

## MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

OFFICIAL RECORD COPY

Licensee

1. Citisteel USA, Inc.

3. License Number 07-30359-01

2. 4001 Philadelphia Pike  
Claymont, Delaware 19703

4. Expiration Date March 31, 2007

5. Docket or  
Reference No. 030-343136. Byproduct, Source, and/or  
Special Nuclear Material7. Chemical and/or Physical  
Form8. Maximum Amount that Licensee  
May Possess at Any One Time  
Under This License

A. Cesium 137

A. Sealed sources

A. See Item 9.A., not to  
exceed 30 curies total

9. Authorized use

A. For possession and use in Kay Ray, Accuray, Ohmart, LFE, Berthold System, Inc., Data Measurement Corp., Flow Measurement Systems, Ronan Engineering or Texas Nuclear devices which have been evaluated and approved for licensing purposes and authorized for distribution under a license issued by the U.S. Nuclear Regulatory Commission or an Agreement State.

## CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at 4001 Philadelphia Pike, Claymont, Delaware.
11. The licensee may not possess and use materials authorized in Items 6, 7, and 8, until: (1) the licensee has constructed the facilities and obtained the equipment described in the application and supporting documentation; and (2) the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406 has been notified in writing that activities authorized by the license will be initiated.

In accordance with the requirements set forth in 10 CFR 30.36(b), 40.42(b), and 70.38(b), the licensee shall promptly notify the Nuclear Regulatory Commission, in writing, of a decision not to complete the facility, acquire equipment, or possess and use authorized material.

12. Licensed material shall be used by, or under the supervision of, Leslie B. Thompson.
13. Licensed material shall only be used by, or under the supervision and in the physical presence of, individuals who have received the training described in application dated November 15, 1996 and letter dated February 24, 1997 and have been designated in writing by the Radiation Safety Officer.

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PDR ADOCK 03034313  
B PDR



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**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

07-30359-01

Docket or Reference Number

030-34313

14. The Radiation Safety Officer for this license is Leslie B. Thompson.
15. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.
- B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.
- C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.
- D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.
- E. Sealed sources and detector cells need not be leak tested if:
- (i) they contain only hydrogen-3; or
  - (ii) they contain only a radioactive gas; or
  - (iii) the half-life of the isotope is 30 days or less; or
  - (iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or
  - (v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.
- F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Director, Division of Nuclear Materials Safety, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.



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- G. The licensee is authorized to collect leak test samples for analysis by Measurex-DMC. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.
16. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.
  17. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.
  18. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.
  19. Each gauge shall be tested for the proper operation of the on-off mechanism and indicator, if any, at no longer than six-month intervals or at such longer intervals as specified by the manufacturer and approved by the Commission or an Agreement State in a registration certificate referred to in 10 CFR 32.210.
  20. Installation, initial radiation survey, relocation, removal from service, maintenance, and repair of devices containing sealed sources shall be performed by Measurex-DMC or by persons specifically licensed by the Commission or an Agreement State to perform such services. Installation, replacement, and disposal of sealed sources shall be performed only by persons specifically licensed by the Commission or an Agreement State to perform such services.
  21. Prior to initial use and after installation, relocation, dismantling, alignment, or any other activity involving the source or removal of the shielding, the licensee shall assure that a radiological survey is performed to determine radiation levels in accessible areas around, above, and below the device with the shutter open. This survey shall be performed only by persons authorized to perform such services by the Commission or an Agreement State.
  22. The licensee shall operate each device containing licensed material within the manufacturer's specified temperature and environmental limits such that the shielding and shutter mechanism of the source holder are not compromised.
  23. The licensee shall assure that the shutter mechanism of each device is locked in the closed position during periods when a portion of an individual's body may be subject to the direct radiation beam. The licensee shall review and modify as appropriate its "lock-out" procedures whenever a new device is obtained to incorporate the device manufacturer's recommendations.
  24. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

**MATERIALS LICENSE  
SUPPLEMENTARY SHEET**

License Number

07-30359-01

Docket or Reference Number

030-34313

25. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

- A. Application dated November 15, 1996
- B. Letter dated February 24, 1997

MAR 11 1997

Date \_\_\_\_\_

For the U.S. Nuclear Regulatory Commission

**ORIGINAL SIGNED BY:**

**ERIC H. REBER**

By

Division of Nuclear Materials Safety

Region I

King of Prussia, Pennsylvania 19406

MAR 11 1997

License No. 07-30359-01  
Docket No. 030-34313  
Control No. 124025

Leslie B. Thompson  
Manager, Safety  
Citisteel USA, Inc.  
4001 Philadelphia Pike  
Claymont, DE 19703

Dear Mr. Thompson:

This refers to your request for an NRC license. Enclosed with this letter is the license.

Please review the enclosed document carefully and be sure that you understand all conditions. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Please be advised that your license expires at the end of the day, in the month, and year stated in the license. Until your license is terminated, you must conduct your program involving byproduct materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers; Inspections," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.
2. Not possess and use materials authorized in Items 6, 7, and 8, on the license until:
  - a. you have constructed the facilities and obtained the equipment described in the license application and supporting documentation; and
  - b. you have notified the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406 in writing, that activities authorized by the license will be initiated.
3. Notify NRC, in writing, within 30 days:

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ML 10

- a. when an authorized user or Radiation Safety Officer, permanently discontinues performance of duties under the license or has a name change; or
  - b. when the mailing address on the license changes (no fee is required if the location of byproduct material remains the same).
4. In accordance with 10 CFR 30.36(b) and/or license condition, notify NRC, promptly, in writing, and request termination of the license:
  - a. when you decide to terminate all activities involving materials authorized under the license; or
  - b. if you decide not to complete the facility, acquire equipment, or possess and use authorized material.
5. Request and obtain a license amendment before you:
  - a. permit anyone to work as an authorized user under the license;
  - b. change Radiation Safety Officer;
  - c. order byproduct material in excess of the amount, or radionuclide, or form different than authorized on the license;
  - d. add or change the areas of use, or address or addresses of use identified in the license application or on the license; or
  - e. change ownership of your organization.
6. Submit a complete renewal application with proper fee or termination request at least 30 days before the expiration date of your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of byproduct material after your license expires is a violation of NRC regulations. A license will not normally be renewed, except on a case-by-case basis, in instances where licensed material has never been possessed or used.

In addition, please note that NRC Form 313 requires the applicant, by his/her signature, to verify that the applicant understands that all statements contained in the application are true and correct to the best of the applicant's knowledge. The signatory for the application should be the licensee or a certifying official of the licensee rather than the Radiation Safety Officer or a consultant.

You will be periodically inspected by the NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in



L. B. Thompson  
Citisteel USA, Inc.

-3-

enforcement action against you. This could include issuance of a notice of violation, or imposition of a civil penalty, or an order suspending, modifying or revoking your license as specified in the "General Statement of Policy and Procedure for NRC Enforcement Actions," (Enforcement Policy), NUREG 1600.

Since serious consequences to employees and the public can result from failure to comply with NRC requirements, prompt and vigorous enforcement action will be taken when dealing with licensees who do not achieve the necessary meticulous attention to detail and the high standard of compliance which NRC expects of its licensees.

Thank you for your cooperation.

Sincerely,

**ORIGINAL SIGNED BY:**  
**ERIC H. REBER**

Eric H. Reber  
Division of Nuclear Materials Safety

License No. 07-30359-01  
Docket No. 030-34313  
Control No. 124025

Enclosures:

1. License No. 07-30359-01
2. 10 CFR Parts 2, 19, 20, 30, and 170
3. NRC Form 3 and 313

DOCUMENT NAME: R:\WPS\MLTR\LO730359.01

To receive a copy of this document, indicate in the box: "C" = Copy w/o attach/encl "E" = Copy w/ attach/encl "N" = No copy

OFFICE	DNMS/RI	<input checked="" type="checkbox"/> N	DNMS/RI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NAME	Reber/ehr	ER					
DATE	03/11/97		03/ /97		03/ /97		03/ /97

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TELEPHONE CONVERSATION RECORD	Date: February 6, 1997	Time: 3:00pm
Mail Control No.: 124025	License No.:	Docket No.: 030-34313
Person Called: Leslie Thompson	Organization: Citisteel USA, Inc.	Telephone Number: (302) 792-5405
Person Calling: Eric H. Reber / (215) 337-5276		
Subject: License application		
<p>Summary:</p> <p>✓ Please confirm that Leslie Thompson is a representative of the corporation who is authorized to sign official documents. Please also confirm that Leslie Thompson is a management representative?</p> <p>✓ Please confirm that any employee who will operate your device or perform other duties involving the device will attend the training similar to that given at the time of installation or will receive equivalent training and instruction before assuming duties in the vicinity of the device.</p> <p>✓ Please submit a description of the method and procedures for detecting a cooling system failure that will be sufficient to prevent damage to sealed alarms in your devices. This system may include audible or visible alarms.</p>		
Action Required/Taken:		
Signature: <i>Eric H. Reber</i>	Date: 2/6/97	

(SEE ATTACHED)

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FEB 28 1997



**Jerome Downie**

*Director, Human Resources*

February 24, 1997

Mr. Eric H. Reber  
U.S. Nuclear Regulatory Commission  
Region 1  
475 Allendale Road  
King of Prussia, PA 19406-1415

Dear Mr. Reber,

Mr. Thompson is Manager, Safety of CitiSteel USA. As a Manager he is authorized, in addition to me, to sign official documents for the Company regarding the Radiation Permit, Radiation Safety Training, and the Radiation Safety Program.

Sincerely,

A handwritten signature in black ink, appearing to read "Jerome Downie". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Jerome Downie  
Director, Human Resources

cc: file



February 7, 1997

Mr. Eric H. Reber  
U.S. Nuclear Regulatory Commission  
Region 1  
475 Allendale Road  
King of Prussia, PA 19406-1415

Dear Mr. Reber;

Initially all of our employees who will work around the thickness gauge will attend training conducted by the DMC Training Department. This training requirement is contained in our contract.

Before any newly hired or transferred employees are allowed to work around the gauge, they will be trained by Mr. Thompson Manager, Safety who has attended the forty hour Radiation Safety Officer Course.

Sincerely,

A handwritten signature in dark ink, appearing to read "Bud Rossi".

Bud Rossi  
Vice President, Operations

cc: file



Leslie Thompson  
Safety Manager  
CitiSteel USA

In response to your request for a description of the method and procedure for detecting a cooling system failure the following will be incorporated in the control system:

- 1) A flow switch will be utilized to detect a lack of or deficiency of cooling water as determined by the manufacturer.
- 2) An audible and visual alarm will be installed at the containment building, visible by the the operator and any employees in the main walkway utilized by all Plate Mill personnel.
- 3) A visual alarm will also be displayed along with an audio tone on the operator's monitor in the main pulpit.
- 4) The manufacturer will be requested to install and interlock in the control program to either retract the measurement device if a problem is sensed while in use or to prevent the measurement device from being traversed into position if a problem is sensed prior to positioning.

I trust this procedure will suffice your requirement. If additional information is required please contact me. A copy of this will be forwarded to the manufacturer and their reply will be copied to you and filed with project correspondence.



