & RESOLVER WINDING	0	REF		
.....8	Part	3E34401016-3	B	HOUSING, BRUSHLESS, SINGLE, SIZE 9 GHD INPUT	1	1.000		
.....9	Document	1135902018A	--	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		

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.....9	Document	2595902054A	1	ENGINEERING INSTRUCTIONS .4375-72 NS THREADS	0	REF		
.....9	Document	3E34401010/020	D	HOUSING, SIZE 8	0	REF		
.....9	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....9	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....9	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	0	0.005		
.....8	Part	3E33404122-1	–	WINDING ASSEMBLY, SIZE 8, BRUSHLESS	2	1.000		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Document	9995902825A	A	INSTRUCTIONS, ENGINEERING INSERTION AND TERMINATION OF SYNHRO WINDING ASSEMBLIES	0	REF		
.....9	Part	3E33406007A	D	TYPE STACK, STATOR 16 SLOT SIZE 8	1	1.000		
.....10	Document	3E33406001/025	D	TYPE STACK, STATOR, SIZE: 8	0	REF		
.....10	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....10	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....10	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....10	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	REF		
.....10	Part	3E94410007A	–	LAMINATION SZ 8 16 SLOT	1	26.000		
.....10	Part	9999953001A	A	POWDER MATERIAL, EPOXY	2	0.050		

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.....10	Part	9999957002A	C	VARNISH, EPOXY	3	0.050		
.....10	Part	9999958073A	A	ONE, ONE, ONE, TRICHLOROETHANE INHIBITED	4	0.100		
.....10	Part	9999958004A	B	ACETONE	5	0.100		
.....9	Part	9999581206A	H	WIRE, MAGNET, #35 SML	2	0.010		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	3	3.000		
.....9	Part	9994542110A	F	INSULATOR, SLOT .002 .445	4	12.000		
.....10	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....9	Part	3E99962001A	A	LACING CORD	5	0.500		
.....10	Document	3E99962001/007	A	LACING CORD	0	REF		
.....9	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	6	0.001		
.....9	Part	9999954016B	B	MATERIALS, LIQUID	7	0.001		
.....9	Part	M16878/6BCB2	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, RED	8	24.000		
.....9	Part	M16878/6BCB0	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLACK	9	24.000		
.....9	Part	M16878/6BCB4	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, YELLOW	10	24.000		
.....9	Part	M16878/6BCB6	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLUE	11	24.000		
.....8	Part	3E34402700M	2	END BELL, RESOLVER	3	1.000		
.....9	Part	3E34402100A	1	END BELL, RESOLVER	0	1.000		
.....8	Part	3E93452047A	AL	BOBBIN WINDING ASSY, STATOR SIZE 8, BRUSHLESS	4	1.000		
.....9	Document	3E93452031/060	AL	BOBBIN WINDING, STATOR	0	REF		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Part	3E34452002A	E	BOBBIN, STATOR	1	1.000		
.....10	Document	9995902287A	B	INSTRUCTIONS, ENGINEERING TRANSFER MOLDING FUNCTIONS, SAFETY, SETUP AND PRODUCTION	0	REF		

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.....10	Part	9999952103A	F	MOLDING, EPOXY	0	0.250		
.....11	Document	9999952100/130	D	MOLDING, EPOXY CO#38294 INA.	0	REF		
.....9	Part	9999581206A	H	WIRE, MAGNET, #35 SML	2	0.005		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	3	1.000		
.....9	Part	M16878/6BCB29	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, RED/WHTE	4	24.000		
.....9	Part	M16878/6BCB09	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLK/WHT	5	24.000		
.....9	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	6	0.100		
.....9	Part	9999957207A	–	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	7	0.001		
.....9	Part	9999957250A	–	SOLDER, BAR (60%SN, 40%PB)	8	0.001		
.....9	Part	9994969003A	A	TAPE, INSULATION, ELECTRICAL	9	0.001		
.....8	Part	3E34407102B	2	RETURN PATH, STATOR	5	1.000		
.....9	Document	9995902200A	A	INSTRUCTIONS, ENGINEERING ANNEALING AND OXIDE RESISTANCE COATING OF ALLE.4750 & CAR. 49	0	REF		
.....8	Part	3E34407101C	2	RETURN PATH, STATOR	6	1.000		
.....9	Document	9995902200A	A	INSTRUCTIONS, ENGINEERING ANNEALING AND OXIDE RESISTANCE COATING OF ALLE.4750 & CAR. 49	0	REF		
.....8	Part	9999957207A	–	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	7	0.001		
.....7	Part	3E3C433122-1	–	ROTOR ASSEMBLY, SIZE 8, BRUSHLESS, ABL INPUT	2	1.000		
.....8	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....8	Document	9995902232A	D	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF SYNCHRO & RESOLVER WINDING	0	REF		

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.....8	Part	3E33424122-1	--	ROTOR WINDING ASSY, SIZE 8, BRUSHLESS ABL INPUT	1	1.000		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Document	9995902825A	A	INSTRUCTIONS, ENGINEERING INSERTION AND TERMINATION OF SYNHRO WINDING ASSEMBLIES	0	REF		
.....9	Part	3E33410011A	C	SPIDER STACK, ROTOR, SIZE: 8, 12 SLOTS, SKEW: 12 DEG.	1	1.000		
.....10	Document	3E33410001/025	C	SPIDER STACK, ROTOR, SIZE 8	0	REF		
.....10	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	1.000		
.....10	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	1.000		
.....10	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	1.000		
.....10	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	1.000		
.....10	Part	3E94424008A	--	LAMINATION SZ 8 12 SLOT	1	24.000		
.....10	Part	9999953001A	A	POWDER MATERIAL, EPOXY	2	0.050		
.....10	Part	9999957002A	C	VARNISH, EPOXY	3	0.050		
.....10	Part	9999958004A	B	ACETONE	4	0.100		
.....9	Part	3E34421115-1	--	ROTOR SHAFT, SINGLE, ABL INPUT	2	1.000		
.....10	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....9	Part	9999954072A	A	LIQUID MATERIAL, RED POLYURETHANE INSULATOR, SYNTHITE ER-41	3	0.001		

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.....9	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	4	0.001		
.....9	Part	9994542108A	F	INSULATOR, SLOT .002 .390	5	10.000		
.....10	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....9	Part	9999581211A	H	WIRE, MAGNET #41 AWG, SML	6	0.010		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	7	1.000		
.....9	Part	9994565803A	--	RING, RETAINING (CRESCENT)	8	1.000		
.....9	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	9	0.001		
.....9	Part	9999954016B	B	MATERIALS, LIQUID	10	0.001		
.....8	Part	3E93452009A	AD	BOBBIN WINDING ASSY, SIZE 8 BRUSHLESS, ROTOR	2	1.000		
.....9	Document	3E93452001/030	AD	BOBBIN WINDING ASSY, ROTOR CO#35224 REV.	0	REF		
.....9	Part	3E34452100A	D	BOBBIN, ROTOR	1	1.000		
.....10	Document	9999950004A	D	RND, .500 DIA CARPENTER 49, MIL-N-14411	0	0.548		
.....11	Document	9999950001/005	D	MATERIAL, METAL, FERROUS, NICKEL-IRON, HIGH PERMEABILITY ALL	0	REF		
.....9	Part	9999581211A	H	WIRE, MAGNET #41 AWG, SML	2	0.050		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9994969003A	A	TAPE, INSULATION, ELECTRICAL	3	2.000		
.....9	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	4	0.020		
.....8	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	3	0.001		
.....8	Part	3E99962001A	A	LACING CORD	4	1.000		
.....9	Document	3E99962001/007	A	LACING CORD	0	REF		
.....8	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	5	0.001		
.....8	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	6	1.000		

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.....8	Part	9999954016B	B	MATERIALS, LIQUID	7	0.001		
.....7	Part	9994565104A	C	RETAINING RING T.438 .025	3	1.000		
.....8	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....7	Bearing	1994575107A	W	BEARING, BALL, PRECISION .410 O.D., .125 I.D.	4	2.000		
.....8	Document	1994575103/152	W	BEARING, BALL PRECISION	0	REF		
.....7	Part	3E34486001A	D	COVER, THREADED	5	1.000		
.....8	Document	9999950313A		RND/PG .49985/.50015 416, COND T, RC24-30, ASTM-A582	0	0.230		
.....7	Part	9994560077A	AE	WASHER, PLAIN	6	1.000		
.....7	Part	9994559500-94	AK	SHIM, WASHER .370 X .295 X .002 THK	7	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-95	AK	SHIM, WASHER .370 X .295 X .003 THK	8	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-96	AK	SHIM, WASHER .370 X .295 X .006 THK	9	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-97	AK	SHIM, WASHER .370 X .295 X .008 THK	10	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-98	AK	SHIM, WASHER .370 X .295 X .010 THK	11	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9999957004A	G	RETAINING COMPOUND	15	0.001		
.....7	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	16	0.001		
.....5	Part	3M9C522001A	B	HOUSING ASSEMBLY, GEARHEAD, SPUR, SIZE 9	2	1.000		
.....6	Document	1135902018A	--	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Hobbed/Shaped	3994511033-1	--	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	4	1.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Part	2994455036A	M	SPRING, ANTI-BACKLASH	5	1.000		
.....6	Document	2994455035/049	M	SPRING, ANTI-BACKLASH	0	REF		
.....5	Hobbed/Shaped	3994511034-1	–	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	6	1.000		
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Bearing	9994575408B	AM	BEARING, BALL, ANNULAR, FLANGED	7	8.000		
.....6	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
.....5	Part	3M13511009-1	–	ANTI-BACKLASH GEAR ASSEMBLY, SIZE 9 (42R-120DP/12E-120DP)	8	1.000		
.....6	Part	2995521001B	A	ASSEMBLY AND INSPECTION OF ANTI- BACKLASH GEAR ASSB.	0	REF		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Hobbed/Shaped	3M94513020-1	–	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		

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.....6	Hobbed/Shaped	399D511136-13	B	GEAR, ANTI-BACKLASH, HOBBED, PRESS-ON, 42R-120DP	2	1.000		
.....7	Document	399D511136	B	GEAR, ANTI-BACKLASH	0	REF		
.....6	Part	2994455019A	B	SPRING, ANTI-BACKLASH	3	1.000		
.....7	Document	2994455001/019	B	SPRING 227-R71	0	REF		
.....6	Hobbed/Shaped	399D511136-15	B	GEAR, ANTI-BACKLASH, HOBBED, FREE RUNNING, 42R-120DP	4	1.000		
.....7	Document	399D511136	B	GEAR, ANTI-BACKLASH	0	REF		
.....6	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	5	0.001		
.....5	Hobbed/Shaped	3M13515011-1	–	GEAR ASSEMBLY, SPUR, SIZE 9 (42R-120DP/12E-120DP)	9	1.000		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513021-1	–	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524009A	D	GEAR BLANK, (42R-120) FOR PRESS-ON PINIONS	2	1.000		
.....7	Document	3M94524005/019	D	GEAR, BLANK (.0939 I.D.)	0	REF		
.....5	Hobbed/Shaped	3M13515012-1	–	GEAR ASSEMBLY, SPUR, SIZE 9 (29E-120DP/12E-120DP)	10	1.000		

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.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513022-1	–	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524010A	D	GEAR BLANK, (29E-120) FOR PRESS-ON PINIONS	2	1.000		
.....7	Document	3M94524005/019	D	GEAR, BLANK (.0939 I.D.)	0	REF		
....5	Hobbed/Shaped	3M13515014-1	–	GEAR ASSEMBLY, SPUR, SIZE 9 (42R-120DP/25-120DP)	11	1.000		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513023-1	–	GEAR, PINION, HOBBED, SIZE 9 (25T-120DP)	1	1.000		

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.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524036-1	B	GEAR BLANK - .0939 I.D.	2	1.000		
.....7	Document	3M94524036	B	GEAR BLANK - .0939 I.D.	0	REF		
.....5	Part	3M14507023-1	–	SLEEVE, MOUNTING, GEARHEAD, SIZE 9	14	1.000		
.....6	Document	1135902018A	–	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Hobbed/Shaped	3994521003-1	A	SHAFT, OUTPUT, GEARHEAD, SIZE: 9, HOBBED/12E-120	15	1.000		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Bearing	32C4575001A	A	BEARING, BALL (BALL GAGE RETAINER	16	2.000		
.....6	Part	9999959036A	1	LUBRICANT SILICONE GREASE (DC-33) (LIGHT CONSISTENCY)	0	5.500		
.....5	Part	9994565107A	C	RETAINING RING, INTERNAL BASIC.375 OD, .026 THK	17	2.000		
.....6	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....5	Part	9994559500-88	AK	SHIM, WASHER X .250 X .002 THK	.370 19	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-89	AK	SHIM, WASHER X .250 X .003 THK	.370 20	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-90	AK	SHIM, WASHER X .250 X .006 THK	.370 21	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-91	AK	SHIM, WASHER X .250 X .008 THK	.370 22	3.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		

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.....5	Part	9994559500-92	AK	SHIM, WASHER .370 X .250 X .010 THK	23	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994562036A	C	WASHER, WAVE SPRING	24	1.000		
.....6	Document	9994562036/045	C	WASHER, WAVE SPRING	0	REF		
.....5	Part	9994559500-86	AK	SHIM, WASHER .370 X .193 X .008 THK	25	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	2994569214A	G	PIN .052D-.125L	35	1.000		
.....6	Document	2994569200/234	G	PIN, SPIROL	0	REF		
.....5	Part	2994556290A	--	SPACER	37	1.000		
.....5	Part	3E36412120-1	--	STAMP, IDENTIFICATION, OFFSET	40	0.010		
.....5	Part	9999957004A	G	RETAINING COMPOUND	50	0.020		
.....5	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	51	0.020		
.....5	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	52	0.001		
.....5	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	53	0.001		
.....5	Part	9999959079A	C	MIXTURE, BRAYCOTE 1632 AND MOLYCOTE Z POWDER	55	0.001		
.....6	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	0	10.000		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	16.000		
.....5	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	56	0.750		
.....5	Part	9999957029A	D	PRIMER, SILICONE	57	0.300		
....4	Document	3E35918120	--	DESIGN HIGHLIGHT REVIEW	0	1.000		
...3	Part	2994557380-2	--	SEAL, O-RING, FLUOROSILICONE, 1.057 ID X .070 W	27	1.000		
...3	Part	2994557380-1	A	SEAL, O-RING	28	1.000		
...3	Part	2A83532001-1	--	CLEVIS ASSEMBLY	29	1.000		
....4	Part	2A84532001-1	--	CLEVIS, (POSITION 5)	1	1.000		

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.....5	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....4	Part	MS14103-4	–	BEARING, PLAIN, SELF-LUBRICATINGSELF-ALIGNING, LOW SPEED	1	1.000		
...3	Part	2B74567009A	B	NUT	30	1.000		
....4	Document	MIL-STD-1907	–	INSPECTION, SOUNDNESS REQUIREMENTS	0	REF		
....4	Document	MIL-STD-6866	–	INSPECTION, LIQUID PENETRANT	0	REF		
....4	Document	QQ-P-35	–	PASSIVATION TREATMENTS FOR CORROSION-RESISTING STEEL	0	REF		
...3	Part	2A84461001-1	–	RETAINER, SEAL	31	1.000		
....4	Document	2A85902005-1	–	ENGINEERING INSTRUCTIONS 1.0930-40 UNJS-3B THDS	0	REF		
...3	Screw	MS16995-2	–	SCREW, #2-56 X .250 SAME AS 998-D568-108A REV. C	32	3.000		
...3	Part	2994487165A	D	CLAMP (SERVO MOUNTING)	33	3.000		
....4	Document	2994487164/170	D	CLAMP (SERVO MOUNTING)	0	REF		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...3	Part	2A84504001-1	–	KEY	34	1.000		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
...3	Screw	NAS1352C03-6	–	SCREW	35	2.000		
...3	Screw	NAS1352C03-12	–	SCREW, CAP, SOCKET HEAD, CORR-RES#3-48 X .250 LG PASSIVATED	36	2.000		
...3	Screw	998D568248A	D	SCREW #4-40X1.500	37	3.000		