Frank Hancock  
Manager Engineering

TELEPHONE CONVERSATION RECORD	Date: February 6, 1997	Time: 3:00pm
Mail Control No.: 124025	License No.:	Docket No.: 030-34313
Person Called: Leslie Thompson	Organization: Citisteel USA, Inc.	Telephone Number: (302) 792-5405
Person Calling: Eric H. Reber / (215) 337-5276		
Subject: License application		
<p><b>Summary:</b>  Please confirm that Leslie Thompson is a representative of the corporation who is authorized to sign official documents. Please also confirm that Leslie Thompson is a management representative?</p> <p>Please confirm that any employee who will operate your device or perform other duties involving the device will attend the training similar to that given at the time of installation or will receive equivalent training and instruction before assuming duties in the vicinity of the device.</p> <p>Please submit a description of the method and procedures for detecting a cooling system failure that will be sufficient to prevent damage to sealed sources in your devices. This system may include audible or visible alarms.</p>		
Action Required/Taken:		
Signature: <i>Eric H. Reber</i>	Date: <i>2/6/97</i>	

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November 15, 1996

U. S. Nuclear Regulatory Commission  
Region I  
Nuclear Material Section 8  
631 Park Avenue  
King of Prussia, PA. 19406

Dear Sirs:

This letter serves as a formal request from CitiSteel USA, Inc. to obtain a material license for the Measurex-DMC equipment and handling.

Attached are the application (NRC Form 313), a check covering the application fee in the amount of \$550.00 and necessary attachments for the application.

Please call me if you have any questions @ (302) 792-5405.

Thank you for your consideration in this matter.

Sincerely,

Leslie Thompson, CSP  
Manager, Safety

LT/ps

Attachments



Les Thompson, CSP  
MANAGER, SAFETY

4001 PHILADELPHIA PIKE  
CLAYMONT, DELAWARE 19703-2794 U.S.A.  
302-792-5405  
FAX: 302-791-6650

124025  
DEC 16 1996

(10-94)

10 CFR 30, 32, 33,  
34, 35, 36, 39 and 40

## APPLICATION FOR MATERIAL LICENSE

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 9 HOURS. SUBMITTAL OF THE APPLICATION IS NECESSARY TO DETERMINE THAT THE APPLICANT IS QUALIFIED AND THAT ADEQUATE PROCEDURES EXIST TO PROTECT THE PUBLIC HEALTH AND SAFETY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-8 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0120), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

## APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY  
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS  
U.S. NUCLEAR REGULATORY COMMISSION  
WASHINGTON, DC 20555-0001

## ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

## IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND,  
MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA,  
RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION  
NUCLEAR MATERIALS SAFETY BRANCH  
U.S. NUCLEAR REGULATORY COMMISSION, REGION I  
475 ALLENDALE ROAD  
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO  
RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA,  
SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION II  
101 MARIETTA STREET, NW, SUITE 2900  
ATLANTA, GA 30323-0190

## IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN,  
SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION III  
801 WARRENVILLE RD  
LISLE, IL 60532-2351

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS,  
LOUISIANA, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA,  
OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH,  
WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION  
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV  
611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TX 76011-8064

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

## 1 THIS IS AN APPLICATION FOR (Check appropriate item)

☒  
☐  
☐

A. NEW LICENSE

B. AMENDMENT TO LICENSE NUMBER \_\_\_\_\_

C. RENEWAL OF LICENSE NUMBER \_\_\_\_\_

## 2 NAME AND MAILING ADDRESS OF APPLICANT (Include Zip code)

CITISTEEL USA, INC.  
4001 PHILADELPHIA PIKE  
CLAYMONT, DE 19703

## 3 ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

SAME

## 4 NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

LESLIE THOMPSON

TELEPHONE NUMBER

302 792-5405

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

## 5 RADIOACTIVE MATERIAL

a. Element and mass number; b. chemical and/or physical form; and c. maximum amount  
which will be possessed at any one time

## 6 PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED

## 7 INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE

## 8 TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

## 9 FACILITIES AND EQUIPMENT

## 10 RADIATION SAFETY PROGRAM

## 11 WASTE MANAGEMENT

## 12 LICENSEE FEES (See 10 CFR 170 and Section 170.31)

FEE CATEGORY

AMOUNT  
ENCLOSED \$ 550.00

## 13 CERTIFICATION. (Must be completed by applicant) THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 82 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER - TYPE/PRINTED NAME AND TITLE

LESLIE THOMPSON, MANAGER, SAFETY

SIGNATURE

*Leslie Thompson*

DATE

11/15/96

## FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
-------------	---------	--------------	-----------------	--------------	----------

\$

APPROVED BY

DATE

124025



**5. SEALED SOURCE:**

- a. Cesium-137 in special form; Source capsule is a model X.60/1 (USNRC Model CDC.PE3) manufactured by Amersham.
- b. Device is a model CE-30 (Registry of Radioactive Sealed Source and Devices Safety Evaluation of Device number MD-381-D-102S) distributed by Measurex-DMC and manufactured by JL Shepard (See Attachment #1).
- c. 30 Curies

**6. DMC 450 HOT PLATE MILL ISOTOPE THICKNESS GAUGING SYSTEM**  
used to measure the thickness of flat rolled steel plate.

**7. INDIVIDUAL RESPONSIBLE:** Leslie B. Thompson, Manager, Safety (attended 40 hr. Radiation Safety Officer Training Course) (See Attachment #2 & #3).

Mr. Thompson is a Certified Safety Professional with a Masters of Industrial Safety and Health from the University of Minnesota. He has been employed as a Safety Professional for 20 years.

From 1985 until 1988 he was employed as Safety Manager at the Princeton University Plasma Physics Laboratory. He attended several radiation safety courses, conducted by the Department of Energy, in Radiation Hazards, Emergency Procedures, and Emergency Response. He has attended two 40 hour courses on Radiation Safety which included written examinations.

On September 16, 1996, Mr. Thompson attended the 40 Hour Radiation Safety Training Course (RSO) sanctioned to fulfill the NRC Licensing Requirement. A copy of the course certificate is enclosed.

**OTHER CITISTEEL PERSONNEL SHALL RECEIVE TRAINING BY MEASUREX DMC IN OPERATION OF THE GAUGE AND RADIATION SAFETY. TRAINING WILL BE CONDUCTED PRIOR TO GAUGE OPERATION.**

**8. TRAINING OUTLINE**

See Attachment # 4

**9. FACILITIES AND EQUIPMENT**

Maximum C-frame travel from off-line to full forward is 40 feet (12192mm). For greater distances than this, please consult the factory.

## CENTER OF EXCELLENCE FOR THE METALS INDUSTRY



ISO 9001 Certified - Certificate Registration 09 100 3255

P.O. Box 490

PHONE: (301) 948-2450

Gaithersburg, Maryland 20884 U.S.A.

FAX: (301) 670-0506

TO: Frank Hancock  
CO: CitiSteel  
FAX: 302-792-1195  
REF: Job Number 96-8736

FROM: Alan Crosby (x319)  
DEPT: Project Management  
DATE: 5 December, 1996  
REF:

cc: Linda Lubitz, Rick Blank

Dear Mr. Hancock,

Thank You for your fax dated 2 December 1996. I apologize for not responding sooner.

Per our telephone conversation Tuesday, I would like to confirm the details of the safety interlock for your system. Measurex-DMC will provide a software interlock for the shutter at no additional cost. The shutter will be rendered inoperable unless the C-frame is in a specified area of the mill. The area of operation for the shutter will be from 180" (referenced from the offline limit switch) to 360" (the forward limit switch). Measurex-DMC will try to make this range adjustable in a data file so that Citisteel maintenance personnel can adjust the operating range, but the mill operators cannot adjust this range.

Please do not hesitate to contact me if you have any questions.

Best Regards,

A handwritten signature in dark ink, appearing to be "AL" followed by a stylized flourish.

Alan Crosby  
Project Manager

**QUESTION #5**  
**ATTACHMENT # 1**

REGISTRY OF RADIOACTIVE SEALED SOURCE AND DEVICES  
SAFETY EVALUATION OF DEVICE(Amended August 14, 1987)  
(Page 1 only)NO: MD-381-D-102SDATE: August 14, 1987PAGE 1 of 3DEVICE TYPE: Thickness Gauge ComponentMODEL: CE 30MANUFACTURER/DISTRIBUTOR: Data Measurement Corporation  
15884 Gaither Drive  
Gaithersburg, Maryland 20877  
(Formerly Industrial Gauging and Control)SEALED SOURCE MODEL DESIGNATION: Amersham X.60/1ISOTOPE: Cesium-137MAXIMUM ACTIVITY: 30 curiesLEAK TEST FREQUENCY: 6 monthsPRINCIPLE USE: Gamma GaugeCUSTOM DEVICE: \_\_\_\_\_ YES \_\_\_\_\_ X \_\_\_\_\_ NO



REGISTRY OF RADIOACTIVE SEALED SOURCE AND DEVICES  
SAFETY EVALUATION OF DEVICE

NO.: MD381D102S

DATE: March 29, 1983

PAGE 3 OF 3

DEVICE TYPE: Thickness Gauge Component

EXTERNAL RADIATION LEVELS (CONT'D):

system. Tests using typical roll stock in the beam indicated radiation levels of 35 to 250 mr/hr depending on the thickness of the roll stock. Outside of the jaws of the device, radiation levels reported by the manufacturer are less than 2 mr/hr at a distance of four feet from the unshielded beam of a 30 Curie Source.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

Industrial Gauging and Control, Inc. is authorized by Maryland Radioactive Material License MD-31-088-02 to distribute the source holder as a component of a IGCI thickness gauge to specifically licensed recipients only.

The installation, dismantling, relocation, and testing of the device is performed by the manufacturer. The manufacturer supplies a manual, repairs the gauge and performs all maintenance that requires access to the "operate" - "retracted" system of the Shepherd source. The manual states that "leak tests" of the source must be performed at least once every six months by an individual licensed to perform such test. Leak testing service is also provided by the manufacturer.

ISSUING AGENCY:

Maryland State Department of Health and Mental Hygiene

Date: March 30, 1983

Received by: Charles R. Flynn

Charles R. Flynn

Date: April 5, 1983

Received by: Robert E. Corcoran

Robert E. Corcoran



# Cesium-137

## Gamma sources

Sources contain the radionuclide as compressed pellets of cesium chloride or sulfate. Doubly encapsulated in welded stainless steel.

Nominal air kerma rate at 1 metre† mGy/hr	Nominal equivalent activity*† Ci	Nominal content activity Ci	Capsule type	Double encapsulation code
14.4	5	5	X.60/2	CDC.6024
28.8	10	10	X.60/1	CDC.6025
57.6	20	20	X.60/1	CDC.600
78.6	27	30	X.60/1	CDC.601
131	46	50	X.61/1	CDC.611
267	93	100	X.62/1	CDC.621
534	186	200	X.63/1	CDC.631
995	346	400	X.64/1	CDC.641
2462	855	1200	X.65/1	CDC.651
3667	1273	2200	X.66/1	CDC.661

†End window measurement

\*Tolerance - 10%, + 15%

For definition of equivalent activity, see page E1

**Recommended working life: 15 years**

### Quality Control

Wipe test A

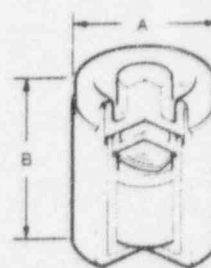
Bubble test D

Helium leak test H

The maximum concentration of  $^{134}\text{Cs}$  in all of these  $^{137}\text{Cs}$  sources is <5.0%.

For remote source handling equipment please see the Amertest Gamma Radiography Products catalog.

## X.60-X.64

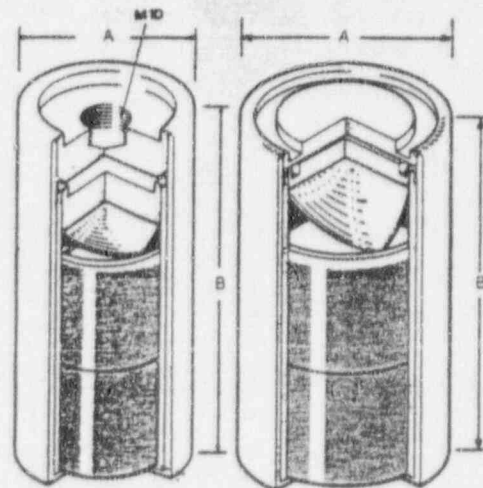


### Capsule dimensions and Safety performance testing

Capsule	Overall diam. 'A' mm	Overall height 'B' mm	Safety performance testing ANSI/ISO classification	IAEA special form	IDNS Model No.
X.60/1	12.45	17.85	E63535	GB/190/S	CDC.PE3
X.60/2	12.45	17.85	E63635	GB/196/S	CDC.PE2
X.61/1	14.6	20.2	E63535	GB/197/S	CDC.PE4
X.62/1	17.4	22.7	E63635	GB/198/S	CDC.PE5
X.63/1	21.2	26.2	E63636	GB/199/S	CDC.PE6
X.64/1	27.0	28.2	E63535	GB/200/S	CDC.PE7

## X.65

## X.66



### Capsule dimensions and Safety performance testing

Capsule	Overall diam. 'A' mm	Overall height 'B' mm	Safety performance testing ANSI/ISO classification	IAEA special form	IDNS Model No.
X.65/1	30.0	70.0	E63535	GB/201/S	CDC.PE8
X.66/1	36.1	65.0	E63535	GB/202/S	CDC.PE9

### Quality control:

Leakage and Contamination tests, see page D1

A Test Report is supplied with each source or batch of sources.

**Safety performance testing**, see page F1

Dimensions in mm

**Recommended working life**, see page F2

**QUESTION #7**  
**ATTACHMENT # 2 & # 3**

# Certificate of Training

This Certifies That

*Les Thompson*

has successfully completed the 40-hour course of instruction for

## Radiation Safety Officer

September 16-20, 1996

Presented By

CSI-Radiation Safety Training  
3827 Farragut Avenue  
Kensington, MD 20895

and

Radiation Service Organization  
P.O. Box 1526  
Laurel, MD 20725

*Ray Johnson*

Raymond Johnson, C.H.P., P.E.  
Course Director



Attachment #3

## **CSI - Radiation Safety Training and Radiation Service Organization**

# **Radiation Safety Officer Agenda**

### **Day 1      Monday, September 16, 1996**

**Instructor: Ray Johnson, C.H.P., P.E., CSI - Radiation Safety Training**

- 8:00 Registration and Orientation
- 8:15 Overview and Course Objectives,  
Radiation Risk Perceptions
- 8:45 Pre-Test
- 9:15 Atomic Structure and Radioactivity,  
The Natural and Man Made Radiation Environment, Radon,  
Units of Radioactive Decay and the Decay Law,  
Interactions of Radiation with Matter, Radiation Quantities and Units,
- 12:00 Lunch (Provided)
- 1:00 Biological Effects of Radiation, Risks of Radiation Exposure,  
Risks to the Pregnant Worker, Radiation Risk Communication
- 5:00 Adjourn

### **Day 2      Tuesday, September 17, 1996**

**Instructor: Dr. Keith Earnshaw**

- 8:00 Radiation Protection Standards, 10 CFR Part 19 and 20
- 10:00 Essential Highlights of 10 CFR Part 21, 30, 31, 33
- 11:00 Medical Use: 10 CFR Part 35, Part 31.11
- 12:00 Lunch
- 1:00 More Part 35
- 1:30 External Dosimetry, Shielding, and Internal Dosimetry
- 5:00 Adjourn

**Day 3      Wednesday, September 18, 1996**

**Instructor: Ray Johnson**

8:00 Radiation Detection Instruments

**Instructors: Ray Johnson, Keith Earnshaw, and Greg Smith, RSO, Inc.**

10:00 Radiation Instruments Laboratory

12:00 Lunch

**Instructor: Ray Johnson**

1:00 Radiation Statistics

2:30 Contamination Control and Health Physics Surveys

5:00 Adjourn

**Day 4      Thursday, September 19, 1996**

**Instructor: Ray Johnson**

8:00 Quality Assurance

**Instructor: Keith Earnshaw**

10:00 Radioactive Waste Management, Waste Minimization, Mixed Wastes

12:00 Lunch

**Instructor: Ray Johnson**

1:00 Communication Styles and Effective Risk Communications

3:00 Communication Factors in Implementing Radiation Safety Programs

5:00 Adjourn

**Day 5      Friday, September 20, 1996**

**Instructor: Keith Earnshaw**

8:00 Transport, Shipment, and Receipt of Radioactive Materials,  
Ordering, Receipt, and Opening Procedures

10:00 Preparing a Regulatory License Application

12:00 Lunch (Provided)

**Instructor: Ray Johnson and Keith Earnshaw**

1:00 Preparing for Regulatory Inspections and Program Audits

2:30 Radiation Protection Program Management,  
Challenges for NSO's, Information Resources

3:30 Final Exam and Review

5:00 Presentation of Certificates



# **Radiation Safety Officer Manual Contents**

## **Section 1 - Radiation Fundamentals**

Atomic Structure, Radioactivity, Natural Radiation,  
Radon, Interaction of Radiation, Quantities

## **Section 2 - Radiation Risks**

Biological Effects, Health Risks, Prenatal Exposure

## **Section 3 - Radiation Standards**

10 CFR Part 19, 10 CFR Part 20,  
Medical Uses of Byproduct Material

## **Section 4 - Dosimetry**

External, Internal Exposure, Internal Dosimetry, Bioassay,  
Radiopharmaceuticals

## **Section 5 - Principles of Radiation Detection**

Principles, Instruments, Sensitivity Factors,  
Semiconductors, Liquid Scintillation

## **Section 6 - Radiation Counting Statistics**

Principles, Statistics, Chi-Square, QA Goals, Language of Quality, Control Charts, Quality Assurance

## **Section 7 - Transportation of RAM**

Transportation, DOT Regulations, Proposed Rules, Postal Service

## **Section 8 - Radiation Risk Communication**

Communication Styles, Risk Assessment, Motivating Homeowners, Source of Risk Perceptions, Insights in Communications

## **Section 9 - Radioactive Waste Disposal**

Waste Form and Waste Class, Mixed Wastes, Low-level Waste Treatment, Regional Compacts, Site Requirements

## **Section 10 - Radiation Program Administration**

Program Manual, Safety Surveys, Air Sampling, Preparing for an Inspection, Reg. Guide 8.7 Reporting Exposures, Reg. Guide 8.34 Monitoring



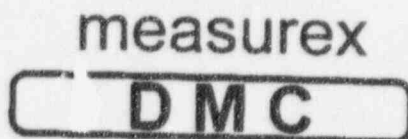
# Radiation Safety Officer

## Introduction

Topic	Page
Goals and Objectives	1
Radiation Symbols and Images	5
Radiation Risk Perceptions	7
Two-Word Risk Assessments	10
Instinct vs Science	11
Roles of Lifestyle Values	15



**QUESTION #8**  
**ATTACHMENT # 4**



CENTER OF EXCELLENCE FOR THE METALS INDUSTRY  
ISO 9001 Certified - Certificate Registration 09 100 3255

P.O. Box 490, Galthersburg, Maryland, 20884 U.S.A.  
(301) 948-2450 FAX:(301) 670-0506

Internet dmcmnorb@access.digex.net or <http://www.access.digex.net/~dmcmnorb/>

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Date: November 18, 1996  
To: Mr. Les Thompson  
FAX: (302) 791-6650  
From: Brad Webster, Mx/Data Measurement Corp. (DMC)  
Subj: Training schedule request.

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Mr. Thompson;

Here is the information you requested. I have included the training schedule for the maintenance course. The maintenance course schedule is based on training here at Measurex/DMC and requires a great deal of access to the gauge. For this reason we recommend not conducting the class at the job sight unless unlimited access to the gauge can be arranged. If you have any other questions or need any further information please feel free to contact me.

Regards,

A handwritten signature in dark ink, appearing to read "Brad Webster".

Brad Webster  
Training coordinator

Phone # (302) 792-5405

## DMC 450 TCeC Maintenance Training Course

### Day One (Lunch when required)

1. Introduction to DMC
2. Radiation safety
3. Theory of radiation thickness gauging
4. System block diagram and signal flow
5. System familiarization and functions
6. Operations class
7. AT compatible computer theory
  1. Basic hardware
  2. Basic functions
  3. Set up
8. File setup and operation

### Day Two (Lunch when required)

1. Motherboard and expansion card familiarization
2. Schematic analysis:
  - a. DMC opto input module
  - b. DMC opto output module
  - c. DMC relay module
3. Detector construction, operation and troubleshooting
4. Source holder
5. Motion control system
6. Quiz
7. DMC 450 signal flow
8. Using the DMC 450 diagnostics package
9. Preventative maintenance checks and common problems

**DMC 450 TCeC MAINTENANCE TRAINING COURSE (pg. 2)**

**Day Three (Lunch when required)**

1. Troubleshoot gauge faults
2. Final exam
3. Questions and answers
4. Review recommended spares list
5. DMC services
6. Course critique

**QUESTION #9**  
**ATTACHMENT # 5**

**QUESTION #9**  
**ATTACHMENT # 6**



# CITISTEEL USA, INC.

## SAFETY POLICY

POLICY: Lockout/Tagout Policy

SAFETY ADMINISTRATOR: Mike Bl

ORIGINAL POLICY DATE: 07/20/92

DIRECTOR, HR: Rowe

REVISION DATE: 02/24/95

### PURPOSE

Provide protection for employee and contractors from unexpected energization or start up of the machinery or equipment, or the release of stored energy which could cause injury to employees when performing maintenance, parts replacement work and equipment installation. Compliance with 29 CFR 1910.147 and 1910.333.

### DEFINITIONS

Affected employee - An employee whose job requires them to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or whose job requires them to work in an area in which such servicing or maintenance is being performed. For our purposes, all non-office employees and office employees who might have to enter the production area should be considered an affected employee.

Authorized employee - A person who locks out machines or equipment and performs the servicing or maintenance on that machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties including performing maintenance or service on a machine must be locked out.

Capable of being locked out - An energy-isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it.

Energized - Connected to an energy source, or containing residual or stored energy.

Energy-isolating device - A mechanical device that physically prevents the transmission or release of energy including, but not limited to, the following:

- a manually operated circuit breaker;
- a disconnect switch;
- a manually operated switch by which the conductors of a circuit can be disconnected from all supply connectors

124025

- and no pole can be operated independently;
- a slide gate;
- a slip bind;
- a line valve;
- a block;
- any similar device used to block or isolate energy.

The term does not include a pushbutton, selector switch, guard interlock switch, and/or other control circuit-type devices.