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el	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
	Document	998D568001/999	E	MACHINE SCREW	0	REF		
	Part	2994563025-1	--	LOCK WASHER	38	1.000		
	Part	2994567154-1	--	SPANNER NUT	39	1.000		
	Part	MTC100-BF1-P32	--	CONNECTOR, BOX MOUNT, 20 PIN	40	1.000		
	Part	MTCP-BS1-P34	B	CONNECTOR, BOX MOUNT, 5 PIN	41	1.000		
	Screw	2A84568002-1	A	SCREW, ELECTRICAL CONNECTOR	42	4.000		
	Part	D-128-0042	--	SOLDER SLEEVE	43	28.000		
	Part	2994560065-1	--	WASHER, THREAD SEAL	44	4.000		
	Screw	NAS1352C02-8	--	SCREW	45	4.000		
	Part	CTA-0079	--	PIN, CONTACT, SIZE 16, SIZE 16	46	5.000		
	Part	9999958209A	A	COATING, EPOXY, TWO COMPONENT, WHITE, LUSTERLESS	47	6.000		
	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	48	6.000		
	Part	9999957004A	G	RETAINING COMPOUND	49	1.000		
	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	50	60.000		
	Part	M23053/5-103-0	--	INSULATION SLEEVING, HEATSHRINKID .093 ID .046 THK .020 BLK	51	10.000		
	Part	M23053/5-105-0	--	INSULATION SLEEVING, HEATSHRINKID .187 ID .093 THK .020 BLK	52	10.000		
	Part	MS20995C20	--	WIRE, SAFETY OR LOCK .020 DIA.	53	30.000		
	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	54	4.000		
	Part	M23053/5-107-0	--	INSULATION SLEEVING, HEATSHRINKID .375 ID .187 THK .025 BLK	55	18.000		
	Part	3994560012A	--	WASHER, PLAIN, RVDT CLUSTER MOUNT, #4-40 SCREW	56	1.000		
	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
	Part	740F-33-24	--	JUMPER ASSEMBLY POWER	57	1.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
..3	Part	2A74412210-1	--	NAMEPLATE	58	1.000		
..3	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	59	1.000		
..3	Screw	998D568256A	D	SCREW #4-40X1.750	60	1.000		
...4	Document	998D568001/999	E	MACHINE SCREW	0	REF		
..3	Part	2994483151-1	--	SWITCH, THERMAL	61	1.000		
..3	Part	M16878/6BEB0	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD24AWG, 7STRD, 200C, 250V, BLACK	62	14.000		
..3	Part	M16878/6BEB2	--	WIRE, PTFE, 200 DEG. C, 250 VOLT #24 AWG, 7 STRAND, RED	63	14.000		
..3	Part	M16878/6BEB5	--	WIRE, PTFE, 200 DEG. C, 250 VOLT 24 AWG, 7 STRAND, GRN	64	14.000		
..3	Part	M23053/5-104-0	--	INSULATION SLEEVING, HEATSHRINKID .125 ID .062 THK .020 BLK	65	14.000		

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Part Number 2A7180Z210A
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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
0	Sales P/N	2A7180Z210A		LINEAR ACTUATOR				
.1	Document	2A7210	-	LINEAR ACTUATOR	0	REF		
.1	Part	2A71480210-1	–	LINEAR ACTUATOR	1	1		
..2	Part	2A72480210-1	–	FINAL ASSEMBLY	1	1		
...3	Part	2A83512001-1	–	PLATE, MOUNTING, FEEDBACK ASSEMBLY	1	1.000		
....4	Part	2A84512001-3	A	PLATE, MOUNTING, FEEDBACK	1	1.000		
.....5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
....4	Part	MS21209C0215	–	INSERT, SCREW THREAD, HELI-COIL .086-56 X .129 (1.5 D)	2	3.000		
....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	0.050		
...3	Part	2A83401006-6	A	HOUSING, SLIDER, ASSEMBLY	2	1.000		
....4	Document	2A83401006	A	HOUSING, SLIDER ASSEMBLY	0	REF		
....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	0	REF		
....4	Part	2A84401002-13	E	HOUSING, SLIDER	1	1.000		
.....5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
.....5	Document	2A84401002	–	HOUSING, SLIDER CO#39455 REV.	0	REF		
.....5	Document	2A85902005-1	–	ENGINEERING INSTRUCTIONS 1.0930-40 UNJS-3B THDS	0	REF		
.....5	Document	9999951800-5	A	XTRSN, 6.500 LONG ALUM. 6061-T651, QQ-A-200/8	0	REF		
.....6	Document	9999951800	–	XTRSN, 9.125 LONG CO#39823 REV.	0	REF		
....4	Part	MS21209C0425	–	INSERT, SCREW THREAD, HELI-COIL .112-40 X 2.5 DIA.	2	4.000		
....4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	1.000		
...3	Part	2A84422002-3	C	SLIDER, POSITION 5	3	1.000		
...3	Part	2A83486005-3	A	COVER ASSEMBLY, HELI-COIL, POSITION 5L & 5R	4	1.000		
....4	Part	2A84486008-5	C	COVER CASTING REWORK POSITION 5L & 5R	1	1.000		
....5	Part	2A84486007-3	D	COVER INVESTMENT CASTING	0	1.000		
...4	Part	MS21209C0610	–	INSERT, SCREW THREAD, HELI-COIL 6-32, .138L	2	4.000		

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MPC Products

BOM EXPLOSION REPORT

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·vel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
	Sales P/N	2B7180Z219A		LINEAR ACTUATOR				
	Document	2B7219	-	LINEAR ACTUATOR	0	REF		
	Part	2B71480219-1	--	LINEAR ACTUATOR	1	1		
	Part	2B72480219-1	A	ACTUATOR, LINEAR	1	1		
3	Part	2A83512001-1	--	PLATE, MOUNTING, FEEDBACK ASSEMBLY	1	1.000		
4	Part	2A84512001-3	A	PLATE, MOUNTING, FEEDBACK	1	1.000		
.5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
4	Part	MS21209C0215	--	INSERT, SCREW THREAD, HELI-COIL .086-56 X .129 (1.5 D)	2	3.000		
4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	0.050		
3	Part	2A83401006-6	A	HOUSING, SLIDER, ASSEMBLY	2	1.000		
4	Document	2A83401006	A	HOUSING, SLIDER ASSEMBLY	0	REF		
4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	0	REF		
4	Part	2A84401002-13	E	HOUSING, SLIDER	1	1.000		
5	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
5	Document	2A84401002	--	HOUSING, SLIDER CO#39455 REV.	0	REF		
5	Document	2A85902005-1	--	ENGINEERING INSTRUCTIONS 1.0930-40 UNJS-3B THDS	0	REF		
5	Document	9999951800-5	A	XTRSN, 6.500 LONG ALUM. 6061-T651, QQ-A-200/8	0	REF		
.6	Document	9999951800	--	XTRSN, 9.125 LONG CO#39823 REV.	0	REF		
4	Part	MS21209C0425	--	INSERT, SCREW THREAD, HELI-COIL .112-40 X 2.5 DIA.	2	4.000		
4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	3	1.000		
	Part	2A84422002-3	C	SLIDER, POSITION 5	3	1.000		
	Part	2A83486005-3	A	COVER ASSEMBLY, HELI-COIL, POSITION 5L & 5R	4	1.000		
4	Part	2A84486006-5	C	COVER CASTING REWORK POSITION 5L & 5R	1	1.000		
5	Part	2A84486007-3	D	COVER INVESTMENT CASTING	0	1.000		
4	Part	MS21209C0610	--	INSERT, SCREW THREAD, HELI-COIL 6-32, .138L	2	4.000		
	Part	2B73568008-1	--	SCREW ASSY, BALL (3/8-8 4 CIRCUIT)	5	1.000		

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evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
..4	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
ł	Document	2995902090A	A	INSTRUCTIONS, ENGINEERING BALL-SCREW NUT ASSEMBLY	0	REF		
ł	Document	9995902834A	A	INSTRUCTIONS, ENGINEERING CLEANLINESS SPECIFICATION FOR BALL SCREW ASSEMBLIES	0	REF		
..4	Screw	2BDD568203A	D	SCREW, BALL	1	1.000		
...5	Document	2BDD568200/250	D	BALL SCREW, 3/8-8	0	REF		
..4	Part	2BDD567008-1	A	NUT, BALL (5 CIRCUIT)	2	1.000		
..4	Part	2BDD504005B	D	KEY, RETURN, 4 RETURN PATHS, 3/8-8 BS RET .062 DIA BALL NOM	3	1.000		
...5	Document	2BDD504004/010	B	KEY, RETURN, 3 RETURN PATHS, CO#36731 REV.	0	REF		
..4	Part	2B94550030A	N	BALL .0620 DIA.	4	88.000		
...5	Document	2B94550001/100	N	BALLS, PRECISION SPHERICAL	0	REF		
..4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	5	20.000		
3	Part	2994483151-1	--	SWITCH, THERMAL	6	1.000		
3	Bearing	2A84575002-2	--	BEARING, 3/4 LINEAR	7	1.000		
.4	Document	2A84575002	--	BEARING, LINEAR, 3/4	0	REF		
3	Part	2B73401023-1	--	HOUSING, JIG-BORED ASSEMBLY	8	1.000		
.4	Document	9995902224A	F	HELI-COIL INSERTION INSTRUCTION	0	REF		
.4	Part	2B73401022-1	--	HOUSING, JIG-BORED	1	1.000		
.4	Part	MS21209C0320	--	NUT, HELI-COIL INSERT #3-48, .198	2	2.000		
..4	Part	MS21209C0320	--	NUT, HELI-COIL INSERT #3-48, .198	3	2.000		
..4	Part	MS21209C0220	--	INSERT, SCREW THREAD, HELI-COIL .086-56 X 2.0 DIA.	4	4.000		
..4	Part	9999958074A	D	PRIMER, ZINC-CHROMATE	5	0.050		
.3	Part	2A83532002-1	--	CLEVIS ASSEMBLY	9	1.000		
.4	Part	2A84532002-1	A	CLEVIS FOR MS14103-4	1	1.000		
..5	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		

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4	Part	MS14103-4	--	BEARING, PLAIN, SELF-LUBRICATINGSELF-ALIGNING, LOW SPEED	2	1.000		
3	Part	2A84567002-1	A	NUT, RETAINER	10	1.000		
4	Document	9995902004A	J	INSTRUCTIONS, ENGINEERING ANODIZING OF ALUMINUM PARTS	0	REF		
3	Part	2A44413003A	--	ADAPTER, THREADED	11	1.000		
4	Document	1995902002A	M	ENG INSTRUCTIONS MIL-C-5541 ALUM IRIDITE	0	REF		
3	Hobbed/Shaped	2A84514001-3	B	GEAR, PRESS-ON, 68T / 64DP	12	1.000		
4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
3	Part	2A44560001A	B	WASHER, PLAIN	13	1.000		
4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
3	Part	2994556370A	--	SPACER	14	1.000		
3	Part	2994557380-3	--	SEAL, O-RING, FLUOROSILICONE, 2.614 ID X .070 W	15	1.000		
3	Part	2A84560001-1	--	WASHER, PLAIN	16	1.000		
4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
3	Part	2994557107-6	--	SEAL ASSEMBLY, SPRING LOADED 1/16" CROSS SECTION	17	2.000		
4	Document	2994557107	--	SEAL ASSEMBLY, SHAFT, SPRING LOADED - 1/16" NOMINAL CROSS-SE	0	REF		
3	Part	2B73514002-1	--	GEAR ASSEMBLY 39T/96DP 17T/72 ENLARGED	18	1.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
...4	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	1.000		
...4	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	1.000		
...4	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	1.000		
....5	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
...4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	1.000		
...4	Part	2B74513014-1	–	GEAR, PINION 17T/72 ENLARGED	1	1.000		
..4	Hobbed/Shaped	2A84524001-1	–	GEAR, BLANK	2	1.000		
..3	Part	2B74513013-1	–	GEAR, IDLER 34T/72DP(ENL.)	19	1.000		
..3	Part	2B73510001-1	A	GEAR ASSY, SLIP CLUTCH 49T/72 DP (RED.)- 40T/64DP	20	1.000		
...4	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
...4	Part	2B74513012-1	–	PINION, GEAR, 40T - 64DP	1	1.000		
....5	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
...5	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
..4	Part	2B74524005-1	–	GEAR, SLIP CLUTCH 49T/72DP (ENLARGED)	2	1.000		
...5	Document	9995902008A	A	INSTRUCTIONS, ENGINEERING NETWORK ASSEMBLY	0	REF		
..4	Part	2A34560006-3	A	WASHER, PRECISION	3	2.000		

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evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
...5	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....6	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
...5	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
.4	Part	2A34560002-3	B	WASHER, BELLEVILLE	4	2.000		
...5	Document	2A34560002	B	WASHER, BELLEVILLE	0	REF		
...5	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.4	Part	2A34567003-1	A	NUT, SLIP CLUTCH, SPRING RETAINING	5	1.000		
.4	Part	9994559500-318	AK	SHIM, WASHER .330 X .265 X .001 THK	6	4.000		
..5	Document	9994559500	AK	SHIM - WASHER	0	REF		
.4	Part	9994559500-319	AK	SHIM, WASHER .330 X .265 X .005 THK	7	4.000		
..5	Document	9994559500	AK	SHIM - WASHER	0	REF		
.4	Part	9994559500-320	AK	SHIM, WASHER .330 X .265 X .010 THK	8	4.000		
...5	Document	9994559500	AK	SHIM - WASHER	0	REF		
.4	Part	9999957004A	G	RETAINING COMPOUND	9	0.500		
3	Bearing	9994575428D	AM	BEARING, BALL, ANNULAR, FLANGED	21	6.000		
.4	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
.4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
3	Hobbed/Shaped	2994511007-1	B	ANTI-BACKLASH GEAR 68T/64DP 25 DEG PA	23	1.000		
3	Bearing	9994575863A	N	BEARING P13-P15	24	2.000		
.4	Document	9994575831/870	L	BEARING CO# 36524 INA.	0	REF		
.4	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
3	Part	1CD1200045-1	--	BLDC MOTOR / F.D. /TACH	25	1		
.4	Part	1CD2200045-1	--	FINAL ASSEMBLY, BLDC MOTOR/FD/TACH	0	1.000		

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.evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
...5	Document	1995902027A	C	INSTRUCTIONS, ENGINEERING FINAL ASSEMBLY, CAPS, MOTORS, MOTOR-TACHS & MTR ALTERNATORS	0	REF		
...5	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
...5	Document	9995902021A	J	INSTRUCTIONS, ENGINEERING USE AND APPLICATION OF "LOCTITE" SEALANT	0	REF		
...5	Part	1BD3405010-1	C	STATOR & HOUSING ASSY, SIZE D BLDC MOTOR, SIDE LEAD EXIT	2	1.000		
....6	Document	1BD3405010	C	STATOR & HOUSING ASSY, SIZE D BLDC MOTOR, SIDE LEAD EXIT	0	REF		
....6	Part	9995400003A	B	INSTRUCTIONS, ENGINEERING ASSEMBLY, STATOR AND HOUSING (MOTOR AND MOTOR TACHOMETER)	0	REF		
....6	Document	9995412001A	F	INSTRUCTIONS, ENGINEERING IDENTIFICATION MARKING OF SERVO COMPONENTS	0	REF		
....6	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
....6	Part	1BD3404032-1	C	WINDING ASSY, BLDC MOTOR, 4 POLE, THREE PHASE, OPEN BORE	49	1.000		
.....7	Document	1995902007A	B	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF MOTOR STATOR WINDING ASSEMBLY	0	REF		
.....7	Document	1BD3404032	C	WINDING ASSY, BLDC MOTOR, 4 POLE, THREE PHASE, OPEN BORE	0	REF		
.....7	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
.....7	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....7	Document	9995906002A	5	INSTRUCTION, INSPECTION	0	REF		
.....7	Part	11D3406005-1	A	STACK, TYPE, 12 SLOT, OPEN BORE MODIFIED D MOTOR	68	1.000		