Energy source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other energy.

Hot tap - A procedure used in repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) which are under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water and steam distribution systems.

Lockout - The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device - A device that uses a positive means, such as a lock, to hold energy-isolating device in the safe position and prevent the energizing of a machine or equipment.

Tagout - The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy-isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Normal production operations - The utilization of a machine or equipment to perform its intended production function.

"Off" or "Open" position - In an electrical switch, the position that does not allow the flow of electricity. In a valve, "open" is the position that allows electricity to flow. In a valve, "closed" is the position that does not allow the substance to flow.

"On" or "Closed" position - In an electrical switch, the position that allows electricity to flow. In a valve, "closed" is the position that does not allow the substance to flow.

Servicing and/or maintenance - Workplace activities such as construction, installing, setting-up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. This includes, but is not limited to lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected

energization or start up of equipment or release of hazardous energy.

Setting up - Any work performed to prepare a machine or equipment to perform its normal production operation.

### SPECIFIC PROCEDURES

Specific lockout/tagout procedures have been developed for machinery that has been locked out. No work can proceed until the General Supervisor writes and provides the authorized employee with a specific procedure. These specific procedures are documented in Appendices E-H.

### LOCKOUT PROCEDURE

1. Authorized employee will make a survey using Appendix D to locate and identify all isolating devices to be certain which switch(es), valve(s), or other energy-isolating devices apply to the equipment to be locked out. More than one energy source (electrical, mechanical, or other) may be involved. Type(s) and location(s) of energy-isolating means.
2. Notify the area supervisor that a lockout system is going to be used and why.
3. Notify all affected employees that a lockout system is going to be used and why. The authorized employee shall know the type and magnitude of energy that the machine or equipment utilizes and shall understand the hazards thereof.
4. If the machine or equipment is operating, shut it down by normal stopping procedure (depress stop button, open toggle switch, etc.)
5. Open and lock all switches, close and lock all valves so that the equipment is isolated from all of its energy sources. Stored energy (such as springs, elevated parts, rotating equipment, hydraulic systems, air, gas or water pressure systems), must be dissipated or restrained.
6. Lockout/tagout device application
  - a. Locks and/or tags shall be affixed to each energy isolating device by the authorized employee.
  - b. Each lock shall have a "Danger - DO NOT OPERATE" tag attached to it that identifies the assigned owner of the lock and the date and time it was put on the energy isolating device. The locks and tags shall be singularly

identified.

- c. Locks shall be affixed in a manner that will hold the energy isolating devices in a safe or off manner.
- d. Tags shall be affixed in a manner that will clearly indicate that the operation or movement of the energy isolating device from the safe or off position is prohibited.
- e. Tags that cannot be directly affixed to the energy isolating device shall be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.
- f. All potentially hazardous stored or residual energy shall be relieved, disconnected, restrained or otherwise rendered safe. If there is the possibility of reaccumulation of stored energy to a hazardous level verification of isolation shall continue until the possibility of reaccumulation no longer exists.
- g. After insuring that no one is exposed, and as a check on having disconnected the energy sources, operate all START buttons, etc. to verify that the equipment will not operate.  
**WARNING:** Be sure to return all controls to the "NEUTRAL" or "OFF" position after the test.

7. Only now can mechanical work begin.

#### TESTING OR POSITION OF MACHINES, EQUIPMENT, OR COMPONENTS THEREOF

In situations which lockout or tagout devices must be temporarily removed from the energy isolating device and the machine or equipment energized to test or position the machine, equipment or component thereof, the following sequence of actions shall be followed:

- a. Clear the machine or equipment of tools and materials.
- b. Remove employees from the machine or equipment area.
- c. Remove the lockout or tagout devices.
- d. Energize and proceed with testing or positioning.
- e. Deenergize all systems and reapply energy control measures in accordance with the requirements set forth in this instruction.



## PROCEDURE INVOLVING MORE THAN ONE PERSON

When more than one individual is required to lockout equipment, each must place their own personal lock device on each energy-isolating device. When an energy isolating device cannot accept multiple locks or tags, a multiple lockout device (hasp) may be used. If a single lock is used on each power-isolating device key(s) should then be placed in a lockable box or cabinet which allows the use of multiple locks to secure it. Everyone working in the machine/equipment will then use their own lock to secure the box or cabinet. The last person to remove their lock is responsible for restoring the machine/equipment to normal production operation.

## ELECTRICAL LOCKOUT/TAGOUT - 29 CFR 1910.333(b)

electrical work requires a lock and a tag be used together. However a tag may be used by itself only if the electrical disconnecting source does not have lockout capabilities

Locks can be placed without a tag only under the following conditions :

1. Only one circuit or piece of equipment is deenergized.
2. The lockout period does not extend beyond the work shift.
3. Employees exposed to the hazards associated with reenergizing the circuit or equipment are familiar with this procedure.

## ELECTRICAL TEST VERIFICATION OF DEENERGIZED CIRCUITS - 29 CFR 1910.333(b)(iv)(B)

A qualified person shall use test equipment to test the circuit elements and electrical parts of the equipment to which employees will be exposed and verify that the circuit elements and equipment parts are deenergized. The test shall also determine if any energized condition exists as a result of inadvertently induced voltage or unrelated voltage backfeed even though specific parts of the circuit to be tested is over 600 volts, nominal, the test equipment shall be immediately checked for proper operation immediately before and immediately after this test.

## WORK ON ENERGIZED CIRCUITS

Approval must be obtained from the Maintenance Supervisor prior to any work on energized circuits. The Maintenance Supervisor will verify that by deenergizing circuits that it will create additional or increased hazards or it is infeasible due to equipment design or operational limitations.

**NOTE:** Working on energized parts requires the wearing of appropriate personal protective equipment. The Safety Administrator will be responsible for specifying appropriate PPE to be used to ensure compliance with 29 CFR 1910.335. PPE for electrical hazards shall meet, and be used and maintained in accordance with ANSI J6.1 through J6.7.

#### **SEQUENCE FOR RESTORING MACHINE OR EQUIPMENT TO NORMAL PRODUCTION OPERATIONS**

1. After the servicing and/or maintenance is completed, all tools have been removed, and all guards reinstalled, notify the area supervisor that the machine/equipment is available for production.
2. Verify that all employees are clear; remove all locks.
3. Notify all affected employees. If the operator(s) is(are) available, or at the request of the area supervisor, operate all the necessary switches and/or valves to restore power to the machine/equipment.

#### **LOCKOUT DEVICES REMOVAL**

Each lockout device shall be removed from each energy-isolating device by the employee who applied the device. If the equipment is not completely repaired, the lockout should remain in place until work is completed.

If work continues from one shift to the next shift, the following steps should be taken

If an employee on the first shift is being relieved by an employee on the second shift, the first shift employee should only remove their lock when the second shift employee is there and ready to install their own lock. It might be necessary for a supervisor to use their lock to replace the first shift employee's lock before the end of the shift and then wait for the second shift employee's shift to start so they can then place their lock on the equipment to avoid unnecessary overtime.

If the work seems to be completed but remains locked out, the following steps should be taken

1. After a reasonable attempt to contact the lock owner, two (2) authorized supervisors should be present to remove the lock.



Reasonable attempt includes:

- \* Checking time card rack for employee to see if they have clocked out;
  - \* Paging the authorized employee to verify they have left the facility; and
  - \* Calling contractor if they are the authorized employee.
2. The authorized supervisor should verify that all work has been completed, all tools have been removed, and all appropriate guards are in place.
  3. The lock may now be removed (cut off).
  4. If possible, jog the equipment. If it appears safe, test it at normal operation speed before releasing it for production. Under no circumstances should a piece of equipment be started unless the supervisor agrees that it appears to be safe.
  5. Making all reasonable efforts to contact the authorized employee to inform him/her that his/her lockout device has been removed, and ensuring that the authorized employee has knowledge before he/she resumes work at that facility. Call employee at home. If contact is not made, place a note on time card so employee can be informed before starting work the next day; or if outside contractor is authorized employee, leave note in Security that will be given to the contractor the next work day.
  6. Entry must be made in maintenance log referring to lockout removal.

**CONTRACTORS**

The Safety Administrator will inform all outside contractors of the elements of this program and obtain information regarding their lockout program. This information shall be conveyed to CitiSteel employees. The work efforts covered by the procedure shall be fully coordinated and complied with.

**TRAINING**

Training will be provided to ensure that the purpose and function of this energy control program are understood by employees and that the knowledge and skills required for the safe application, usage and removal of energy controls are required by employees. The Safety Administrator is responsible for all training. See Appendix J for the key points of lockout/tagout.

### Authorized Employees

Training shall be conducted for all authorized employees. Records of this training including the training dates, an outline of the material covered and a list of attendees, will be kept by the Human Resources Department. The training shall consist of, but not be limited to:

1. The purpose and use of the lockout program.
2. The recognition of hazardous energy sources.
3. The type(s) and magnitude(s) of energy available within the facility.
4. The method(s) to be used to lockout each type of energy-isolating device they will encounter within the facility.

### Affected Employees

Training shall be conducted for all affected employees. Records of this training, including the training dates, an outline of the material covered and a list of attendees, will be kept in the Human Resources Department. This training shall consist of, but not be limited to:

1. The purpose and use of the lockout program.
2. The prohibition relating to attempts to restart or re-energize machines or equipment which are locked out.

### **RETRAINING**

Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or process that present a new hazard, or when there is a change in the energy control procedures.

Additional retraining shall be conducted whenever a periodic inspection shows, or whenever management has reason to believe, that this procedure is not being followed.

Records of this training including the training dates, an outline of the material covered and a list of attendees, will be kept in the Human Resources Department.

### **PERIODIC INSPECTION**

An inspection shall be conducted on each shift at least annually to insure that the provisions of this procedure are being followed.

This inspection shall contain at least the following elements:

1. The inspection shall be conducted by an authorized employee other than the one(s) utilizing the lockout/tagout procedure being inspected and the Safety Administrator.
2. The inspection shall be designed to document and correct any deviations from the procedure.
3. The inspection shall include a review, between the inspector and each authorized employee, of that employee's responsibilities under the procedure and how they relate to the work being done. This review shall be documented by the inspector.
4. Records of the inspection shall also identify the machine or equipment on which the lockout was being utilized, the date and time of the inspection, the employee(s) included in the inspection and the name of the person performing the inspection.
5. Records of all inspections under this procedure shall be kept on file for not less than three years in the Maintenance Department.

**QUESTION # 10**  
**ATTACHMENT # 7**

CITISTEEL USA, INC.  
MEASUREX DMC-EMERGENCY PROCEDURE

In the event of suspected damage to the radionuclide or to a source-holder containing a radionuclide, the following actions must be taken:

- 1a) Set up and maintain a 10 meter (approx. 33 ft.) radius exclusionary boundary about the radionuclide or source-holder. No one is to be allowed inside this area unless they have had radiation safety training and are equipped with active measuring/monitoring equipment.
- 1b) Set up and maintain a 30 meter (approx. 100 ft.) radius monitored boundary about the radionuclide or source-holder. No one is to be allowed inside this area unless they have had radiation safety training and are equipped with radiation monitoring equipment.
- 2) Isolate any personnel who may have been contaminated or exposed. Inform medical response personnel of potential contamination and have them perform decontamination of the affected personnel. **DO NOT** allow potentially contaminated clothing or waste water to be discarded via trash or sewage, this could result in a contamination problem. All waste products are to be surveyed for contamination; they are then to be segregated and disposed in accordance to their level of contamination.
- 3) Contact Measurex-DMC  
at (301) 948-9559 (Emergency)  
(301) 948-2450 ext 404/341 (RSO phone)  
or (301) 670-0506 (FAX)
- 4) Have an individual trained in radiation safety and equipped with a survey meter, examine the area and answer the following question:

Is the radionuclide installed or not installed in a source holder?