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evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....8	Document	11D3406005	A	STACK, TYPE, 12 SLOT, OPEN BORE MODIFIED D MOTOR	0	REF		
.....8	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....8	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....8	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....8	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....8	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	REF		
.....8	Part	11D4406023-1	--	LAMINATION, TYPE, STATOR, SIZE D, 12 SLOT, OPEN BORE, M-19	91	37.000		
.....8	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	92	0.020		
.....8	Part	9999957002A	C	VARNISH, EPOXY	95	0.200		
.....7	Part	M16878/6BFB9	--	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND WHT	73	24.000		
.....7	Part	M16878/6BFB2	--	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND RED	76	24.000		
.....7	Part	M16878/6BFB4	--	WIRE, PTFE, 200 DEG. C, 250 VOLT 22 AWG 7 STRAND YEL	77	24.000		
....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	80	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	81	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
....7	Part	9999581032A	B	WIRE, MAGNET J-W-1177/15 32 AWG	82	0.020		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....7	Part	9999952091-2	--	MOLDING 3/8 IN. POLYIMIDE TAPE	86	1.000		
....7	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)	87	0.050		
....7	Part	722HNAT	--	LACING TAPE NOMEX, .055W X.010THK (MIL-T-43435, SZ4, FIN. C)	88	0.300		

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.....7	Part	9999957002A	C	VARNISH, EPOXY	91	0.200		
.....7	Part	9994543081A	C	SLOT WEDGE	92	12.000		
.....8	Document	9994543081/099	C	SLOT WEDGE	0	REF		
.....7	Part	9994542120A	F	INSULATOR, SLOT .810 X .002 THK	93	4.000		
.....8	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....6	Part	11D4401006-3	D	HOUSING, D MOTOR, .700 STACK HEIGHT, SQUARE FLANGE	50	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Part	11D4402004-1	C	BELL, END, FOR PRESS-IN FIELD DIRECTOR	51	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	52	0.001		
.....6	Part	1254544001A	A	GROMMET	54	1.000		
.....7	Document	1254544001/006	A	GROMMET	0	REF		
.....6	Part	9994565002L	–	RING, RETAINING, REWORK	56	1.000		
.....7	Part	9994565106A	C	RETAINING RING, BORE .500DX.035T	0	1.000		
.....8	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....6	Part	9999957002A	C	VARNISH, EPOXY	63	0.200		
.....6	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	65	1.500		
.....6	Part	9999957029A	D	PRIMER, SILICONE	66	1.500		
....5	Part	1ED3433004-1	–	ROTOR ASSY, D BLDC MOTOR-11 FD, DC TACH, 11 BRAKE	3	1.000		
.....6	Hobbed/Shaped	1ED4A12005-1	A	SHAFT, ROTOR, D BLDC MOTOR-FD, DC TACH, BRAKE	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		

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.....7	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....8	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
....6	Part	1B94462056A	H	MAGNET, FOUR POLE, FULL SECTORNEO 35, NORTH	2	2.000		
.....7	Document	1B94462052/069	H	MAGNET, FOUR POLE, FULL SECTOR, NEO 35	0	REF		
....6	Part	1B94462074A	H	MAGNET, FOUR POLE, FULL SECTORNEO 35, SOUTH	3	2.000		
.....7	Document	1B94462070/087	H	MAGNET, FOUR POLE, FULL SECTOR, NEO 35	0	REF		
....6	Part	1B94422005A	AA	SLEEVE, ROTOR, BDC MOTOR D-L-BDC	4	2.000		
.....7	Document	1B94422001/024	AA	SLEEVE, ROTOR, BRUSHLESS DC MOTOR	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....6	Part	9999957253A	C	EPOXY ADHESIVE, 2 PART DOLPH'S CR-1056B & CC-1056A	5	0.050		
...5	Part	1B53405127-1	--	STATOR & HOUSING ASSEMBLY, FD, PRESS-IN	4	1.000		
....6	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
....6	Part	1B54401011-1	A	HOUSING, FIELD DIRECTOR & TACH, PRESS-IN	1	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....7	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....7	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	0	0.500		
....6	Part	1B53404804A	N	WINDING ASSY F.D. 3 PHASE CMF202/203	2	1.000		
.....7	Document	1995902009A	E	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF ADJUSTMENT STUD & WINDING ASSY	0	REF		

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.....7	Document	1B53404800/805	N	WINDING ASSEMBLY, 4 POLE, 30, 12 SLOT, FIELD DIRECTOR	0	REF		
.....7	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
.....7	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....7	Document	9995902228A	A	INSTRUCTIONS, ENGINEERING INSPECT.INSTRUCT.F/TERM & FORM FIELD DIR. WINDGS & ASSY STATR	0	REF		
.....7	Part	719C406002A	A	TYPE STACK 6PDCMTR	68	1.000		
.....8	Document	719C406001/200	A	STACK, TYPE	0	REF		
.....8	Part	715D406002A	C	LAMINATION (12 SLOT)	91	10.000		
.....8	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	92	0.001		
.....8	Part	9999957002A	C	VARNISH, EPOXY	93	0.200		
.....7	Part	9994543079A	U	SLOT WEDGES F.D.	69	12.000		
.....8	Document	9994543051/080	U	SLOT WEDGE	0	REF		
.....7	Part	9994542102A	F	INSULATOR, SLOT, ROLL	70	12.000		
.....8	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....7	Part	M16878/6BDB29	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND RED/WHT	71	40.000		
.....7	Part	M16878/6BDB09	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND BLK/WHT	72	40.000		
.....7	Part	M16878/6BDB1	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BROWN	73	40.000		
.....7	Part	M16878/6BDB2	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, RED	75	40.000		
.....7	Part	M16878/6BDB0	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BLACK	76	40.000		
.....7	Part	M16878/6BDB3	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND ORG	77	40.000		
.....7	Part	9999581036A	B	WIRE, MAGNET J-W-1177/15 36 AWG	79	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		

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evel	Part Type	Part Number	Rev	Description		Item	Qty	Ref Des	BOM Notes
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG	J-	80	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.		0	REF		
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG	J-	81	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.		0	REF		
.....7	Part	9999581040A	B	WIRE, MAGNET W-1177/15 40 AWG	J-	82	0.010		
.....8	Document	9999581018/045	B	MAGNET WIRE, HML.		0	REF		
.....7	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)		86	1.000		
.....7	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)		87	0.050		
.....7	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK		88	0.300		
.....7	Part	9999957002A	C	VARNISH, EPOXY		89	1.000		
....6	Part	1454544001A	A	GROMMET		3	1.000		
....6	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230		4	0.001		
....6	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY		5	1.500		
....6	Part	9999957029A	D	PRIMER, SILICONE		7	1.500		
....6	Part	9999957002A	C	VARNISH, EPOXY		8	0.200		
...5	Part	9994559500-112	AK	SHIM, WASHER X .376 X .002 THK	.494	5	1.000		
....6	Document	9994559500	AK	SHIM - WASHER		0	REF		
...5	Part	9994559500-113	AK	SHIM, WASHER X .376 X .003 THK	.494	6	1.000		
....6	Document	9994559500	AK	SHIM - WASHER		0	REF		
...5	Part	9994559500-116	AK	SHIM, WASHER X .376 X .010 THK	.494	7	2.000		
....6	Document	9994559500	AK	SHIM - WASHER		0	REF		
...5	Part	9994559500-114	AK	SHIM, WASHER X .376 X .006 THK	.494	8	1.000		
....6	Document	9994559500	AK	SHIM - WASHER		0	REF		
...5	Part	9994559500-115	AK	SHIM, WASHER X .376 X .008 THK	.494	9	1.000		
....6	Document	9994559500	AK	SHIM - WASHER		0	REF		
...5	Part	9994559500-110	AK	SHIM, WASHER X .270 X .010 THK	.494	10	1.000		
...6	Document	9994559500	AK	SHIM - WASHER		0	REF		

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.....5	Part	9994562103C	D	WASHER, SPRING WASH WAVE S	11	1.000		
.....6	Document	9994562101/111	D	WASHER, WAVE SPRING	0	REF		
.....5	Part	MS16625-4050	--	RING, RETAINING, INTERNAL, BASIC CORRES. STL, .035W .500 BORE	13	1.000		
.....5	Bearing	1994575030B	AA	BEARING, BALL, ANNULAR, 15 18 D R2	15	2.000		
.....6	Document	1994575001/061	AA	BEARING, BALL, ANNULAR	0	REF		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
.....5	Part	7194556040A	--	SPACER	17	1.000		
.....6	Document	9999950310A	00	RND/PG .3126/.3124 416, COND T, RC24-30, ASTM-A582	0	0.400		
.....5	Part	715C424701L	A	ASSEMBLY, LAMINATION	18	1.000		
.....6	Part	715C424021A	B	LAMINATION ASSEMBLY (4 POLE)	0	1.000		
.....7	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....7	Part	9995406007A	3	ENGINEERING INSTRUCATIONS	0	REF		
.....7	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....7	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....7	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....7	Part	715D424007A	--	ROTOR LAMINATION (4 POLE)	1	14.000		
.....7	Part	9999957002A	C	VARNISH, EPOXY	2	0.200		
....5	Part	1C94556002-1	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	19	2.000		
.....6	Document	1C94556002	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....6	Part	1C94556002-3	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....7	Document	1C94556002	A	SPACER, SHAFT, F.D. ROTOR ADJUSTING, KEYED	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		

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evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
...5	Part	9994567831B	1	SPECIAL NUT	21	2.000		
....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...5	Part	8S53404021A	K	WINDING ASSY BDC TACH 3 PHASE WITH "SPIDER"STACK 2A8206	23	1.000		
....6	Document	1995902009A	E	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF ADJUSTMENT STUD & WINDING ASSY	0	REF		
....6	Document	8S53404019/024	B	WINDING ASSY BDC TACH 3 PHASE CO30612 REV.	0	REF		
....6	Part	9995404001A	F	INSTRUCTIONS, ENGINEERING WINDING, INSERTION &TERMINATION OF MOTOR WINDING ASSEMBLIES	0	REF		
....6	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
....6	Document	9995906002A	5	INSTRUCTION, INSPECTION	0	REF		
....6	Part	119C410054A	G	SPIDER STACK .925O.D./.625BORE,100 LONG (BDC TACH)	68	1.000		
.....7	Document	119C410050/079	G	SPIDER STACK "D" O.D./"E" BORECO30106 REV.	0	REF		
.....7	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....7	Document	9995902093B	B	SET-UP OF SUNNEN PRECISION HONING MACHINE & HONING OF STACKS & ROTOR CASTINGS	0	REF		
.....7	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....7	Document	9995906008A	C	INSTRUCTIONS, INSPECTION FOR STUD & INNNER STATOR ASSEMBLIES	0	REF		
.....7	Part	11DD410010A	B	LAMINATION, SPIDER, 12 SLOT	91	7.000		
...6	Part	9994543079A	U	SLOT WEDGES F.D.	69	12.000		
.....7	Document	9994543051/080	U	SLOT WEDGE	0	REF		
....6	Part	9994542133B	F	INSULATOR, SLOT 75E-M80	70	10.000		
.....7	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		

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.....6	Part	M16878/6BDB4	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, YELLOW	73	24.000		
.....6	Part	M16878/6BDB8	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 26 AWG 7 STRAND GRY	74	24.000		
.....6	Part	M16878/6BDB6	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, BLUE	75	24.000		
.....6	Part	M16878/6BDB5	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD26AWG, 7STRD, 200C, 250V, GREEN	76	24.000		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	80	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	81	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999581035A	B	WIRE, MAGNET J-W-1177/15 35 AWG	82	0.010		
.....7	Document	9999581018/045	B	MAGNET WIRE, HML.	0	REF		
.....6	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	86	1.000		
.....6	Part	9999957003B	B	SOLDER, BAR (95% PB, 5% SN)	87	0.050		
.....6	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	88	0.600		
.....6	Part	9999957002A	C	VARNISH, EPOXY	89	0.200		
....5	Part	10D4544004-1	A	GROMMET, TEFLON, SNAP-IN	24	1.000		
....5	Part	1B53461001A	D	MAGNET ASSEMBLY BRUSHLESS D.C. COMMUTATOR, 4 POLE	25	1.000		
.....6	Document	7195902002A	D	INSTRUCTIONS, ENGINEERING CEMENTING OF MAGNET ASSEMBLIES	0	REF		
.....6	Part	1B54556001A	A	SPACER, MAGNET, FOUR POLE BDC TACH	1	1.000		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....6	Part	1B54462001A	–	MAGNET, BDC COMMUTATOR	2	2.000		
.....7	Document	1B54462001/002	–	MAGNET, BDC COMMUTATOR	0	REF		
.....7	Document	9995902157A	A	POLARITY DESIGNATION AND MEASUREMENT OF PERMANENT MAGNET STRENGTH	0	REF		
.....7	Document	9995902206A	B	SPECIFICATION, MATERIAL, MAGNETIC, SAMARIUM COBALT 28 MGOE	0	REF		

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...7	Document	9995902207A	B	INSTRUCTIONS, ENGINEERING PROCEDURE, MAGNETIC TESTING (MAGNETIC COMPARATOR)	0	REF		
..6	Part	1B54462002A	–	MAGNET, BDC COMMUTATOR 11-BDC COMM-S	3	2.000		
...7	Document	1B54462001/002	–	MAGNET, BDC COMMUTATOR	0	REF		
...7	Document	9995902157A	A	POLARITY DESIGNATION AND MEASUREMENT OF PERMANENT MAGNET STRENGTH	0	REF		
...7	Document	9995902206A	B	SPECIFICATION, MATERIAL, MAGNETIC, SAMARIUM COBALT 28 MGOE	0	REF		
...7	Document	9995902207A	B	INSTRUCTIONS, ENGINEERING PROCEDURE, MAGNETIC TESTING (MAGNETIC COMPARATOR)	0	REF		
..6	Part	1B54422004A	–	SLEEVE, MAGNET ASSEMBLY, BDC	4	2.000		
...7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...7	Document	9999950039A	10	RND .750 416, COND T, RC24-32, ASTM-A582	0	0.300		
....8	Document	9999950031/060	10	STAINLESS STEEL - TYPE 416	0	REF		
..6	Part	9999957267-1	–	HIGH TEMPERATURE EPOXY TRA-BOND 223F01	5	0.050		
..6	Part	2994569845L	W	PIN, SPRING .062D-.110L	7	1.000		
...7	Part	2994569234A	G	PIN .062D-.188L	0	1.000		
....8	Document	2994569200/234	G	PIN, SPIROL	0	REF		
...7	Document	2994569835/864	W	PIN, SPRING	0	REF		
5	Part	1R54401001-1	B	HOUSING, BRAKE, PRESS-IN	27	1.000		
.6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
5	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	44	1.500		
5	Part	9999957029A	D	PRIMER, SILICONE	45	1.500		
5	Part	9999957004A	G	RETAINING COMPOUND	46	0.500		
5	Part	1CD6412012-1	–	STAMP, IDENTIFICATION, OFFSET	50	0.010		
‡	Document	1CD5906007	–	TEST REPORT, BLDC MOTOR, FD, TACH	0	1.000		