On the basis of that answer, perform the actions of either 4a) or 4b).

- 4a) Radionuclide is installed in a source-holder -  
Determine the shutter position by use of external shutter position indicators.
- i. If the shutter is OPEN or ON and will not close by removal of the air and electrical inputs to the source holder, isolate the source-holder by placing it in a container made of approximately 0.5 inches thick steel, go to step 5.

- ii. If the shutter is in the CLOSED or OFF position, go to step 5.
- 4b) Radionuclide is not installed in a source-holder -  
Isolate the radionuclide by placing it in a container made of approximately 0.5 inches thick steel, go to step 5.
- 5) Take a swipe of all accessible external surfaces, (container or source-holder) and also meter survey those surfaces.
- 6) Take a survey for contamination and radiation the affected monitored and exclusionary areas.
- 7) The monitored and exclusionary boundaries can be taken down when the swipe survey results show no contamination or radiation in that are. (If necessary, use a licensed decontamination company to decontaminate the area.)
- 8) The damaged radionuclide/source-holder can be transported by common carrier when it is established using the results of the swipe survey and meter survey, just what sorts of measures will be necessary to deal with the contamination and radiation that resulted from the accident.
- 9) Document the accident and all subsequent actions taken. Be sure to notify all relevant governmental agencies.

In the event of a loss or theft of the source/device, immediately contact the Measurex-DMC Radiation Safety Officer.

(301) 948-2450 ext 404/341	(RSO phone)
or (301) 670-0508	(FAX)

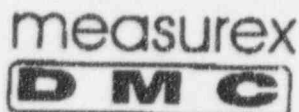
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**QUESTION # 10**  
**ATTACHMENT # 8**

**FACSIMILE MESSAGE**

**PAGE 1 OF 1**



**CENTER OF EXCELLENCE FOR THE METALS INDUSTRY**  
**ISO 9001 Certified - Certificate Registration 09 100 3255**

P.O. Box 490, Gaithersburg, Maryland, 20884 U.S.A.  
 (301) 948-2450 FAX: (301) 670-0506

Internet dmcnorb@access.digex.net or <http://www.access.digex.net/~dmcnorb/>

**TO: Frank Hancock**  
**CO: CitiSteel**  
**FAX: 302-792-0203**  
**DATE: 18 June 1996**

**FROM: Linda Lubitz**  
**EXT: 227**

copy to: Dana LeSage / CitiSteel

**Reference: DMC HOT PLATE MILL ISOTOPE THICKNESS GAUGING SYSTEM**  
**Proposal DMC-10176**

Dear Frank:

In reply to your questions regarding radioisotope source disposal:

- DMC has a specific license issued by the State of Maryland (under the auspices of the Nuclear Regulatory Commission). **License number: MD-31-088-02** Should CitiSteel wish to dispose of the Cesium-137 source, you would transfer it back to DMC and we would then officially take legal possession of the source and store it here at our facility until we are ready to do our next disposal. Once the paperwork is completed for the transfer of the source from CitiSteel to DMC, and we receive the source, CitiSteel is no longer legally responsible for it.
- DMC agrees to take the Cesium-137 source back for disposal if CitiSteel stops using it before it's useful life expires.
- We will assist you in completing the paperwork in order for you to obtain your specific license to possess and use (not repair) the Cesium-137 source in the thickness gauge. We have done this, very successfully, for many customers in the past.
- We will assist you in developing your radiation safety program.

I agree that it would be a good idea to put some line items in your order that summarize or restate the above. We have no problem at all with that.

Regards,

*Linda Lubitz*

Linda Lubitz  
 Area Sales Manager

OFFICIAL RECORD COPY ML 10

1 2 4 0 2 5  
 DEC 16 1996



A Measurex Company  
Center of Excellence for the Metals Industry

**DMC 450 HOT PLATE MILL ISOTOPE  
THICKNESS GAUGING SYSTEM**

**PROPOSAL TO  
CITISTEEL USA  
CLAYMONT, DELAWARE**

**ATTENTION: Mr. Frank Hancock**  
**PROPOSAL: DMC-10176**  
**DATE: 22 March 1996**

15884 Gaither Drive  
Gaithersburg, MD 20877

Phone: (301) 948-2450  
Fax: (301) 670-0506

Internet: [dmcnorb@access.digex.net](mailto:dmcnorb@access.digex.net)  
or: <http://www.access.digex.net/~dmcnorb>

**OFFICIAL RECORD COPY ML 10**

**1 2 4 0 2 5  
DEC 16 1996**

## TABLE OF CONTENTS

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## **MEASUREX/DMC Commitment to Quality**

Measurex/DMC's dynamic growth and continuing need to maintain high-quality product standards that meet our customers' expectations, has resulted in an adoption of a total quality management (TQM) philosophy. The TQM policy will improve all aspects of Measurex/DMC's operations: the overall quality of the goods we produce, service to our end users, and customer relations. The driving force that fueled this change was the international acceptance of the ISO 9000 quality standards. Within the next two years, many of our customers will require certification under this standard as part of conducting business. Measurex/DMC has implemented the ISO 9000 approach to total quality management. Measurex/DMC has selected the ISO 9001 standards and has received certification under this standard.

The above statement means that Measurex/DMC will support the TQM policies by the total management support of the quality process, with specific attention to detail, to attain our goals. This will require support from the Board of Directors, the President, and the rest of the Measurex/DMC team.

This process will certify Measurex/DMC as a true leader both in equipment and total quality.





# CERTIFICATE



The TÜV-Zertifizierungsgemeinschaft e.V.  
hereby certifies that

**Measurex Data Measurement Corp.**

**15884 Gaither Drive  
Gaithersburg, MD 20877, USA**

has established and applies  
a quality system for

**Design, Manufacture, Installation and  
Servicing of Industrial Gauging and Controls.**

An audit was performed, Report No. **3255**  
Proof has been furnished that the requirements according to  
**ISO 9001 / ANSI/ASQC Q9001-1994 / EN ISO 9001**  
are fulfilled.

The certificate is valid until  
**September 1996**  
Certificate Registration No.  
**74 100 3255**

Bonn, Germany, January 4, 1996

A stylized, handwritten signature in black ink, likely belonging to a member of the TÜV CERT Executive Board.

TÜV CERT Executive Board



**TUV Rheinland  
of North America**

Newtown, CT, January 4, 1996

A stylized, handwritten signature in black ink, likely belonging to a representative of the TÜV CERT Certification Body of TÜV Rheinland of North America, Inc.

TÜV CERT Certification Body of  
TÜV Rheinland of North America, Inc.





Lloyd's Register  
Quality Assurance

CERTIFICATE OF APPROVAL

*This is to certify that the Quality Management System of:*

**DMC (UK) Ltd.**  
**Northfleet, Kent, U.K.**

*has been approved by Lloyd's Register Quality Assurance  
Limited to the following Quality Management System Standards:*

**ISO 9001:1994**

*The Quality Management System is applicable to:*

***Design, manufacture and in-house servicing of non-contact  
material thickness measuring equipment systems to customer  
specification, including software customisation in accordance  
with TickIT; manufacture and servicing of  
DMC standard range of equipment.***

Approval  
Certificate No: 924869

Original Approval: 12th June 1995

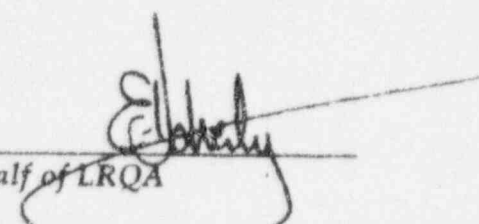
Current Certificate: 12th June 1995

Certificate Expiry: 31st May 1998

Deutscher Akkreditierungsrat



TGA-ZQ-002/91

  
on behalf of LRQA

*The approval is subject to the company maintaining its system to the required standards, which will be monitored by LRQA.*

PRICE AND LIST OF EQUIPMENT

DMC 450 HOT PLATE MILL ISOTOPE THICKNESS

GAUGING SYSTEM

1. HOT PLATE MILL C-FRAME (72 INCH AIR GAP,  
160 INCH THROAT DEPTH)  
  
Source Holder and Radioisotope Source 30 Curie  
Cesium 137  
Seven Inch (175mm) Diameter Ionization Chamber  
Detector Assembly  
C-Frame Drive Motor and Encoder  
Air Regulator and Lubricator  
Stainless Steel Water Carrying Members  
Festoon with Overhead Beam (Twenty (20)  
Feet)
2. GAUGE RAILS (FOR A C-FRAME TRAVEL  
DISTANCE OF TWENTY (20 ) FEET)
3. MILL JUNCTION BOX WITH LOCAL  
CONTROLS (115VAC)
4. DMC 450 MAIN ELECTRONICS CABINET  
(115VAC)  
  
DMC 450 Microcomputer System (80486DX Processor)  
System Inputs and Outputs  
Motion Control Software - Expanded  
Serial Communication Link (DMC Standard)  
210 MByte Hard Disk Drive  
Isolated Analog Outputs  
Diagnostics Package with Monitor  
Plate Temperature Compensation with  
Dual Wavelength Pyrometer

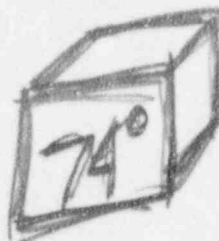
5. VOLTAGE REGULATOR/CONDITIONER
6. DESKTOP PC BASED UNIVERSAL  
OPERATOR'S CONTROL CONSOLE  
(UOCC)/COLOR GRAPHICS PRO-  
FILE DISPLAY SYSTEM WITH A  
DESKJET COLOR PRINTER AND A  
PULSE TACHOMETER
7. INTERCOMPONENT CABLING  
  
C-Frame to Mill Junction Box - As required  
up to 30 Feet  
Mill Junction Box to Main Electronics  
Cabinet - 50 Feet  
Ethernet® Cable from Main Elec-  
tronics Cabinet to Desktop PC  
Based Universal Operator's Con-  
trol Console (UOCC) Color Graphics  
Profile Display Sysrem - 50 Feet
8. TWO (2) SETS OF OPERATING AND MAINTENANCE  
MANUALS (DMC STANDARDS)
9. TWO (2) SETS OF DRAWINGS ON WHITE PAPER  
WITH DMC TITLE BLOCKS (DMC STANDARDS)

PRICING

U.S. DOLLARS

One (1) DMC 450 Hot Plate Mill  
Isotope Thickness Gauging System  
includes one (1) each items 1 - 9,  
as indicated above in Proposal  
**DMC-10176.**

**\$ 308,550.00**  
=====

OPTIONSUNIT PRICE

- |     |   |    |           |
|-----|---|----|-----------|
| 10. | <u>CLOSED LOOP CHILLER (AIR COOLED) FOR ONE (1) HOT PLATE MILL C-FRAME</u>  | \$ | 20,500.00 |
| 11. | <u>DMC 450 MAIN ELECTRONICS CABINET AIR CONDITIONING</u>  | \$ | 2,560.00  |
| 12. | <u>SAMPLE STAND AND BOXED SET OF SIX (6) INCH CALIBRATION SAMPLES</u>   | \$ | 12,300.00 |
| 13. | <u>ADDITIONAL INTERCOMPONENT CABLING</u>  |    |           |
|     | Mill Junction Box to Main Electronics Cabinet   | \$ | 18.50     |
|     | Ethernet® Cable from Main Electronics Cabinet to Desktop PC Based Universal Operator's Control Console (UOCC) Color Graphics Profile Display System | \$ | 5.00      |
|     |   |    | per foot  |
| 14. | <u>SET OF DRAWINGS ON AUTO-CAD DISKETTES (RELEASE 12) WITH DMC TITLE BLOCKS (DMC STANDARDS)</u>   | \$ | 2,000.00  |
| 15. | <u>TRAINING OF USER'S PERSONNEL AT MEASUREX/DMC'S FACTORY, GAITHERSBURG, MARYLAND</u>   | \$ | 6,500.00  |

One (1) Week (Five (5) Days)

Note: Price is for training performed in 1996.



16. START-UP AND COMMISSIONING  
SERVICES

Twenty-three (23) Days for Base System	\$	26,115.00
---	----	-----------

Thirty (30) Days for Base System with UOCC	\$	33,815.00
---	----	-----------

Note: Price is for service  
performed in 1997.

These prices are for single quantities and are quoted in U.S. Dollars, domestic packed, F.O.B. Factory, Gaithersburg, Maryland.

Unless otherwise stated elsewhere in this proposal, pricing for multiple gauges is predicated on all gauges being identical in all respects - both in hardware and software.

DELIVERY

If order is placed by mid-April 1996, delivery will be scheduled for end November 1996 provided that drawings submitted for customer approval are returned to Measurex/DMC (with customer's mark of approval) within two (2) weeks of their receipt. These approval drawings will be sent to the customer within three (3) weeks of order placement. Any delay in returning the drawings to Measurex/DMC may result in a like delay in shipment.

PAYMENT TERMS

Our terms of payment are:

- 30% of total value due with order issuance
- 20% of total value due at start of manufacturing
- 40% of total value due at time of shipment
- 10% of total value due on acceptance, but not to exceed ninety (90) days after shipment



All past due balances are subject to an interest charge of the lesser of 1 1/2% per month or the maximum rate allowable under the applicable law in the jurisdiction of the invoicee.

All payments should be made by wire transfer or by certified check.

#### MEASUREX/DMC DELAYED SHIPMENT POLICY

If the shipment date of the equipment is postponed as a result of: purchaser's request, purchaser's alteration of the scope of supply, or purchaser's requested changes that delay shipment in any way, then the purchaser agrees to accept and pay billing as if equipment had been shipped according to the original contractual schedule (i.e., ship in place).

In such an event, Measurex/DMC will store the equipment for 30 days at no charge. Thereafter, a storage fee of 0.25% per week (or any part thereof) will be imposed on the total equipment value.

Wipe tests on radioactive sources (mandated by the US NRC at six months intervals) that may come due during the storage period will be charged at \$150/source.

No shipments will be made unless all previous invoices have been paid.

#### ARBITRATION

Any controversy or claim arising out of, or relating to this contract, or the breach thereof, shall be settled by arbitration in accordance with the Commercial Arbitration Rules of the American Arbitration Association, and judgement upon the award rendered by the arbitrator(s) may be entered in any court having jurisdiction thereof.

#### VALIDITY

These prices are firm and will remain valid until 30 June 1996. After that time, we would request an opportunity to review the proposal.

## DOCUMENTATION AND SERVICE

### Drawings and Manuals

Two (2) copies of instruction manuals and black line prints (11 inches x 17 inches) will be supplied after completion and shipment of the system. Mylar reproducible drawings are available at additional cost.

### Engineering Information

Our Engineering Design Department will submit installation outline drawings and intercomponent wiring diagrams for electrical, air and water connections, for customer consideration and approval prior to manufacture of the system. One copy of these documents should be returned to us with customer's mark of approval within two (2) weeks of receipt.

Our Engineering Test Department, upon their completion of final test of the completed system, will, on request, submit copies of accumulated test data, including drift recordings, etc., to the customer as an indication of performance under tests conditions.

### Installation and Commissioning

The equipment is provided ready for customer installation. Unless expressly stated in our proposal or order acknowledgement, Measurex/DMC's equipment prices do not include installation supervision, on-site training of customer's personnel, or commissioning services. Quotations can be provided for such services.

A fixed price for commissioning will be supplied upon request. This price will not include travel time or expenses. These charges will be billed to the customer at actual cost. The fixed price will apply only if included in the original order and provided installation is complete upon arrival of Measurex/DMC's service technician.

Customer responsibilities for installation include:

1. Unpack and install equipment on-line
2. Hook-up of utilities (i.e. water, air, AC power)
3. All wiring to gauges and peripherals (i.e. chart recorder, tachometer, pyrometer)

If these items are not complete when our technician arrives on-site, the customer will incur additional charges for time spent idle or time spent completing these tasks.

Measurex/DMC recommends that a set of commissioning spares be purchased with each system. This will aid in prompt completion of start-up and commissioning and avoid costly delays. If recommended spare parts are not available on-site during commissioning, the customer will assume responsibility for our technician's additional time and living expenses, if no other duties remain outstanding while he awaits delivery of the components.

The additional charges referenced above will be invoiced at our normal hourly rates in effect at the time of service.

#### Field Service

Field Service for modifications or repair of equipment is performed when requested. Such service will be charged at vendor's rate at time of service. Time as well as travel time is invoiced. Expenses incurred are billed at actual cost.

## APPLICATION

=====

Installation:	Plate Mill
Material:	Low Carbon Steel
Plate Thickness:	3/8 inch to 4 inches
Plate Width:	160 inches
Plate Temperature:	1750°F
Air Gap:	6 feet
Throat Depth:	(Full Scan Depth)

## UTILITIES REQUIRED

=====

Power:	Electronic - 220/240V, AC; 50/60 Hertz, Single Phase, 500VA
	Mill Junction Box and Motor - 220/240V AC; 50/60 Hertz, Single Phase, 1KVA
Air:	Dry air, filtered at 60 - 150 psi/ 4 - 10 bars maximum, 10scfm (17m <sup>3</sup> /HR)
Water:	37.5 liters/10 gallons per minute at a pressure of 210 kPa/30 psi not to exceed 37.8°C/100°F for water jackets



## PERFORMANCE SPECIFICATIONS

### HOT PLATE MILL ISOTOPE THICKNESS GAUGING SYSTEM

#### USING AN IONIZATION CHAMBER DETECTOR

Material: Hot Steel Plate

Radiation Source: 30 Ci Cesium 137

Air Gap: 1800mm

Time Constant: (63% of step change) selectable in the range of 50ms to 1 sec.

Statistical Noise: At the following time constants and thicknesses, the 2 sigma values (95% confidence limits) are better than:

<u>Thickness</u>	<u>Time Constant</u>	
	<u>100ms</u>	<u>300ms</u>
5mm	$\pm 20\mu\text{m}$	$\pm 12\mu\text{m}$
10mm	$\pm 23\mu\text{m}$	$\pm 13\mu\text{m}$
15mm	$\pm 26\mu\text{m}$	$\pm 15\mu\text{m}$
20mm	$\pm 30\mu\text{m}$	$\pm 18\mu\text{m}$
30mm	$\pm 40\mu\text{m}$	$\pm 23\mu\text{m}$
40mm	$\pm 53\mu\text{m}$	$\pm 31\mu\text{m}$
50mm	$\pm 70\mu\text{m}$	$\pm 41\mu\text{m}$
60mm	$\pm 94\mu\text{m}$	$\pm 54\mu\text{m}$
70mm	$\pm 125\mu\text{m}$	$\pm 72\mu\text{m}$
80mm	$\pm 166\mu\text{m}$	$\pm 96\mu\text{m}$
90mm	$\pm 222\mu\text{m}$	$\pm 128\mu\text{m}$
100mm	$\pm 295\mu\text{m}$	$\pm 171\mu\text{m}$

---

MISCSPEC/106  
HOT STEEL PLATE  
CS 137  
21 DEC. 1994



Occasional noise pulses due to uncontrollable external influences (such as cosmic rays) may be observed.

Accuracy of Stored  
Calibration:

The superstandard program guarantees the calibration curve is more accurate than the individual standards used to generate the curve.

Overall Accuracy:

Better than  $\pm 0.2\%$ ,  $\pm 5\mu\text{m}$ . This is defined as the sum of errors due to accuracy of stored calibration, ambient air and strip temperature variations (up to  $\pm 12^\circ\text{C}$ ), pass line height variation ( $\pm 25\text{mm}$ ), pass angle variation ( $\pm 2^\circ$ ), and short term drift. (See Note 5.)

Repeatability  
(Short Term):

Short term repeatability with an external master standard is better than  $\pm 0.1\%$ .

Drift:

$\pm 0.25\%$  of target per eight (8) hours automatically eliminated by auto-zero correction feature.

Correction for  
Gauge Drift:

Auto - Zero correction when no material is present in the beam.

By pressing "CAL" in twenty (20) seconds maximum with no material between the jaws of the gauge.

Head-End Response:

About 0.5 second, at a time constant of 0.1 second.

C-Frame Traversing  
Speed:

Adjustable in the range 0.6 - 4.0m/min for transverse profile scanning purposes and up to 16m/min for positioning and retraction off-line.

NOTE:

1. Ambient temperature to be from  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  and plate temperature, measured by pyrometers, to give equivalent thickness at  $20^{\circ}\text{C}$ , provided the coefficient of the thermal expansion is accurately known throughout the temperature range.
2. Input voltage regulation not to exceed  $\pm 15\%$  of rated nominal voltage. (Voltage regulator is supplied).
3. The above specifications are for a detector cooled with a chiller having a maximum temperature variation of  $\pm 3^{\circ}\text{C}$ .
4. Stabilization time from cold start one (1) hour.
5. The guaranteed aggregate error, including statistical noise at a time constant of 300ms, will not exceed:

<u>Steel Thickness</u>	<u>Error</u>
5mm	$\pm 17\mu\text{m}$
10mm	$\pm 22\mu\text{m}$
20mm	$\pm 33\mu\text{m}$
30mm	$\pm 45\mu\text{m}$
40mm	$\pm 60\mu\text{m}$
50mm	$\pm 80\mu\text{m}$
70mm	$\pm 115\mu\text{m}$
100mm	$\pm 234\mu\text{m}$

Measurex/DMC reserves the right to change this specification at any time prior to placement of an order.