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_evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
..3	Part	3E31200120-1	A	RESOLVER, BRUSHLESS, SIZE 8, GEARED	26	1.000		
...4	Part	3E32200120-1	C	FINAL ASSEMBLY, BRUSHLESS, GEARED SIZE: 8	0	1.000		
....5	Part	2995521001B	A	ASSEMBLY AND INSPECTION OF ANTI- BACKLASH GEAR ASSB.	0	REF		
....5	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
....5	Document	3E35906120	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	1.000		
....5	Document	9995412007A	A	INSTRUCTIONS, ENGINEERING IDENTIFICATION MARKING FOR COMPONENTS WITH AIR CURE INK	0	REF		
....5	Document	9995902021A	J	INSTRUCTIONS, ENGINEERING USE AND APPLICATION OF "LOCTITE" SEALANT	0	REF		
....5	Document	9995902145A	A	INSTRUCTIONS, ENGINEERING PROCEDURE F/AUTOMATING METER'G OF LUBRICANT TO GEARHEAD ASSYS	0	REF		
....5	Part	3E31200122-1	A	BRUSHLESS, SIZE: 8 SINGLE	1	1.000		
.....6	Part	3E32200122-1	B	FINAL ASSEMBLY, SINGLE, SIZE 9 GHD INPUT	0	1.000		
.....7	Document	3E35902001A	--	ENG INSTRUCTIONS	0	REF		
.....7	Document	3E35906119	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	REF		
.....7	Document	3E35906120	--	TEST REPORT, GEARED, BRUSHLESS, SIZE:8, SINGLE	0	REF		
.....7	Document	3E35906122	A	TEST REPORT, BRUSHLESS, SIZE: 8 SINGLE	0	1.000		
.....7	Part	3E3C405122-1	--	STATOR & HOUSING ASSY SIZE 8, BRUSHLESS	1	1.000		
.....8	Document	9995902232A	D	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF SYNCHRO & RESOLVER WINDING	0	REF		
.....8	Part	3E34401016-3	B	HOUSING, BRUSHLESS, SINGLE, SIZE 9 GHD INPUT	1	1.000		
.....9	Document	1135902018A	--	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....9	Document	2595902054A	1	ENGINEERING INSTRUCTIONS .4375-72 NS THREADS	0	REF		

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evel	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....9	Document	3E34401010/020	D	HOUSING, SIZE 8	0	REF		
.....9	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....9	Document	9995902248A	E	INSTRUCTIONS, ENGINEERING 3M-5230 BLUE EPOXY POWDER COATING PROCEDURE	0	REF		
.....9	Part	9999957216A	C	RESIN, EPOXY, ELECTRICAL, CLASS B, SCOTCHCAST 5230	0	0.005		
.....8	Part	3E33404122-1	--	WINDING ASSEMBLY, SIZE 8, BRUSHLESS	2	1.000		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Document	9995902825A	A	INSTRUCTIONS, ENGINEERING INSERTION AND TERMINATION OF SYNHRO WINDING ASSEMBLIES	0	REF		
.....9	Part	3E33406007A	D	TYPE STACK, STATOR 16 SLOT SIZE 8	1	1.000		
.....10	Document	3E33406001/025	D	TYPE STACK, STATOR, SIZE 8	0	REF		
.....10	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	REF		
.....10	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	REF		
.....10	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	REF		
.....10	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	REF		
.....10	Part	3E94410007A	--	LAMINATION SZ 8 16 SLOT	1	26.000		
.....10	Part	9999953001A	A	POWDER MATERIAL, EPOXY	2	0.050		
.....10	Part	9999957002A	C	VARNISH, EPOXY	3	0.050		
.....10	Part	9999958073A	A	ONE, ONE, ONE, TRICHLOROETHANE INHIBITED	4	0.100		
.....10	Part	9999958004A	B	ACETONE	5	0.100		
.....9	Part	9999581206A	H	WIRE, MAGNET, #35 SML	2	0.010		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		

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.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	3	3.000		
.....9	Part	9994542110A	F	INSULATOR, SLOT .002 .445	4	12.000		
.....10	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....9	Part	3E99962001A	A	LACING CORD	5	0.500		
.....10	Document	3E99962001/007	A	LACING CORD	0	REF		
.....9	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	6	0.001		
.....9	Part	9999954016B	B	MATERIALS, LIQUID	7	0.001		
.....9	Part	M16878/6BCB2	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, RED	8	24.000		
.....9	Part	M16878/6BCB0	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLACK	9	24.000		
.....9	Part	M16878/6BCB4	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, YELLOW	10	24.000		
.....9	Part	M16878/6BCB6	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLUE	11	24.000		
.....8	Part	3E34402700M	2	END BELL, RESOLVER	3	1.000		
.....9	Part	3E34402100A	1	END BELL, RESOLVER	0	1.000		
.....8	Part	3E93452047A	AL	BOBBIN WINDING ASSY, STATOR, SIZE 8, BRUSHLESS	4	1.000		
.....9	Document	3E93452031/060	AL	BOBBIN WINDING, STATOR	0	REF		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Part	3E34452002A	E	BOBBIN, STATOR	1	1.000		
.....10	Document	9995902287A	B	INSTRUCTIONS, ENGINEERING TRANSFER MOLDING FUNCTIONS, SAFETY, SETUP AND PRODUCTION	0	REF		
.....10	Part	9999952103A	F	MOLDING, EPOXY	0	0.250		
.....11	Document	9999952100/130	D	MOLDING, EPOXY CO#38294 INA.	0	REF		
.....9	Part	9999581206A	H	WIRE, MAGNET, #35 SML	2	0.005		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	3	1.000		
.....9	Part	M16878/6BCB29	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, RED/WHTE	4	24.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....10	Part	9995407003A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, DEGREASING OF	0	1.000		
.....10	Document	9995902214A	A	INSTRUCTIONS, ENGINEERING VARNISHING PROCEDURE FOR CEMENTING OF LAMINATED STACKS	0	1.000		
.....10	Document	9995902824A	B	INSTRUCTIONS, ENGINEERING COATING INSTRUCTIONS	0	1.000		
.....10	Part	3E94424008A	–	LAMINATION SZ 8 12 SLOT	1	24.000		
.....10	Part	9999953001A	A	POWDER MATERIAL, EPOXY	2	0.050		
.....10	Part	9999957002A	C	VARNISH, EPOXY	3	0.050		
.....10	Part	9999958004A	B	ACETONE	4	0.100		
.....9	Part	3E34421115-1	–	ROTOR SHAFT, SINGLE, ABL INPUT	2	1.000		
.....10	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....9	Part	9999954072A	A	LIQUID MATERIAL, RED POLYURETHANE INSULATOR, SYNTHITE ER-41	3	0.001		
.....9	Part	9999957207A	–	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	4	0.001		
.....9	Part	9994542108A	F	INSULATOR, SLOT .002 .390	5	10.000		
.....10	Document	9994542101/139	F	INSULATOR, SLOT, ROLL	0	REF		
.....9	Part	9999581211A	H	WIRE, MAGNET #41 AWG, SML	6	0.010		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	7	1.000		
.....9	Part	9994565803A	–	RING, RETAINING (CRESCENT)	8	1.000		
.....9	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	9	0.001		
.....9	Part	9999954016B	B	MATERIALS, LIQUID	10	0.001		
.....8	Part	3E93452009A	AD	BOBBIN WINDING ASSY, SIZE 8 BRUSHLESS, ROTOR	2	1.000		
.....9	Document	3E93452001/030	AD	BOBBIN WINDING ASSY, ROTOR CO#35224 REV.	0	REF		
.....9	Part	3E34452100A	D	BOBBIN, ROTOR	1	1.000		
.....10	Document	9999950004A	D	RND, .500 DIA CARPENTER 49, MIL-N-14411	0	0.548		

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.....9	Part	M16878/6BCB09	--	LEADWIRE, EXTRUDED, PTFE, CPR CTD28AWG, 7STRD, 200C, 250V, BLK/WHT	5	24.000		
.....9	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	6	0.100		
.....9	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	7	0.001		
.....9	Part	9999957250A	--	SOLDER, BAR (60%SN, 40%PB)	8	0.001		
.....9	Part	9994969003A	A	TAPE, INSULATION, ELECTRICAL	9	0.001		
.....8	Part	3E34407102B	2	RETURN PATH, STATOR	5	1.000		
.....9	Document	9995902200A	A	INSTRUCTIONS, ENGINEERING ANNEALING AND OXIDE RESISTANCE COATING OF ALLE.4750 & CAR. 49	0	REF		
.....8	Part	3E34407101C	2	RETURN PATH, STATOR	6	1.000		
.....9	Document	9995902200A	A	INSTRUCTIONS, ENGINEERING ANNEALING AND OXIDE RESISTANCE COATING OF ALLE.4750 & CAR. 49	0	REF		
.....8	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	7	0.001		
.....7	Part	3E3C433122-1	--	ROTOR ASSEMBLY, SIZE 8, BRUSHLESS, ABL INPUT	2	1.000		
.....8	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....8	Document	9995902232A	D	INSTRUCTIONS, ENGINEERING CAPILLARY IMPREGNATION OF SYNCHRO & RESOLVER WINDING	0	REF		
.....8	Part	3E33424122-1	--	ROTOR WINDING ASSY, SIZE 8, BRUSHLESS ABL INPUT	1	1.000		
.....9	Document	9995902009A	N	SOLDERING STANDARD	0	REF		
.....9	Document	9995902825A	A	INSTRUCTIONS, ENGINEERING INSERTION AND TERMINATION OF SYNHRO WINDING ASSEMBLIES	0	REF		
.....9	Part	3E33410011A	C	SPIDER STACK, ROTOR, SIZE: 8, 12 SLOTS, SKEW: 12 DEG.	1	1.000		
.....10	Document	3E33410001/025	C	SPIDER STACK, ROTOR, SIZE 8	0	REF		
.....10	Part	9995406008A	D	INSTRUCTIONS, ENGINEERING LAMINATIONS, STACK, PRE-ASSEM- BLY & INSPECTION OF	0	1.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9999957004A	G	RETAINING COMPOUND	15	0.001		
.....7	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	16	0.001		
....5	Part	3M9C522001A	B	HOUSING ASSEMBLY, GEARHEAD, SPUR, SIZE 9	2	1.000		
.....6	Document	1135902018A	–	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....5	Hobbed/Shaped	3994511033-1	–	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	4	1.000		
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....5	Part	2994455036A	M	SPRING, ANTI-BACKLASH	5	1.000		
.....6	Document	2994455035/049	M	SPRING, ANTI-BACKLASH	0	REF		
....5	Hobbed/Shaped	3994511034-1	–	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	6	1.000		
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....5	Bearing	9994575408B	AM	BEARING, BALL, ANNULAR, FLANGED	7	8.000		
.....6	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
....5	Part	3M13511009-1	–	ANTI-BACKLASH GEAR ASSEMBLY, SIZE 9 (42R-120DP/12E-120DP)	8	1.000		
.....6	Part	2995521001B	A	ASSEMBLY AND INSPECTION OF ANTI- BACKLASH GEAR ASSB.	0	REF		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....11	Document	9999950001/005	D	MATERIAL, METAL, FERROUS, NICKEL-IRON, HIGH PERMEABILITY ALL	0	REF		
.....9	Part	9999581211A	H	WIRE, MAGNET #41 AWG, SML	2	0.050		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9994969003A	A	TAPE, INSULATION, ELECTRICAL	3	2.000		
.....9	Part	9999957207A	–	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	4	0.020		
.....8	Part	9999957207A	–	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	3	0.001		
.....8	Part	3E99962001A	A	LACING CORD	4	1.000		
.....9	Document	3E99962001/007	A	LACING CORD	0	REF		
.....8	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	5	0.001		
.....8	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	6	1.000		
.....8	Part	9999954016B	B	MATERIALS, LIQUID	7	0.001		
.....7	Part	9994565104A	C	RETAINING RING T.438 .025	3	1.000		
.....8	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....7	Bearing	1994575107A	W	BEARING, BALL, PRECISION .410 O.D. .125 I.D.	4	2.000		
.....8	Document	1994575103/152	W	BEARING, BALL PRECISION	0	REF		
.....7	Part	3E34486001A	D	COVER, THREADED	5	1.000		
.....8	Document	9999950313A		RND/PG .49985/.50015 416, COND T, RC24-30, ASTM-A582	0	0.230		
.....7	Part	9994560077A	AE	WASHER, PLAIN	6	1.000		
.....7	Part	9994559500-94	AK	SHIM, WASHER .370 X .295 X .002 THK	7	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-95	AK	SHIM, WASHER .370 X .295 X .003 THK	8	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-96	AK	SHIM, WASHER .370 X .295 X .006 THK	9	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-97	AK	SHIM, WASHER .370 X .295 X .008 THK	10	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-98	AK	SHIM, WASHER .370 X .295 X .010 THK	11	1.000		

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.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9999957004A	G	RETAINING COMPOUND	15	0.001		
.....7	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	16	0.001		
.....5	Part	3M9C522001A	B	HOUSING ASSEMBLY, GEARHEAD, SPUR, SIZE 9	2	1.000		
.....6	Document	1135902018A	–	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Hobbed/Shaped	3994511033-1	–	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	4	1.000		
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Part	2994455036A	M	SPRING, ANTI-BACKLASH	5	1.000		
.....6	Document	2994455035/049	M	SPRING, ANTI-BACKLASH	0	REF		
.....5	Hobbed/Shaped	3994511034-1	–	GEAR, ANTI-BACKLASH, HOBBED (42R-120DP)	6	1.000		
.....6	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Bearing	9994575408B	AM	BEARING, BALL, ANNULAR, FLANGED	7	8.000		
.....6	Document	9994575400/499	AM	BEARING, BALL, ANNULAR - FLANGED	0	REF		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	REF		
.....5	Part	3M13511009-1	--	ANTI-BACKLASH GEAR ASSEMBLY, SIZE 9 (42R-120DP/12E-120DP)	8	1.000		
.....6	Part	2995521001B	A	ASSEMBLY AND INSPECTION OF ANTI- BACKLASH GEAR ASSB.	0	REF		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....11	Document	9999950001/005	D	MATERIAL, METAL, FERROUS, NICKEL-IRON, HIGH PERMEABILITY ALL	0	REF		
.....9	Part	9999581211A	H	WIRE, MAGNET #41 AWG, SML	2	0.050		
.....10	Document	9999581201/260	H	MAGNET WIRE, SML SINGLE INSULATION LAYER	0	REF		
.....9	Part	9994969003A	A	TAPE, INSULATION, ELECTRICAL	3	2.000		
.....9	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	4	0.020		
.....8	Part	9999957207A	--	RESIN, EPOXY, ELECTRICAL CLASS F, SCOTCHCAST 280	3	0.001		
.....8	Part	3E99962001A	A	LACING CORD	4	1.000		
.....9	Document	3E99962001/007	A	LACING CORD	0	REF		
.....8	Part	9999957054A	E	SOLDER WIRE, ROSIN CORE	5	0.001		
.....8	Part	9999952003A	5	TAPE TEFLON (PRESSURE SENSITIVE)	6	1.000		
.....8	Part	9999954016B	B	MATERIALS, LIQUID	7	0.001		
.....7	Part	9994565104A	C	RETAINING RING T.438 .025	3	1.000		
.....8	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....7	Bearing	1994575107A	W	BEARING, BALL, PRECISION .410 O.D. .125 I.D.	4	2.000		
.....8	Document	1994575103/152	W	BEARING, BALL PRECISION	0	REF		
.....7	Part	3E34486001A	D	COVER, THREADED	5	1.000		
.....8	Document	9999950313A		RND/PG .49985/.50015 416, COND T, RC24-30, ASTM-A582	0	0.230		
.....7	Part	9994560077A	AE	WASHER, PLAIN	6	1.000		
.....7	Part	9994559500-94	AK	SHIM, WASHER .370 X .295 X .002 THK	7	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-95	AK	SHIM, WASHER .370 X .295 X .003 THK	8	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-96	AK	SHIM, WASHER .370 X .295 X .006 THK	9	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-97	AK	SHIM, WASHER .370 X .295 X .008 THK	10	1.000		
.....8	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....7	Part	9994559500-98	AK	SHIM, WASHER .370 X .295 X .010 THK	11	1.000		

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.....7	Document	3M94524005/019	D	GEAR, BLANK (.0939 I.D.)	0	REF		
.....5	Hobbed/Shaped	3M13515012-1	--	GEAR ASSEMBLY, SPUR, SIZE 9 (29E-120DP/12E-120DP)	10	1.000		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513022-1	--	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524010A	D	GEAR BLANK, (29E-120) FOR PRESS-ON PINIONS	2	1.000		
.....7	Document	3M94524005/019	D	GEAR, BLANK (.0939 I.D.)	0	REF		
.....5	Hobbed/Shaped	3M13515014-1	--	GEAR ASSEMBLY, SPUR, SIZE 9 (42R-120DP/25-120DP)	11	1.000		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513023-1	--	GEAR, PINION, HOBBED, SIZE 9 (25T-120DP)	1	1.000		

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.....6	Hobbed/Shaped	3M94513020-1	–	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....7	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....6	Hobbed/Shaped	399D511136-13	B	GEAR, ANTI-BACKLASH, HOBBED, PRESS-ON, 42R-120DP	2	1.000		
.....7	Document	399D511136	B	GEAR, ANTI-BACKLASH	0	REF		
.....6	Part	2994455019A	B	SPRING, ANTI-BACKLASH	3	1.000		
.....7	Document	2994455001/019	B	SPRING 227-R71	0	REF		
.....6	Hobbed/Shaped	399D511136-15	B	GEAR, ANTI-BACKLASH, HOBBED, FREE RUNNING, 42R-120DP	4	1.000		
.....7	Document	399D511136	B	GEAR, ANTI-BACKLASH	0	REF		
.....6	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	5	0.001		
.....5	Hobbed/Shaped	3M13515011-1	--	GEAR ASSEMBLY, SPUR, SIZE 9 (42R-120DP/12E-120DP)	9	1.000		
.....6	Document	2995902026A	F	INSTRUCTIONS, ENGINEERING LASER WELDING OPERATIONS PROCEDURE	0	REF		
.....6	Document	9995515003A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR GEAR SHAFT ASSEMBLY	0	REF		
.....6	Document	9995902010C	D	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....7	Document	9095902107A	A	PROCEDURE FOR PACKAGING, CASE HARDENING, CLEANING & MICRO- DEBURRING OF STAINLESS STEEL	0	REF		
.....6	Hobbed/Shaped	3M94513021-1	–	GEAR, PINION, HOBBED, SIZE 9 (12E-120DP)	1	1.000		
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524009A	D	GEAR BLANK, (42R-120) FOR PRESS-ON PINIONS	2	1.000		

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MPC Products

BOM EXPLOSION REPORT

Part Number 2B7180Z219A
Part Revision -
Part Description LINEAR ACTUATOR

PRODUCTION RELEASE

Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....6	Document	9994562036/045	C	WASHER, WAVE SPRING	0	REF		
.....5	Part	9994559500-86	AK	SHIM, WASHER .370 X .193 X .008 THK	25	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	2994569214A	G	PIN .052D-.125L	35	1.000		
.....6	Document	2994569200/234	G	PIN, SPIROL	0	REF		
.....5	Part	2994556290A	–	SPACER	37	1.000		
.....5	Part	3E36412120-1	–	STAMP, IDENTIFICATION, OFFSET	40	0.010		
.....5	Part	9999957004A	G	RETAINING COMPOUND	50	0.020		
.....5	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	51	0.020		
.....5	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	52	0.001		
.....5	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	53	0.001		
.....5	Part	9999959079A	C	MIXTURE, BRAYCOTE 1632 AND MOLYCOTE Z POWDER	55	0.001		
.....6	Part	9999958097A	A	MOLYKOTE Z POWDER LUBRICANT (MOLYBDENUM DISULFIDE)	0	10.000		
.....6	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	0	16.000		
.....5	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	56	0.750		
.....5	Part	9999957029A	D	PRIMER, SILICONE	57	0.300		
....4	Document	3E35918120	–	DESIGN HIGHLIGHT REVIEW	0	1.000		
...3	Part	2994557380-2	–	SEAL, O-RING, FLUOROSILICONE, 1.057 ID X .070 W	27	1.000		
...3	Part	2994557380-1	A	SEAL, O-RING	28	1.000		
...3	Part	2A83532001-1	–	CLEVIS ASSEMBLY	29	1.000		
....4	Part	2A84532001-1	–	CLEVIS, (POSITION 5)	1	1.000		
.....5	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....4	Part	MS14103-4	–	BEARING, PLAIN, SELF-LUBRICATINGSELF-ALIGNING, LOW SPEED	1	1.000		
...3	Part	2B74567009A	B	NUT	30	1.000		
....4	Document	MIL-STD-1907	–	INSPECTION, SOUNDNESS REQUIREMENTS	0	REF		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
.....7	Document	9995513001A	B	INSTRUCTIONS, ENGINEERING INSPECTION INSTRUCTIONS FOR PINION SHAFT	0	REF		
.....6	Part	3M94524036-1	B	GEAR BLANK - .0939 I.D.	2	1.000		
.....7	Document	3M94524036	B	GEAR BLANK - .0939 I.D.	0	REF		
.....5	Part	3M14507023-1	--	SLEEVE, MOUNTING, GEARHEAD, SIZE 9	14	1.000		
.....6	Document	1135902018A	--	ENGINEERONG INSTRUCTIONS .8125-72NS THDS	0	REF		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Hobbed/Shaped	3994521003-1	A	SHAFT, OUTPUT, GEARHEAD, SIZE: 9, HOBBED/12E-120	15	1.000		
.....6	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
.....5	Bearing	32C4575001A	A	BEARING, BALL (BALL GAGE RETAINER	16	2.000		
.....6	Part	9999959036A	1	LUBRICANT SILICONE GREASE (DC33) (LIGHT CONSISTENCY)	0	5.500		
.....5	Part	9994565107A	C	RETAINING RING, INTERNAL BASIC.375 OD, .026 THK	17	2.000		
.....6	Document	9994565101/125	C	RING, RETAINING, INTERNAL, BASIC	0	REF		
.....5	Part	9994559500-88	AK	SHIM, WASHER .370 X .250 X .002 THK	19	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-89	AK	SHIM, WASHER .370 X .250 X .003 THK	20	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-90	AK	SHIM, WASHER .370 X .250 X .006 THK	21	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-91	AK	SHIM, WASHER .370 X .250 X .008 THK	22	3.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994559500-92	AK	SHIM, WASHER .370 X .250 X .010 THK	23	1.000		
.....6	Document	9994559500	AK	SHIM - WASHER	0	REF		
.....5	Part	9994562036A	C	WASHER, WAVE SPRING	24	1.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
....4	Document	MIL-STD-6866	–	INSPECTION, LIQUID PENETRANT	0	REF		
....4	Document	QQ-P-35	–	PASSIVATION TREATMENTS FOR CORROSION-RESISTING STEEL	0	REF		
...3	Part	2A84461001-1	–	RETAINER, SEAL	31	1.000		
....4	Document	2A85902005-1	–	ENGINEERING INSTRUCTIONS 1.0930-40 UNJS-3B THDS	0	REF		
...3	Screw	MS16995-2	–	SCREW, #2-56 X .250 SAME AS 998-D568-108A REV. C	32	3.000		
...3	Part	2994487165A	D	CLAMP (SERVO MOUNTING)	33	3.000		
....4	Document	2994487164/170	D	CLAMP (SERVO MOUNTING)	0	REF		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...3	Part	2A84504001-1	–	KEY	34	1.000		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
....4	Document	9995902088A	D	INSTRUCTIONS, ENGINEERING DRI-TOUCH CORROSION RETARDANT COATING	0	REF		
...3	Screw	NAS1352C03-6	–	SCREW	35	2.000		
...3	Screw	NAS1352C03-12	–	SCREW, CAP, SOCKET HEAD, CORR-RES#3-48 X .250 LG PASSIVATED	36	2.000		
...3	Screw	998D568248A	D	SCREW #4-40X1.500	37	3.000		
....4	Document	998D568001/999	E	MACHINE SCREW	0	REF		
...3	Part	2994563025-1	–	LOCK WASHER	38	1.000		
...3	Part	2994567154-1	–	SPANNER NUT	39	1.000		
...3	Part	M23053/5-105-0	–	INSULATION SLEEVING, HEATSHRINKID .187 ID .093 THK .020 BLK	41	10.000		
...3	Part	M23053/5-104-0	–	INSULATION SLEEVING, HEATSHRINKID .125 ID .062 THK .020 BLK	42	14.000		
...3	Part	2994560065-1	–	WASHER, THREAD SEAL	44	4.000		
...3	Screw	NAS1352C02-8	–	SCREW	45	4.000		
...3	Part	CTA-0079	–	PIN, CONTACT, SIZE 16, SIZE 16	46	5.000		

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Level	Part Type	Part Number	Rev	Description	Item	Qty	Ref Des	BOM Notes
...3	Part	9999958209A	A	COATING, EPOXY, TWO COMPONENT, WHITE, LUSTERLESS	47	6.000		
...3	Part	9999959045A	G	LUBRICANT, MICRONIC GREASE	48	6.000		
...3	Part	9999957004A	G	RETAINING COMPOUND	49	1.000		
...3	Part	9999962001A	B	LACING CORD TEFLON, PRESHRUNK	50	60.000		
...3	Part	M23053/5-103-0	–	INSULATION SLEEVING, HEATSHRINKID .093 ID .046 THK .020 BLK	51	10.000		
...3	Part	MS20995C20	–	WIRE, SAFETY OR LOCK .020 DIA.	53	30.000		
...3	Part	9999957019A	G	ADHESIVE/SEALANT, RTV SILICONE RUBBER, ONE PART, GRAY	54	4.000		
...3	Part	M23053/5-107-0	–	INSULATION SLEEVING, HEATSHRINKID .375 ID .187 THK .025 BLK	55	18.000		
...3	Part	3994560012A	–	WASHER, PLAIN, RVDT CLUSTER MOUNT, #4-40 SCREW	56	1.000		
....4	Document	9995902003C	Z	INSTRUCTIONS, ENGINEERING PROCEDURE FOR PASSIVATING STAINLESS STEEL MATERIAL	0	REF		
...3	Part	740F-33-24	–	JUMPER ASSEMBLY,POWER	57	1.000		
...3	Part	2B74412219-1	–	NAMEPLATE	58	1.000		
...3	Part	9999957044A	D	PRIMER, ANAEROBIC ADHESIVE	59	1.000		
...3	Screw	998D568256A	D	SCREW #4-40X1.750	60	1.000		
....4	Document	998D568001/999	E	MACHINE SCREW	0	REF		
...3	Part	M16878/6BEB0	–	LEADWIRE, EXTRUDED, PTFE, CPR CTD24AWG, 7STRD, 200C, 250V, BLACK	65	14.000		
...3	Part	M16878/6BEB2	–	WIRE, PTFE, 200 DEG. C, 250 VOLT #24 AWG, 7 STRAND, RED	66	14.000		
...3	Part	M16878/6BEB5	–	WIRE, PTFE, 200 DEG. C, 250 VOLT 24 AWG, 7 STRAND, GRN	67	14.000		
...3	Part	D-128-0042	–	SOLDER SLEEVE	71	28.000		
...3	Part	MTC100-BF1-P32	–	CONNECTOR, BOX MOUNT, 20 PIN	72	1.000		
...3	Part	MTCP-BS1-P34	B	CONNECTOR, BOX MOUNT, 5 PIN	73	1.000		
...3	Screw	2A84568002-1	A	SCREW, ELECTRICAL CONNECTOR	74	4.000		

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MPC PRODUCTS CORP.
SKOKIE, ILLINOIS, U.S.A

ATPS WITH SIGNATURES ARE AVAILABLE, CHECK DATA FILES

ACCEPTANCE TEST PROCEDURE

FOR

ASRD, C-LINK TECHNOLOGY

MPC PART NUMBER 2A7210A

SUBMITTED BY: MPC PRODUCTS
CAGE CODE: 19710

DOCUMENT NUMBER: 2A75906210 REV. C

Compiled By:	A. Raabe/Project Engineer Name/Title	11/01/00 Date
Approved By:	A. Raabe/Project Engineer Name/Title	11/01/00 Date

RELEASE DATE: 02NOV00

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

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SAMPLE

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

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4.1	Dielectric Strength Test	3.2.5.1
4.2	Insulation Resistance Test	N/A
5.0	Backlash	3.2.1.1.6
5.1	Actuator Schedule Test	3.2.1.1.4
5.2	Brake Holding Test	3.2.1.1.4
5.3	Mechanical Stroke	3.2.1.1.5
6.0	Position Sensor	3.2.1.1.5
6.1	Electrical Retract Position	3.2.1.1.5
6.2	Null Position	N/A
6.3	Position Trackability	3.2.1.1.1
7.0	Connector Termination	N/A
8.0	Shipping Length	N/A

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE Document No: 2A75906210

Revision: -

LIST OF TEST EQUIPMENT

ITEM NO.	CALIB. FREQ.	DESCRIPTION	ACCURACY
1	1 Year	Digital Multimeter Fluke 8000 Series	0.5%
2	1 Year	Adjustable DC Power Supply HP 6433B 0-36 V, 0-10 A	Regulation: 1%
3	N/A	ATP Test Stand Fixture MPC P/N KML2750009A	N/A
4	N/A	ATP Test Box MPC P/N KML4798004A	N/A
5	1 Year	Dial Indicator Starret No. 555-3041	0.001 in.
6	1 Year	Digital Timer	1/100 sec
7		Part deleted from list	
8	1 Year	Digital Scale, MPC P/N 1340371051A	± .005 lbs
9	1 Year	Dielectric Tester, 1200 Vrms, MPC P/N 10407C	± .1%
10	1 Year	Megohmeter, 1200 VDC, MPC P/N 10409C	± .1%
11		Part deleted from list	
12	1 Year	Hipot Tester #412, Associated Research, 60 Hz, 0-5 milliamps	1%
13	1 Year	Megohm IR Meter #2850, 1-100,000 Megohms	1%

LIST OF TEST EQUIPMENT (cont)

ITEM NO.	CALIB. FREQ.	DESCRIPTION	ACCURACY
14	1 Year	Load cell, Sensotec, 0-1000 lbs, 41/571	N/A
15	1 Year	Digital Voltmeter, North Atlantic Model 2250	1%
16	1 Year	Oscilloscope, Tektronix 7623A, MPC P/N 110073C	1%
17	1 Year	Synchro/Resolver Angle Indicator (SR103/DBA-488)	N/A
18	N/A	Linear Encoder	.0004 inch
19	1 Year	Graphic, Thermal Array Coder WR 7700	N/A

NOTE: The above test equipment, or its functional equivalents, shall be used to perform all of the tests required by this document. Calibration of this equipment shall be performed in accordance with the calibration systems requirements contained in our ISO 9001 system. These calibration requirements follow MPC Procedure ISO5903110, which meets the intent of ISO10012-1.Calibration due dates shall be checked each time before equipment is used.

1.0 SCOPE

This document specifies the Acceptance Test Procedure for the Actuator, manufactured for ASRD. The unit's MPC Part Number is 2A7210A. The actuator consists of a brushless DC motor, 3 phase field detector, tachometer, magnetic brake, spur gears, acme thread drive assembly, geared resolver, housings, 2 electrical connectors, and ancillary hardware.

The unit shall be tested in accordance with (IAW) this document when determining if it meets the requirements of the acceptance test and envelope drawing. The unit shall be accepted only if it has met all the requirements specified within this document.

1.1 APPLICABLE DOCUMENTS

Customer Documents

None	None

MPC Documents

MPC Drawing No. 2A7210	Envelope Drawing
MPC Drawing No. 2A74412210	Identification Drawing
MPC Drawing No. 9995903139	Workmanship
MPC Procedure No. ISO5903110	Control of Inspection, Measurement, and Test Equipment

2.0 GENERAL

The following general requirements shall be observed throughout the testing procedures, unless otherwise specified.