## MEASUREX/DMC EQUIPMENT BASIC SPECIFICATIONS

### VIBRATION AND SHOCK

#### Vibration (@ 57 Hz.)

##### Main Electronics Cabinets

Operating: 1.0 g (0.006 in/0.1524 mm peak - peak) maximum  
Non-Operating: 2.5 g (0.015 in/0.381 mm peak - peak) maximum

##### Sensing Frames (Isotope or X-Ray)

Operating: 1.0 g (0.006 in/0.1524 mm peak - peak) maximum  
Non-Operating: 3.0 g (0.018 in/0.459 mm peak - peak) maximum

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#### Shock (11 msec. duration, single pulse)

##### Main Electronics Cabinets

Operating: 10.0 g maximum  
Non-Operating: 25.0 g maximum

##### Sensing Frames (Isotope or X-Ray)

Operating: 15.0 g maximum  
Non-Operating: 30.0 g maximum

---

### PAINT

All Measurex/DMC equipment is painted Measurex/DMC standard colors (based on product type). The surface to be painted is cleaned and primed (two (2) coats) using a special wash primer (Sherwin Williams P60 G 2 or equivalent). The top coat (three (3) coats) is a special polyurethane based paint (Sherwin Williams Polane B or equivalent). Non-standard color or paint type will be implemented at additional cost.

## SYSTEM DESCRIPTION

### 1. HOT PLATE MILL C-FRAME (72 INCH AIR GAP, 160 INCH THROAT DEPTH)

The hot mill C-frame has been designed for continuous operation on high speed rolling mills. The radiation source, standards magazine, and detector can be removed readily for maintenance.

The air wipe system blows away extraneous material that can accumulate in the radiation window of the lower arm. Two lights located on top of the C-frame indicate the shutter CLOSED or OPEN.

Enclosed within the C-frame is the Cesium 137 radioisotope retractable source in its holder. The motion of the pellet from "active" to the "retracted" position is accomplished by pneumatic means. Filtered dry plant air is required for this operation. Two limit switches are included to indicate the pellet position.

The C-frame moves on flanged wheels thus requiring minimal space under the roll area. A limit switch stops the C-frame at the inner and outer limits.

The air gap and throat depth dimensions are chosen to suit the requirements of the application.

The gauge will be equipped with warning signs designed by the user and Measurex/DMC to suit the appropriate radiation control regulations.

#### Source Holder and Radioisotope Source 30 Curie Cesium 137

Containing the radiation source and is provided with adequate shielding to limit the radiation in unwanted directions.

The source holder is robustly constructed and provided with a pneumatically operated fail-safe shutter mechanism which shuts off the radiation in the measuring gap when required. A mechanically operated flag indicates whether the shutter is OPEN or CLOSED, and a limit switch is fitted to operate external signal lamps indicating shutter position. The switch is so arranged that it will only signal that the source is safe when the shutter is fully closed.



Use or possession of 30 Curie Cesium 137 in the United States requires that the user obtain a "Specific License" granted by the US Nuclear Regulatory Commission. A copy of this license, demonstrating eligibility to possess the source, must be submitted to Measurex/DMC prior to shipment of the source material. Measurex/DMC will be pleased to offer assistance in this process.

#### Seven Inch (175mm) Diameter Ionization Chamber Detector

The detector assembly comprises a very stable ionization chamber, specially designed to give optimum performance, for the radiation source employed, an electrometer amplifier assembly and a stabilized supply to provide the polarizing voltage. The optimization of the detector assembly geometry minimizes source/detector alignment and passline errors.

The electrometer amplifier consists of a high input impedance large gain (approximately 10,000) operational amplifier operating with high DC feedback. The electrometer amplifier is mounted as an integral part of the ionization chamber, thus eliminating the necessity for "noisy" co-axial cables.

#### C-Frame Drive Motor and Encoder

A stationary chain is provided to be installed under the C-frame. A system of sprockets and a worm gear reduction motor pulls the C-frame along the stationary chain eliminating slippage. A slip clutch protects the motor if stalled. C-frame traverse controls are located on the operator's control console, the Main Electronics Cabinet, and optionally at the mill junction box. Limit switches stop the C-frame travel at the inner and outer limits.

A DC motor controller is provided which allows the C-frame to travel across the strip/plate at the following speeds:

- At the strip/plate edges - 1 to 2 inches (25 to 50mm) per second
- Across the body of the strip/plate - 10 inches (250mm) per second

The DC motor controller also provides dynamic braking to stop the C-frame quickly during profiling.



In addition, the drive package provides an absolute position encoder to give absolute position information to the system.

NOTE: This is not a pulse transducer, but an absolute encoder, providing actual C-frame position.

Position resolution is typically  $\pm 0.06$  inch ( $\pm 1.5$ mm) for 60 inch (1500mm) wide strip/plate.

Maximum C-frame travel from off-line to full forward is 40 feet (12192mm). For greater distances than this, please consult factory.

#### Air Regulator and Lubricator

A regulator and lubricator, for valve and cylinder supplies and for fail-safe source shutter operation, is provided.

#### Stainless Steel Water Carrying Members

The cover of the lower arm, the detector housing, and upper arm are of stainless steel double wall construction facilitating water cooling to protect the source, standards magazine, detector and cables from the strip/plate heat. A flow switch on the exit water line in the C-frame connects to the gauge alarm system. Up to 15 meters (50 feet) of cables, air and water hoses are provided as standard, along with a power track or festoon system as required.

#### Festoon with Overhead Beam (Twenty (20) Feet)

An overhead beam with ball bearing trolleys to support the cables and hoses from the C-frame to the mill junction box. The beam section, trolleys, and cable clamps are included.

## 2. GAUGE RAILS (FOR C-FRAME TRAVEL DISTANCE OF TWENTY (20) FEET)

Two (2) crane rails are provided for customer mounting in the mill. C-Frame travel distance will be sized according to throat depth (see typical outline drawings included in Section Eleven (11) for travel distance and rail cross section). Additional travel distance will incur additional charges.

### 3. MILL JUNCTION BOX WITH LOCAL CONTROLS (115VAC)

Enclosure houses all field connections between the electronics, source, detector, and other local equipment including motor controllers. Includes:

1. Industrial quality terminal blocks for direct connections of bare wire.
2. Relay for shutter status indication lamps.
3. Solid state relay for shutter solenoid actuation.
4. Drive control relays (for use with Measurex/DMC drive systems).

When both the gauge rails and power track are purchased, the mill junction box is mounted directly to the gauge rails. For all other applications the mill junction box is supplied loose.

The mill junction box requires power for shutter status lamps, solenoids, and drive controllers.

All cable connections from the mill junction box to the gauge frame are housed in sealed, flexible (liquid tight) conduit. All other conduits and conduit entrances into the enclosure are not provided in order to allow maximum flexibility at the time of installation.

Unit allows local or remote control of shutter and motor drive control. Electric motor is required. Includes:

1. Key switch which selects local or remote drive operation.
2. Switch which selects manual source shutter open or shutter closed.
3. Push buttons for local control of the drive motor: forward or reverse.
4. Plunger type emergency stop which disables the motor drive and the shutter solenoid. The shutter cannot be opened and the motors can not be activated until the E-stop plunger is reset to its normal position.

The mill junction box will be modified to accept 115 VAC ( $\pm 10\%$ ) instead of the standard operation power. This includes pneumatic solenoids, warning lamps, and other equipment requiring AC power. The system block diagram issued with the approval drawings will clearly state power requirements.

4. DMC 450 MAIN ELECTRONICS CABINET (115VAC)

This NEMA 12/IP 55 cabinet measures approximately 69" high x 24" wide x 24" deep (1753mm x 613mm x 613mm). High ambient temperatures will require the air conditioning package. Outline drawings issued during the approval process include all environmental requirements.

All sides of the cabinet are easily removable with easy access to the following:

1. 19 inch (482.9mm) industry-standard rack mounting rails
2. DMC 450 microcomputer chassis which supports a variety of microprocessor and peripheral boards. Also includes:
  - A. Dual fans with a filter increase air flow around the circuit boards.
  - B. Locking access door to disk drive.
  - C. Front panel mount reset switch.
  - D. Rack mounted for easy access and removal.
  - E. Separate circuit board power supply.
3. System power supply panel.
4. Vertically mounted terminal rails which hold a variety of modules including opto-isolators, relays with drivers, and terminal blocks. They are conveniently located for easy access to the interface between the electronics and the external equipment.

5. Circuit breaker panel with hour meter to record total operating time.

Conduit entrances are not cut to allow maximum flexibility at the time of installation.

The Main Electronics Cabinet will be modified to enable each component to accept 115 VAC ( $\pm 10\%$ ) instead of the standard operation power. This includes all DC power supplies, computers and other peripheral equipment requiring AC power. The system block diagram issued with the approval drawings will clearly state power requirements.

#### DMC 450 Microcomputer System (80486DX Processor)

The 450 microcomputer performs all calculations and controls of the gauge. This IBM-type system is housed in a separate chassis in the Main Electronics Cabinet. It features:

1. Intel 80486DX 32 bit processor operating at 33 MHz and a reduced chip count system motherboard proven reliable in industrial environments.
2. Analog input card with 16 bit resolution.
3. Floppy drive controller and IDE hard drive controller.
4. Serial (RS-232) ports with 16 byte FIFO buffers.
5. Printer (Centronics standard) port.
6. Analog output card with 12 bit resolution.
7. Digital input/output card.
8. 3.5 Inch floppy disk drive, 1.44 Mbyte.
9. MS-DOS operating system. Real-time operation handled by gauge software.



10. Sampling rate - about 15,500 samples/second.
11. Update rate - 5.15 milliseconds to analog output.  
(Operator display is updated much slower to enhance readability.)
12. Response time - 0.015 to 10 seconds (dependent on detector)

#### System Inputs and Outputs

The following is a list of standard 450 input and output hardware:

1. Opto-isolated digital inputs.
2. Relay Output Contacts. Contacts (change over, form C type) are available for each of the following:
  - Over Tolerance (Heavy) 1 each/measuring head
  - Under Tolerance (Light) 1 each/measuring head
  - Gauge Healthy (Valid) 1 each/measuring head

Contact ratings: 115 VAC, 1 Amp; 30 VDC, 1 Amp.

3. Analog outputs (two per measuring head). The analog output boards are configured at the factory for either  $\pm 10$  VDC full scale or 4-20 mA full scale. Scaling is technician programmable from the operator's terminal. Analog output values are field programmable from the following:
  - Absolute Measurement
  - Absolute Deviation
  - Target (Setpoint)
  - Percent Deviation
  - Head Position (not all systems)
4. Serial I/O RS-232C for communications with the operator's terminal.



5. Stored data files (Grades or Recipes) on the 3.5 inch MS-DOS compatible floppy disk which can be called up from the operator's terminal. They include gauge setup information such as: time constant, target (set point), tolerances, and composition factors. Grade files can be modified with any MS-DOS editor or directly from the operator's panel (with password protection).

In addition, a GRADE0 file exists with the initial power up parameters. These not only include gauge setup information, but passwords and executable commands such as close source shutter.

#### Motion Control Software - Expanded

Allows expanded control of measuring head position on all gauges with position sensors. This software package includes an additional operator entry/display page for all positioning data including the current head position. With this option, analog outputs can be factory configured to indicate head position. The available motion modes are shown on the attached insert.

The gauge always goes to the full off-line position when the off-line function key is pressed on the operator's terminal. The selected mode becomes active when the gauge makes the transition from off-line to on-line modes.

Forward and reverse limits are used only if they are encountered before the optical sensor finds the edge of the material.

Motion speed is determined only by the motor controller. It is not synchronized with any external or internal parameters.