2.1 TEST CONDITIONS

Unless otherwise specified, the mechanical and electrical tests shall be performed at a temperature of 23 ±5°C and an atmospheric pressure of 28 to 32 inches mercury and 80% maximum humidity (room ambient at MPC Products Corporation).

2.2 TEST PROCEDURES

The Table of Tests lists the tests that are to be performed on the unit. Each unit must pass all these tests in order to be accepted. The numbers in parenthesis following the paragraph titles refer to the applicable paragraphs in the customer Specification.

2.3 TEST SEQUENCE

Tests may be performed in any order.

3.0 PRODUCT EXAMINATION

The unit shall be examined in accordance with MPC Drawing Number 2A7210.

3.1 CONFIGURATION

Product dimensions must comply with MPC drawing 2A7210.

Check (☑) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.2 PRODUCT MARKING

Verify that the identification information on the units are legible and accurate per MPC identification drawing 2A74412210.

Check (☑) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.3 WORKMANSHIP

The unit must be examined to ensure the highest quality of workmanship. The finished units must be free of all burrs, grease and other foreign materials IAW MPC drawing 9995903139.

Check (☑) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.4 WEIGHT

Equipment Required: Item 8 (as described in the list of test equipment on page 5).

Unit weight shall not exceed 3.1 lbs.

Weigh the unit and record the actual weight in the appropriate space on the data sheet.

4.0 PERFORMANCE TESTS

4.1 DIELECTRIC STRENGTH TEST

Equipment Required: Item 9 (as described in the list of test equipment on page 5).

The Dielectric Strength (Dielectric Withstanding Voltage) test is performed at 500 VRMS, 60 Hz, between all the windings and the housing.

For the motor and resolver, check the dielectric strength between all the wires and the housing. That is, connect all the wires of all the respective windings together and apply the 500 VRMS, 60 Hz, test voltage between the bundle of wires and the housing for 1 minute minimum. Also, this test may be performed individually on each winding. The total maximum leakage current permitted is 1.0 mA.

Check (☐) the acceptance box in the appropriate space on the test data sheet if the unit meets this requirement.

4.2 INSULATION RESISTANCE TEST

Equipment Required: Item 10 (as described in the list of test equipment on page 5).

The Insulation Resistance test is performed at 500 VDC between all the windings and the housing.

For the motor and resolver, check the insulation resistance between all the wires and the housing. That is, connect all the wires of all the respective windings together and apply the 500 VDC test voltage between the bundle of wires and the housing. Also, this test may be performed individually on each winding. The total minimum resistance is 100 MΩ.

Check (☐) the acceptance box in the appropriate space on the test data sheet if the unit meets this requirement.

5.0 BACKLASH

Equipment Required: Item 3, 4, 14 and 18 (as described in the list of test equipment on page 5).

The maximum overall end play in the actuator shall not exceed 0.007 inches. With the unit in the test fixture and no power applied, measure the axial end play with a 20 ± 2 pounds tensile and compressive load. The end play is measured at three locations: electrical extend limit (14.046 inches to 14.106 inches), electrical retract limit (9.391 inches to 9.331 inches), and electrical midstroke position (11.689 inches to 11.749 inches).

Record the actual values of axial end play in the proper spaces provided on the data test sheet.

5.1 ACTUATOR SCHEDULE TEST

Equipment Required: Items 2, 3, 4, 6, 14, 16, and 19 (as described in the list of test equipment on page 5).

The input voltage to the motor should be 20.5 VDC. The current limit is set at 7.4 AMPS max.

Record the output of the tachometer on a strip chart recorder. The speed of the actuator (output voltage of the tachometer) must not vary by more than ± 5% over entire stroke. Attach the chart to the ATP data sheets.

Move the actuator to the electrically retracted position by moving the switch on the switch box to position 0 (9.331 to 9.391 inches). Set the linear encoder to 0. Apply 250 +/- 25 pounds compressive load to the actuator. Move the actuator to 2.947 +/- .050 inches. The actuator must complete this in less than 11.3 seconds. Record actual value.

Apply 600+/- 25 pounds compressive load to the actuator. Move the actuator to 4.716 +/- .050 inches. The actuator must complete this in less than 12.6 seconds. Record actual value. Attach tachometer output graphs to data sheets.

5.2 BRAKE HOLDING TEST

Equipment Required: Items 2, 3, 4, and 14 (as described in the list of test equipment on page 5).

Move the actuator to position 10 (2.854 to 2.971 inches from electrical retract) by moving the switch on the switch box to position 10. Apply a 675 +0/-25 lb compressive load on the actuator. Verify that the actuator does not backdrive, and the total deflection is .020 inches maximum.

Check (☒) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

5.3 MECHANICAL STROKE

Equipment Required: Items 2, 3, and 4 (as described in the list of test equipment on page 5).

Apply an input voltage of 20.5 VDC to the motor. Move the actuator to the mechanically retracted position. Set the linear encoder to zero. Move the actuator to the mechanically extended position. Verify that the mechanical stroke is at least 4.765 inches.

Check (✓) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

6.0 POSITION SENSOR

All resolver testing shall be performed with a 530 ±30 lb compression load (oppose extension, aid retraction) to remove the mechanical endplay of the test fixture. The input power to the resolver shall be 7 VAC at 3200 Hz.

6.1 ELECTRICAL RETRACT POSITION

Equipment Required: Items 2, 3, 4, 5, 14, 17, and 18 (as described in the list of test equipment on page 5).

With no load applied to the output ram, move the actuator to its electrically retracted position. The resolver must read 58.5° ± .10°.

Measure the distance between the center points of the fixed end clevis and the output ram. This distance must be 9.361 ± .030 inches.

Record the actual distance value in the appropriate space on the test data sheet.

6.2 NULL POSITION

Equipment Required: Items 2, 3, 4, 5, 14, 17, and 18 (as described in the list of test equipment on page 5).

With a 530 ±30 lb compression load applied to the output ram, move the actuator to its electrically retract position. The resolver must read -58.5° ± .10°. Measure the angle indication of the position sensor. Convert this angular reading to linear stroke of the actuator by using the following formula:

Linear Position = (Resolver angle + 58.5 deg)*0.04029 in/deg

Record the indicated linear position for the resolver in the data sheet.

Record the actual linear position from the measurement device on the test stand.

6.2 NULL POSITION (cont)

The accuracy error of the actuator is the difference of these two measurements. To determine the error of the actuator, use the following formula:

Error = Resolver indicated position – Measured position

Record this calculated area in the test data sheet. The error must not be larger than ± .038 inches.

6.3 POSITION TRACKABILITY

Equipment Required: Items 2, 3, 4, 14, 17, and 18 (as described in the list of test equipment on page 5).

Set the test box to follow stroke profile 2 (reference wing position 2). Move the actuator to the electrically retracted position by moving the switch on the switch box to position 0. The resolver must read -58.5° ± .10°. Set the linear encoder to 0. With a 530 ±30 lb compression load applied to the output ram, move the to position 10 (2.854 to 2.971 inches). Measure the angle indication of the position sensors. Convert this angular reading to linear stroke of the actuator by using the following formula:

Linear Position = (Resolver angle + 58.5 deg)*0.04029 in/deg

Record the indicated linear position for the resolver in the data sheet.

Record the actual linear position from the measurement device on the test stand.

The accuracy error of the actuator is the difference of these two measurements. To determine the error of the actuator, use the following formula:

Error = Resolver indicated position – Measured position

Record this calculated area in the test data sheet. The error must not be larger than ± .058 inches.

6.3 POSITION TRACKABILITY (cont)

With a 530 ±30 lb compression load applied to the output ram, move the to position 20 (3.808 to 3.885 inches). Record the error for position 20 using the same calculations as above. The error must not be larger than ±.038 inches.

With a 530 ±30 lb compression load applied to the output ram, move the to position 30 (4.470 to 4.530 inches). Record the error for position 30 using the same calculations as above. The error must not be larger than ±.030 inches.

7.0 CONNECTOR TERMINATION

Equipment Required: Item 1 (as described in the list of test equipment on page 5).

Apply 500 VDC for five (5) seconds between the following connector pin combinations. Measure and record the insulation resistance value obtained for each combination. This value shall be greater than or equal to 100 megohms.

STEP	PIN (s)	TO PIN (s)
1	A9 and A10 (tied together)	A6, A7 and A8 (tied together)
2	B9 and B10 (tied together)	B8 and B7 (tied together)
3	B9 and B10 (tied together)	B6 and B5 (tied together)

8.0 SHIPPING LENGTH

Equipment Required: Items 2, 3, and 4 (as described in the list of test equipment on page 5).

Upon completion of all above tests, the actuator must be moved to the 20° position for shipping.

Check (✓) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

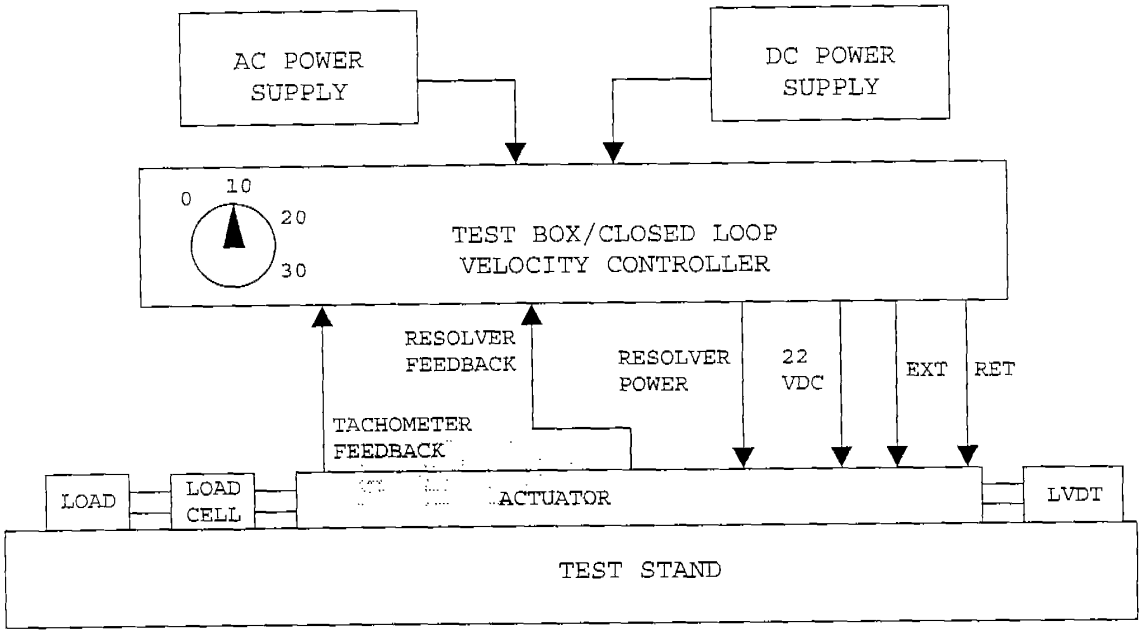


Figure 1
ATP Test Setup - Block Diagram

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

DATA SHEET (1 of 3)

DESCRIPTION Actuator CUST. SPEC. _____ REV. -

MPC P/N 2A7210A S/N _____ DATE CODE _____

CUSTOMER P/N None TESTED BY _____ DATE _____

INSP. BY _____ Q.C. APPVL _____

MPC PARA	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (✓)	ACTUAL VALUE
3.1	N/A	Configuration	MPC Drawing No. 2A7210		
3.2	N/A	Product Marking	MPC Drawing No. 2A74412210		
3.3	N/A	Workmanship	MPC Drawing No. 9995903139		
3.4	N/A	Weight	3.1 lbs. Max.		
4.1	N/A	Dielectric Strength	1.0 mA max. leakage current at 500 VRMS, 60 Hz, 1 minute		
4.2	N/A	Insulation Resistance	100 MΩ minimum resistance at 500 VDC		
5.0	N/A	Backlash, 20 ± 2 lb Reversing Load			
		Electrical Extend Limit (14.046" to 14.106")	Less than .007 inches		
		Electrical Retract Limit (9.391" to 9.331")			
		Electrical Midstroke (11.689" to 11.749")			

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

DATA SHEET (2 OF 3)

S/N_____

MPC PARA	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (Ⓘ)	ACTUAL VALUE
5.1	N/A	Actuator Schedule @ 20.5 VDC, 250 ± 25 lb compressive load			
		Time for actuator to complete 2.947 ± .050 inches	11.3 seconds maximum		
		Acutator Schedule @ 20.5 VDC, 600 ± 25 lb compressive load			
		Time for actuator to complete 1.769 ± .050 inches	12.6 seconds maximum		
5.2	N/A	Brake Holding Test Apply a 675 +0/-25 compressive load to actuator	Unit does not backdrive, and the total deflection is .020 inches maximum		
5.3	N/A	Mechanical Stroke	4.765 inches Min.		
6.1	N/A	Electrical Retract Position	9.361 ± .030 inches		
6.2	N/A	Null Position, 530 ±30 lb compressive load to output ram			
		Resolver angle	Record		
		Calculated Linear Position	(Angle + 58.5°) X 0.04029 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calc. Linear Position - Measured Linear Position	± 0.038 inches Max.		

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2A75906210

Revision: -

DATA SHEET (3 OF 3)

S/N_____

MPC PARA	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (✓)	ACTUAL VALUE
6.3	N/A	Position Trackability			
		Set test box dial to position 10 (2.854 to 2.971 inches)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 58.5°) X0.04029 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.058 inches Max.		
		Position Trackability			
		Set test box dial to position 20 (3.808 to 3.885 inches)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 58.5°) X 0.04029 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.038 inches Max.		
		Set test box dial to position 30 (4.470 to 4.530 inches)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 58.5°) X 0.04029 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.030 inches Max.		
7.0	N/A	Connector Termination			
		*Record insulation resistance between:			
		(Pins A9 and A10) to (Pins A6, A7, and A8)	≥ 100 Megohms		
		(Pins B9 and B10) to (Pins B8 and B7)			
		(Pins B9 and B10) to (Pins B6 and B5)			
8.0	N/A	Shipping Length	Actuator moved to 20° position after all tests are done		

* The parentheses indicate that these pins are tied together

(16)

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS, U.S.A

ACCEPTANCE TEST PROCEDURE

FOR

ASRD, C-LINK TECHNOLOGY

MPC PART NUMBER 2B7219

SUBMITTED BY: MPC PRODUCTS
CAGE CODE: 19710

DOCUMENT NUMBER: 2B75906219 REV. -

Compiled By:	A. Raabe/Project Engineer Name/Title	11/01/00 Date
Approved By:	A. Raabe/Project Engineer Name/Title	11/01/00 Date

RELEASE DATE: 02NOV00

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2B759062219

TABLE OF TESTS

MPC PARA.	DESCRIPTION	CUSTOMER PARA.
3.1	Configuration	N/A
3.2	Product Marking	N/A
3.3	Workmanship	N/A
3.4	Weight	N/A
4.0	Backlash	N/A
4.1	Actuator Schedule Test	N/A
4.2	Mechanical Stroke	N/A
5.0	Position Sensor	N/A
5.1	Electrical Retract Position	N/A
5.2	Null Position	N/A
5.3	Position Trackability	N/A
6.1	Dielectric Strength Test	N/A
6.2	Insulation Resistance Test	N/A
7.0	Shipping Length	N/A

LIST OF TEST EQUIPMENT

ITEM NO.	CALIB. FREQ.	DESCRIPTION	ACCURACY
1	1 Year	Digital Multimeter Fluke 8000 Series	0.5%
2	1 Year	Adjustable DC Power Supply HP 6433B 0-36 V, 0-10 A	Regulation: 1%
3	N/A	ATP Test Stand Fixture MPC P/N KML2750009A	N/A
4	N/A	ATP Test Box MPC P/N KML4798004A	N/A
5	N/A	Terminal Strip KAL2740009A	N/A
6	1 Year	Digital Timer	1/100 sec
7		Not Used	
8	1 Year	Digital Scale, MPC P/N 1340371051A	± .005 lbs
9	1 Year	Dielectric Tester, 1200 Vrms, MPC P/N 10407C	± .1%
10	1 Year	Megohmeter, 1200 VDC, MPC P/N 10409C	± .1%
11		Not Used	
12		Not Used	
13		Not Used	

LIST OF TEST EQUIPMENT (cont)

ITEM NO.	CALIB. FREQ.	DESCRIPTION	ACCURACY
14	1 Year	Load cell, Sensotec, 0-1000 lbs, 41/571	N/A
15		Not Used	
16		Not Used	
17	1 Year	Synchro/Resolver Angle Indicator (SR103/DBA-488)	N/A
18	N/A	Linear Encoder	.0004 inch
19	1 Year	Graphic, Thermal Array Coder WR 7700	N/A

NOTE: The above test equipment, or its functional equivalents, shall be used to perform all of the tests required by this document. Calibration of this equipment shall be performed in accordance with the calibration systems requirements contained in our ISO 9001 system. These calibration requirements follow MPC Procedure ISO5903110, which meets the intent of ISO10012-1.Calibration due dates shall be checked each time before equipment is used.

1.0 SCOPE

This document specifies the Acceptance Test Procedure for the Inboard Aileron Actuator, manufactured for General Atomics. The unit's MPC Part Number is 2B7219. The actuator consists of a brushless DC motor, 3 phase field detector, tachometer, magnetic brake, spur gears, ball screw drive assembly, geared resolver, housings, and ancillary hardware.

The unit shall be tested in accordance with (IAW) this document when determining if it meets the requirements of the acceptance test and envelope drawing. The unit shall be accepted only if it has met all the requirements specified within this document.

1.1 APPLICABLE DOCUMENTS

Customer Documents

None	None

MPC Documents

MPC Drawing No. 2B7219	Envelope Drawing
MPC Drawing No. 2B7411219	Identification Drawing
MPC Drawing No. 9995903139	Workmanship
MPC Procedure No. ISO5903110	Control of Inspection, Measurement, and Test Equipment

1.0 SCOPE

This document specifies the Acceptance Test Procedure for the Inboard Aileron Actuator, manufactured for General Atomics. The unit's MPC Part Number is 2B7219. The actuator consists of a brushless DC motor, 3 phase field detector, tachometer, magnetic brake, spur gears, ball screw drive assembly, geared resolver, housings, and ancillary hardware.

The unit shall be tested in accordance with (IAW) this document when determining if it meets the requirements of the acceptance test and envelope drawing. The unit shall be accepted only if it has met all the requirements specified within this document.

1.1 APPLICABLE DOCUMENTS

Customer Documents

None	None

MPC Documents

MPC Drawing No. 2B7219	Envelope Drawing
MPC Drawing No. 2B74412219	Identification Drawing
MPC Drawing No. 9995903139	Workmanship
MPC Procedure No. ISO5903110	Control of Inspection, Measurement, and Test Equipment

2.0 GENERAL

The following general requirements shall be observed throughout the testing procedures, unless otherwise specified.

2.1 TEST CONDITIONS

Unless otherwise specified, the mechanical and electrical tests shall be performed at a temperature of 23 ±5°C and an atmospheric pressure of 28 to 32 inches mercury and 80% maximum humidity (room ambient at MPC Products Corporation).

2.2 TEST PROCEDURES

The Table of Tests lists the tests that are to be performed on the unit. Each unit must pass all these tests in order to be accepted. The numbers in parenthesis following the paragraph titles refer to the applicable paragraphs in the customer Specification.

2.3 TEST SEQUENCE

Tests may be performed in any order.

3.0 PRODUCT EXAMINATION

The unit shall be examined in accordance with MPC Drawing Number 2B7219.

3.1 CONFIGURATION

Product dimensions must comply with MPC drawing 2B7219.

Check (☑) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.2 PRODUCT MARKING

Verify that the identification information on the units are legible and accurate per MPC identification drawing 2B74412219.

Check (☐) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.3 WORKMANSHIP

The unit must be examined to ensure the highest quality of workmanship. The finished units must be free of all burrs, grease and other foreign materials IAW MPC drawing 9995903139.

Check (☐) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

3.4 WEIGHT

Equipment Required: Item 8 (as described in the list of test equipment on page 5).

Unit weight shall not exceed 3.2 lbs.

Weigh the unit and record the actual weight in the appropriate space on the data sheet.

4.0 BACKLASH

Equipment Required: Item 2, 3, 4, 5, 14, and 18 (as described in the list of test equipment on page 5).

The maximum overall end play in the actuator shall not exceed 0.007 inches. With the unit in the test fixture and no power applied, measure the axial end play with a 15.± 2 pounds tensile and compressive load. The end play is measured at three locations: electrical extend limit (14.046 inches to 14.106 inches), electrical retract limit (9.391 inches to 9.331 inches), and electrical midstroke position (11.689 inches to 11.749 inches).

Record the actual values of axial end play in the proper spaces provided on the data test sheet.

4.1 ACTUATOR SCHEDULE TEST

Equipment Required: Items 1, 2, 3, 4, 5, 6, 14, and 19 (as described in the list of test equipment on page 5).

The input voltage to the motor should be 22.0 VDC. The current limit is set at 5.30 AMPS max.

Record the output of the tachometer on a strip chart recorder. The speed of the actuator (output voltage of the tachometer) must not vary by more than ± 5% over entire stroke. Attach the chart to the ATP data sheets.

Move the actuator to the electrically retracted position by moving the switch on the switch box until the actuator reaches 9.331 to 9.391 inches (position 0). Set the linear encoder to 0. Apply 100 +/- 25 pounds compressive load to the actuator. Move the actuator to 4.300 +/- .050 inches. The actuator must complete this in less than 2.1 seconds. Record actual value.

Attach tachometer output graph to data sheets.

4.2 MECHANICAL STROKE

Equipment Required: Items 2, 3, 4, 5, and 18 (as described in the list of test equipment on page 5).

Apply an input voltage of 22.0 VDC to the motor. Move the actuator to the mechanically retracted position. Set the linear encoder to zero. Move the actuator to the mechanically extended position. Verify that the mechanical stroke is at least 4.765 inches.

Check (✓) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

5.0 POSITION SENSOR

All resolver testing shall be performed with no load. The input power to the resolver shall be 7 VAC at 3200 Hz.

5.1 ELECTRICAL RETRACT POSITION

Equipment Required: Items 2, 3, 4, 5, 14, 17, and 18 (as described in the list of test equipment on page 5).

With no load applied to the output ram, move the actuator to its electrically retracted position. The resolver must read –39.0° ± .10° (321.0° ± .10°).

Measure the distance between the center points of the fixed end clevis and the output ram. This distance must be 9.361 ± .030 inches.

Record the actual distance value in the appropriate space on the test data sheet.

5.2 NULL POSITION

Equipment Required: Items 2, 3, 4, 5, 14, 17, and 18 (as described in the list of test equipment on page 5).

With no load applied to the output ram, move the actuator to its electrically retract position at 9.331 to 9.391 inches. The resolver must read –39.0° ± .10° (321.0° ± .10°). Measure the angle indication of the position sensor. Convert this angular reading to linear stroke of the actuator by using the following formula:

Linear Position = (Resolver angle + 39.0 deg)*0.06044 in/deg

Record the indicated linear position for the resolver in the data sheet.

Record the actual linear position from the measurement device on the test stand.

5.2 NULL POSITION (cont)

The accuracy error of the actuator is the difference of these two measurements. To determine the error of the actuator, use the following formula:

Error = Resolver indicated position – Measured position

Record this calculated area in the test data sheet. The error must not be larger than ± .030 inches.

5.3 POSITION TRACKABILITY

Equipment Required: Items 2, 3, 4, 5, 14, 17, and 18 (as described in the list of test equipment on page 5).

Move the actuator to the electrically retracted position by moving the switch on the switch box until the actuator reaches 9.331 to 9.391 inches (position 0). The resolver must read –39.0° ± .10° (321.0° ± .10°). Set the linear encoder to 0. With no load applied to the output ram, move the actuator until it reaches 2.854 to 2.971 inches (position 10). Measure the angle indication of the position sensors. Convert this angular reading to linear stroke of the actuator by using the following formula:

Linear Position = (Resolver angle + 39.0 deg)*0.06044 in/deg

Record the indicated linear position for the resolver in the data sheet.

Record the actual linear position from the measurement device on the test stand.

The accuracy error of the actuator is the difference of these two measurements. To determine the error of the actuator, use the following formula:

Error = Resolver indicated position – Measured position

Record this calculated area in the test data sheet. The error must not be larger than ± .030 inches.

5.3 POSITION TRACKABILITY (cont)

With no load applied to the output ram, move the actuator until it reaches 3.808 to 3.885 inches (position 20). Record the error using the same calculations as above. The error must not be larger than ±.030 inches.

With no load applied to the output ram, move the actuator until it reaches 4.470 to 4.530 inches (position 30). Record the error using the same calculations as above. The error must not be larger than ±.030 inches.

6.0 PERFORMANCE TESTS

6.1 DIELECTRIC STRENGTH TEST

Equipment Required: Item 9 (as described in the list of test equipment on page 5).

The Dielectric Strength (Dielectric Withstanding Voltage) test is performed at 500 VRMS, 60 Hz, between all the windings and the housing.

For the motor and resolver, check the dielectric strength between all the wires and the housing. That is, connect all the wires of all the respective windings together and apply the 500 VRMS, 60 Hz, test voltage between the bundle of wires and the housing for 1 minute minimum. Also, this test may be performed individually on each winding. The total maximum leakage current permitted is 1.0 mA.

Check (☐) the acceptance box in the appropriate space on the test data sheet if the unit meets this requirement.

6.2 INSULATION RESISTANCE TEST

Equipment Required: Item 10 (as described in the list of test equipment on page 5).

The Insulation Resistance test is performed at 500 VDC between all the windings and the housing.

For the motor and resolver, check the insulation resistance between all the wires and the housing. That is, connect all the wires of all the respective windings together and apply the 500 VDC test voltage between the bundle of wires and the housing. Also, this test may be performed individually on each winding. The total minimum resistance is 100 MΩ.

Check (☐) the acceptance box in the appropriate space on the test data sheet if the unit meets this requirement.

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2B759062219

7.0 SHIPPING LENGTH

Equipment Required: Items 2, 3, 4, 5, and 18 (as described in the list of test equipment on page 5).

Upon completion of all above tests, the actuator must be moved to the electrically retract position for shipping.

Check (✓) the acceptance box in the appropriate space on the data sheet if the unit meets this requirement.

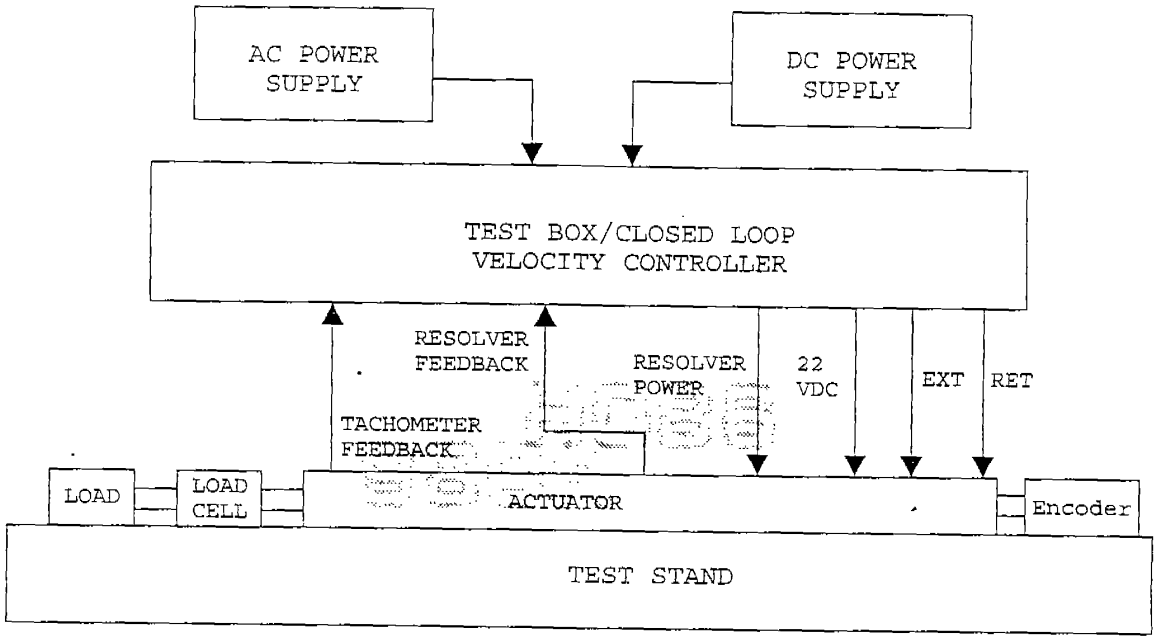


Figure 1
ATP Test Setup - Block Diagram

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2B759062219

DATA SHEET (1 of 3)

DESCRIPTION Actuator CUST. SPEC. None REV. -

MPC P/N 2B7219 S/N _____ DATE CODE _____

TESTED BY _____ DATE _____

INSP. BY _____ Q.C. APPVL _____

MPC PARA	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (■)	ACTUAL VALUE
3.1	N/A	Configuration	MPC Drawing No. 2B7219		
3.2	N/A	Product Marking	MPC Drawing No. 2B74412219		
3.3	N/A	Workmanship	MPC Drawing No. 9995903139		
3.4	N/A	Weight	3.2 lbs. Max.		
4.0	N/A	Backlash, 15 ± 2 lb Reversing Load			
		Electrical Extend Limit (14.046" to 14.106")	Less than .007 inches		
		Electrical Retract Limit (9.391" to 9.331")			
		Electrical Midstroke (11.689" to 11.749")			

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2B759062219

DATA SHEET (2 OF 3)

S/N_____

MPC PARA	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (✓)	ACTUAL VALUE
4.1	N/A	Actuator Schedule @ 22.0 VDC, 100 ± 25 lb compressive load			
		Time for actuator to complete 4.300 ± .050 inches	2.1 seconds maximum		
4.2	N/A	Mechanical Stroke	4.765 inches Min.		
5.1	N/A	Electrical Retract Position	9.361 ± .030 inches		
5.2	N/A	Null Position			
		Resolver angle	Record		
		Calculated Linear Position	(Angle + 39.0°) X 0.06044 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calc. Linear Position - Measured Linear Position	± 0.030 inches Max.		

MPC PRODUCTS CORP.
SKOKIE, ILLINOIS U.S.A.

ACCEPTANCE TEST PROCEDURE

Document No: 2B759062219

DATA SHEET (3 OF 3)

S/N_____

MPC PAR-A	CUSTOMER PARA.	TEST DESCRIPTION	SPECIFICATION/ LIMIT	ACCEPT (Y)	ACTUAL VALUE
5.3	N/A	Position Trackability			
		Set actuator to 2.854 to 2.971 inches (position 10)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 39.0°) X0.06044 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.030 inches Max.		
		Position Trackability			
		Set actuator to 3.808 to 3.885 inches (position 20)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 39.0°) X 0.06044 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.030 inches Max.		
		Set actuator to 4.470 to 4.530 inches (position 30)			
		Resolver angle position	Record		
		Calculated Linear Position	(Angle + 39.0°) X 0.06044 in/deg		
		Actual Linear Position	Record from test stand measurement		
		Error = Calculated Position - Measured Position	± 0.030 inches Max.		
6.1	N/A	Dielectric Strength	1.0 mA max. leakage current at 500 VRMS, 60 Hz, 1 minute		
6.2	N/A	Insulation Resistance	100 MΩ minimum resistance at 500 VDC		
7.0	N/A	Shipping Length	Actuator moved to electrically retract after all tests are done		

DWG NO. 1CD5906007

CAD MAINTAINED
CHANGES SHALL BE
INCORPORATED BY T-S
DESIGN ACTIVITY

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

TEST DATA SHEET,
BRUSHLESS D.C. MOTOR

MPC PART NO: 1CD1200045__

MPC END ITEM: 2B7214

MPC SERIAL NO.: ____

INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100C	CONTRACT NO	MPC PRODUCTS CORP SKOKIE IL. U.S.A.	ACAD
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	DRAWN MARTY AHRNES 00-10-16	TITLE	
TOLERANCES	CHECK MARTY AHRNES 00/10/20	TEST SHEET, BLDC MOTOR, FD / TACH	
ANGLES ± 2°	ENGINEER STEVE ARNER 00/10/20		
DECIMALS ± .005	PROD MGR STEVE ARNER 00/10/20	SIZE A / CAGE CODE 19710 / DWG NO. 1CD5906007	
FRACTIONS ± 1/64	MFG ENG	SCALE 1 / * / RELEASE DATE 00/10/20 / SHEET 1 OF 3	
DO NOT SCALE			

DWG NO. 1CD5906007

END ITEM: 2B7214

MPC PART NO: 1CD1200045

MPC SERIAL NO: _____

MOTOR MECHANICAL

PARAMETERS	LIMITS	ACTUAL	INSPECTION
SHAFT EXTENSION	0.610/0.640		
AXIAL PLAY @ 40 OZ. REVERSING LOAD	0.006/0.012		
RADIAL PLAY @ 8 OZ. REVERSING LOAD	0.0008 MAX.		

MOTOR ELECTRICAL

TEST CONDITIONS @ +25°C

PARAMETERS			LIMITS	ACTUAL	INSPECTION
HOLDING TORQUE WITH EACH PHASE EXCITED AT 3.0 AMP D.C.	(A/C)	(OZ-IN)	3.0 MIN.		
	(B/C)	(OZ-IN)	3.0 MIN.		
	(B/A)	(OZ-IN)	3.0 MIN.		
BEMF AT 3600 RPM (A/C)		(VRMS)	1.55/2.10		
BEMF AT 3600 RPM (B/C)		(VRMS)	1.55/2.10		
BEMF AT 3600 RPM (B/A)		(VRMS)	1.55/2.10		

FIELD DIRECTOR ELECTRICAL

PRIMARY EXCITATION 3.0 VAC (25000 Hz).
MOTOR CURRENT 1.0 AMPS

TEST CONDITIONS @ +25°C

SHAFT POSITION	MOTOR CURRENT			FIELD DIRECTOR OUTPUT					
				PHASE A		PHASE B		PHASE C	
	A	B	C	SPEC.	ACTUAL	SPEC.	ACTUAL	SPEC.	ACTUAL
I	0	+	−	OUT ø		IN ø		(RECORD)*	
II	−	0	+	(RECORD)*		OUT ø		IN ø	
III	+	−	0	IN ø		(RECORD)*		OUT ø	

TEST	SPEC.	ACTUAL
PRIMARY CURRENT (AMPS)	.050 MAX.	
D.O.R. I II III	CW	

TRANSFORMATION RATIO V OUT (PEAK) / V IN (MEASURE TWO PEAKS PER ø)	SPEC.	PHASE A		PHASE B		PHASE C	
		ACT. 1	ACT. 2	ACT. 1	ACT. 2	ACT. 1	ACT. 2
	0.8/1.2						

* MINIMUM BALANCED FIELD DIRECTOR NULL (≤.150 TYP.)

TESTED BY: _____

Q.C. APPROVAL: _____

DATE: _____

	SIZE	CAGE CODE	DWG NO.
MPC PRODUCTS CORP SKOKIE, IL. U.S.A. ACAD	A	19710	1CD5906007
	SCALE NONE	REV LTR	SHEET 2 OF 3

DWG NO. 1CD5906007

END ITEM: 2B7214 MPC PART NO: 1CD1200045

SERIAL NO.: _____

3Ø TACH ELECTRICAL

TEST CONDITIONS @ +25°C

PARAMETERS		LIMITS	ACTUAL	INSPECTION
EMF AT 3600 RPM (YEL, GRY) (VRMS)		0.78/0.92		
EMF AT 3600 RPM (BLU, GRY) (VRMS)		0.78/0.92		
EMF AT 3600 RPM (GRN, GRY) (VRMS)		0.78/0.92		
PHASING, CW ROTATION	YEL(+), GRY(−) TO A+, C−MOTOR BEMF	175°/185°		
	BLU(−), GRY(−) TO B−, A−MOTOR BEMF	175°/185°		
	GRN(+), GRY(−) TO B+, C−MOTOR BEMF	−5°/+5°		

MOTOR, FD, TACH, DIELECTRIC

PARAMETERS	LIMITS	ACTUAL	INSPECTION
ALL Ø'S TO GROUND DIELECTRIC 500 VOLTS (μA)	300 MAX.		
ALL Ø'S TO GROUND INSULATION RESIST. (MEG−OHMS)	100 MIN.		

BRUSHLESS MOTOR TESTING

3Ø P.W.M. AMPLIFIER TEST CONDITIONS @ +25°C

PARAMETERS		LIMITS	ACTUAL	INSPECTION
EXCITATION	(VOLTS DC)		22.0	
NO LOAD SPEED−CW	(RPM)	27,500 MIN.		
NO LOAD SPEED−CCW	(RPM)	27,500 MIN.		
DIRECTION OF ROTATION "NORM"		CW		

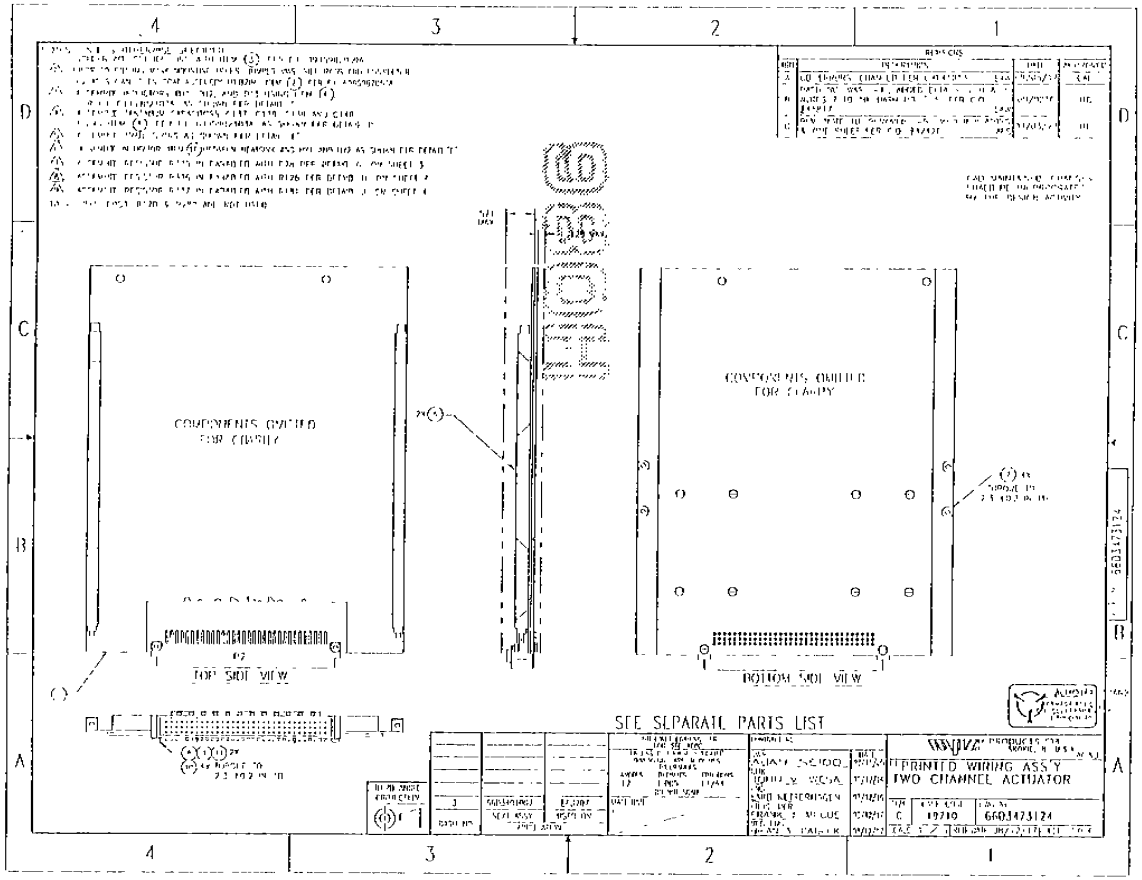
TESTED BY: _____

Q.C APPROVAL: _____

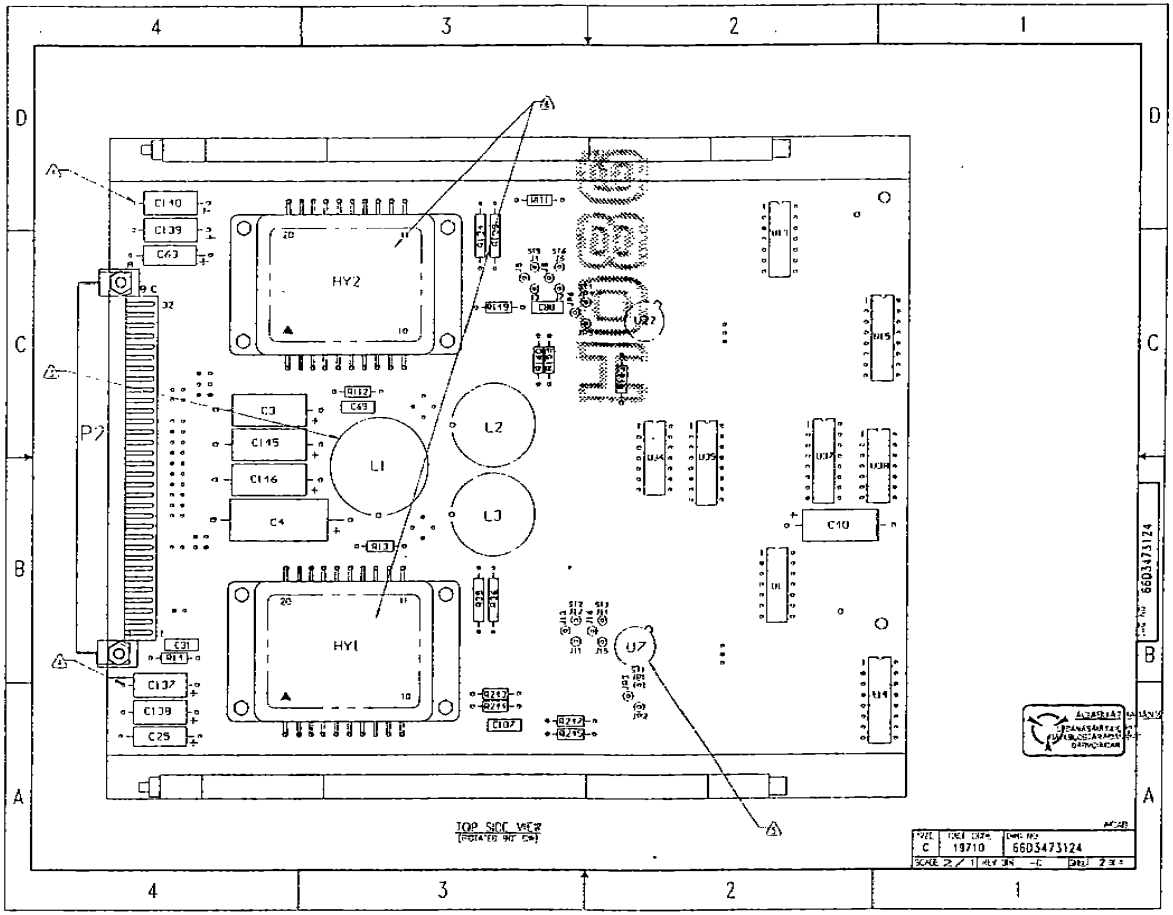
DATE: _____

	SIZE	CAGE CODE	DWG NO.
MPC PRODUCTS CORP SKOKIE, IL. U.S.A.	A	19710	1CD5906007
ACAD	SCALE NONE	REV LTR	SHEET 3 OF 3

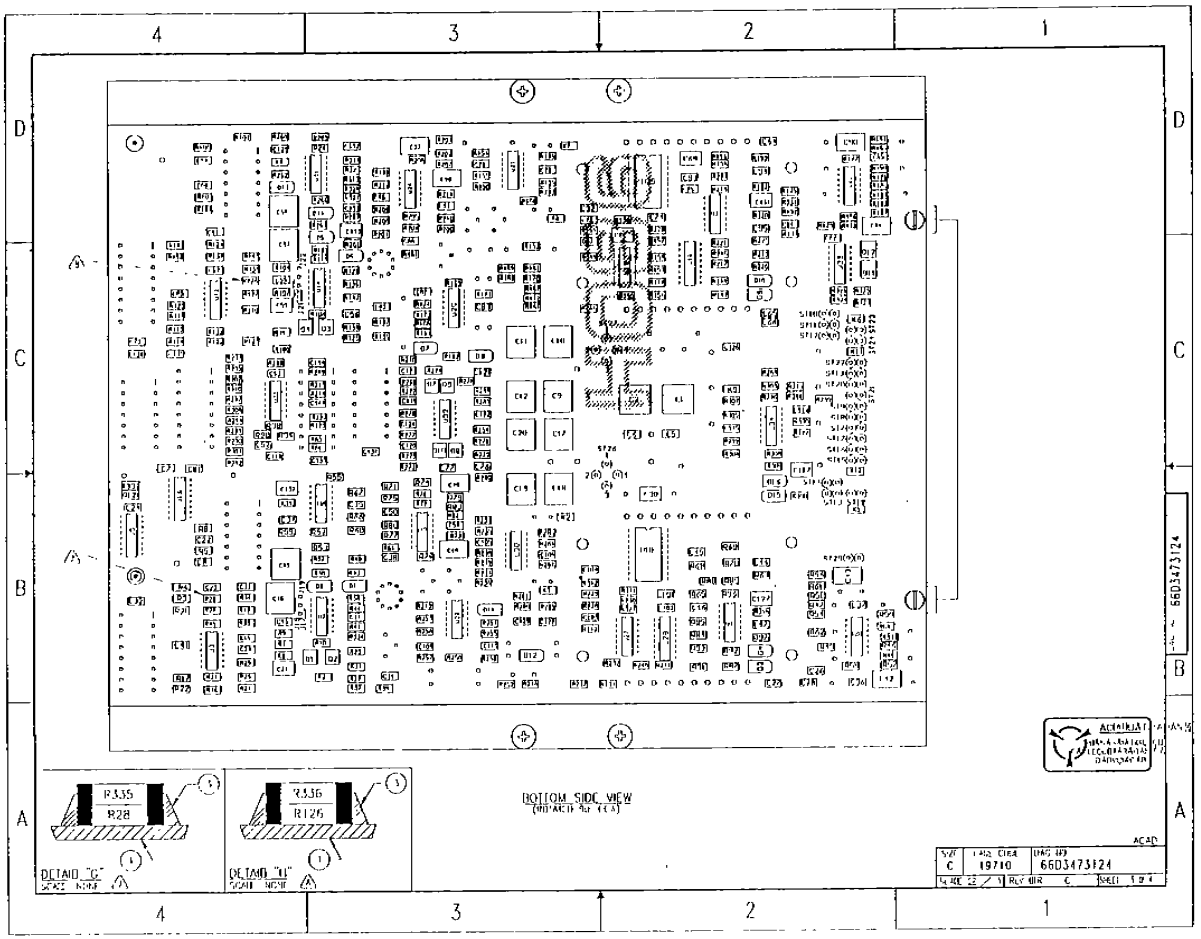
PWB Assembly Drawing (Sheet 1)



PWB Assembly Drawing (Sheet 2)



PWB Assembly Drawing (Sheet 3)



PWB Assembly Drawing (Sheet 4)