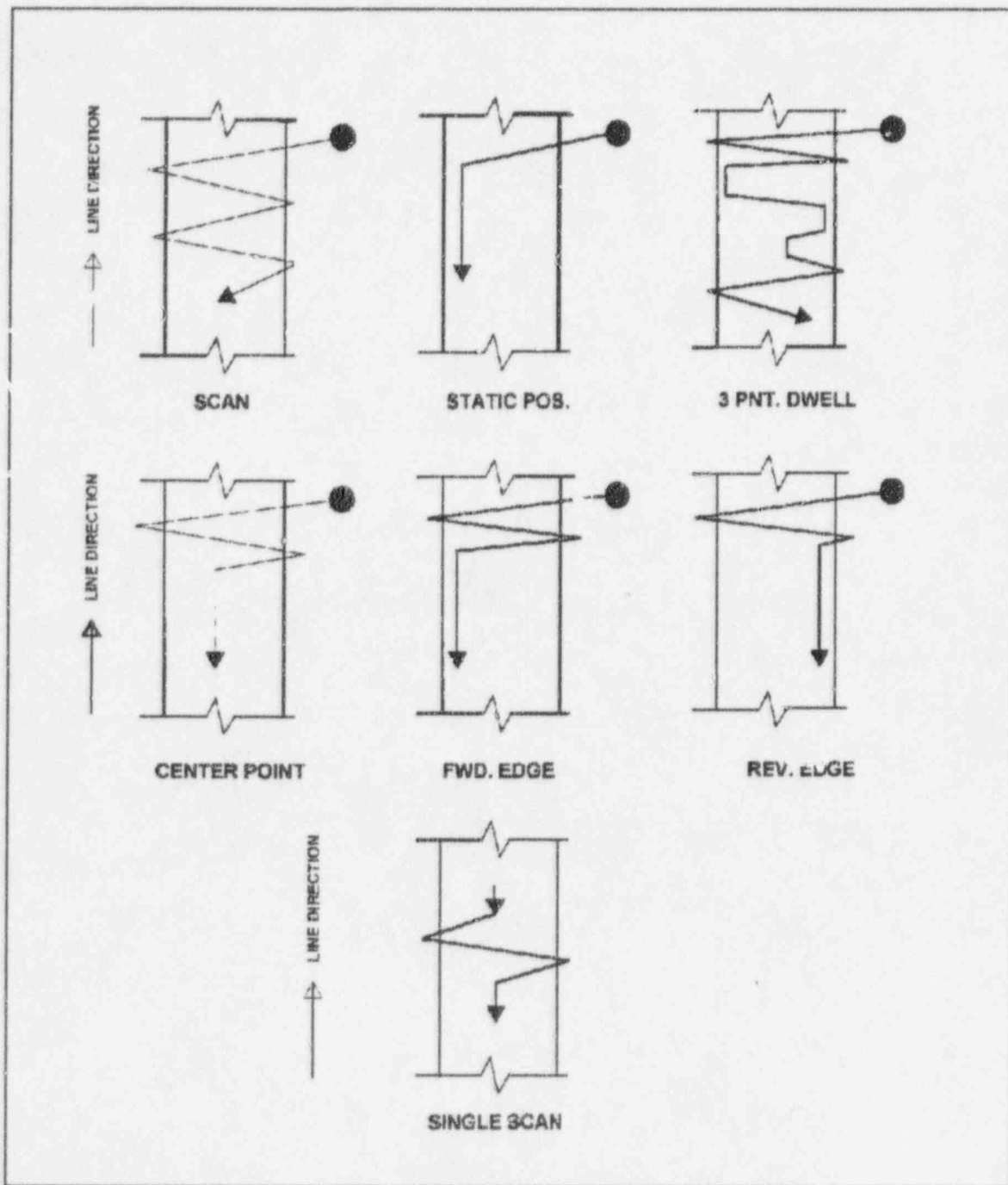
#### Serial Communication Link (DMC Standard)

A serial RS-232C port is available to accept setup parameters or commands from the customer's host computer.

Typical parameters include:

- Nominal Thickness
- Alloy
- High Limit (+ Tolerance)

# MOTION MODES



Low Limit (- Tolerance)  
Calibrate Command  
Shutter Open/Closed Command

In addition, the gauge may be interrogated and current setup parameters and operating status can be returned to the host computer.

A preliminary communication protocol definition for the serial link is shown in Section Seven (7) of this proposal.

#### 210 MByte Hard Disk Drive

The 210 Mbyte hard disk drive permits increased storage with data collection packages and faster boot up. Gauge software can be executed directly from the hard disk once it is loaded from the floppy drive.

Additionally, the hard drive is ideal for custom applications requiring the temporary storage of data until requested by a mill computer.

#### Isolated Analog Outputs

Modules provide isolation for one (1) pair of the systems analog outputs - the outputs are isolated  $\pm 10V$  at 5mA. Isolated analog output modules are powered by an independent isolated power supply.

#### Diagnostics Package with Monitor

The diagnostics package allows execution of self tests and individual control of most inputs and outputs. The package is useful in performing regular maintenance and determining fault locations. DMC 450 diagnostics use a separate monitor and keyboard. This means that the diagnostics can be performed even if the operator's terminal has failed. The following hardware is provided as part of the diagnostics package:

1. VGA monitor with a three foot (one meter) connector cable for temporary connection to the 450 computer chassis in the Main Electronics Cabinet.
2. Keyboard for temporary connection to the computer chassis.
3. Serial loopback tester.

4. Diagnostics software on disk.

Software includes:

1. Measurex/DMC digital I/O controller. Monitor and change all digital I/O including the source shutter.
2. Measurex/DMC analog controller which will set the analog outputs to any predetermined value. It also can monitor all 8 analog inputs including the detector signal.
3. Standard MS-DOS system tests:
  - \* PC Type (XT, AT, etc.)
  - \* Processor Type (8088, 80286, 386, etc.)
  - \* BIOS Date
  - \* MS-DOS Version
  - \* Total Base Memory
  - \* Available Base Memory
  - \* Math Coprocessor Verification
  - \* Current Video Mode
  - \* Type of Graphics Adaptor
  - \* Number of Serial and Parallel Ports
  - \* Flexible and Hard Disk Drive Type Detection
  - \* Status of Disk Verify Flag

Additionally, the software provides off-board loopback tests for the serial ports, available in single-pass or continuous mode, all user selectable. The serial port test menu includes a new operator terminal test which tests the integrity of the data path between the 450 CPU and the operator terminal. An interactive operator keypad test is also provided.

The diagnostic software also provides an extensive full-volume disk media verification utility for all drives. This program, accessible from the main diagnostic menu, automatically detects all flexible and hard disk drives present. It then performs a non-destructive test of all installed flexible and hard disk media with full interactive error detection and reporting. The user can skip the test on any drives he/she does not wish to test.

Note: Diagnostics and gauge (measuring) software cannot run simultaneously.



### Plate Temperature Compensation with Dual Wavelength Pyrometer

Provides for automatic correction of the gauge reading to compensate for plate temperature.

Up to 99 alloy correction temperature curves are provided for various carbon contents of steel, insuring that the precise correction is provided for all steels throughout the temperature range. The curves are programmable by customer's technician if required and are entered as piece-wise-linear curves stored on the hard disk.

In the manual mode, estimated plate temperature may be entered by the operator, maintenance technician, or from the host computer if the serial link feature is included.

A pyrometer is supplied in the C-frame for measuring the plate temperature when the gauge is on-line.

#### 5. VOLTAGE REGULATOR/CONDITIONER

The power conditioning unit will provide voltage regulation as well as protection from electrical noise present on the power line. Electrical noise can cause malfunctions in computer systems such as memory loss, unexplained data deletion, unexplained data entry, garbled printouts, and in some severe cases, microprocessor damage and complete system failure. The unit provided here protects against such problems. It has the following specifications:

Operating Temperature Range:	-20°C to +50°C
Phase:	Single
Input Voltage:	250 - 5000VA; 110/120 - 220/240 - 380/415
Output Voltage:	110/120/220/240 VAC
Output Voltage Regulation:	±5% for an input line variation of ±15%
Output Harmonic Distortion:	Less than 3% total RMS content at full load with rated input voltage



Efficiency:	85% at full load
Dropout:	No loss of output for line loss of 3msec.
Common Mode Noise Rejection:	Greater than 120db
Transverse Mode Noise Rejection:	Greater than 60db
Safety Approvals:	Designed and built per VDE 055 and 0806 specifications. Portable models designed and built per VDE 0805 (compatible with IEC 380/435.)

Customer to specify 50Hz or 60Hz operations.

6. DESKTOP PC BASED UNIVERSAL OPERATOR'S CONTROL CONSOLE (UOCC)/  
COLOR GRAPHICS PROFILE DISPLAY SYSTEM WITH A DESKJET COLOR  
PRINTER AND A PULSE TACHOMETER

The Universal Operator's Control Console (UOCC) is based on a desktop PC and is located remotely from the thickness gauge. It can control up to six gauges using an Ethernet® TCP/IP link. The UOCC uses the advanced OS/2 graphical user's interface (GUI) to display information in easily understood format. The UOCC can, optionally, support graphics for profiling together with display of measured data.

The control terminal has a standard AT keyboard. It has a high visibility VGA color display and a menu driven, user-friendly multipage format for easy data entry. An industrial trackball is also supplied to make data entry as easy as possible.

**UOCC Software Description:**

Data Entry and Display

User-friendly menus and text boxes are used to enter and display the following data:

Shutter Open/Closed  
Calibrate  
Curve Fit  
Nominal (or Target) Thickness  
Alloy Number (or Correction Factor)  
Strip/Plate Temperature (for Hot Mills, or when applicable)  
Over Tolerance Setting  
Under Tolerance Setting  
Profile Commands (Profile Gauges Only)  
Alarm Monitoring and Clearing  
Time and Date Display

### Color Graphics Displays

All color displays are presented in a windowed format and displayed on a high resolution SVGA monitor for easy viewing. Profile graphics are incorporated into the Measurex\DMC UOCC electronics and all communications to and from the gauges are performed over a high speed TCP/IP network. The following information is available in the Graphics Displays:

1. Digital Display of Actual Thickness
2. Bar Graph of Deviation from a Particular Setpoint
3. Gauge Status
4. Data Logging System

The following data is acquired by the main processor:

Center Line Gauge Deviation  
Profile Gauge Deviation  
Mill Speed (from Line Tachometer)

5. Graphics Display System

The UOCC Graphics Display is composed of two (2) separate sections, Data Display and Graph Display.

### Data Display Section

The following parameters are shown for each coil and are based upon values entered from the host computer or manually by an operator.

Coil Number  
Target/Nominal Thickness  
Alloy Number

High Tolerance Setting  
Low Tolerance Setting  
Time/Date  
Crown\*  
Wedge\*  
Edge Drop 1  
Edge Drop 2  
Maximum Thickness\*\*  
Minimum Thickness\*\*  
Average Thickness\*\*  
Standard Deviation\*\*

\* Crown and Wedge data is displayed on the screen for every width profile. These values are calculated using a curve fitting routine designed to provide smoothed data over the two edge zones and the center zone. This results in more accurate profile information and is less sensitive to local spikes.

\*\* If requested at the beginning of the project, Maximum Thickness, Minimum Thickness, Average Thickness, and Standard Deviation data can also be displayed at no additional cost.

### Graph Display Section

The data logger will display a width profile when the gauge is profiling and a length trend when the gauge is not profiling.

#### Cross Strip/Plate Thickness Profile

The thickness profile across the width of the strip/plate is displayed along with center line thickness. Edge and center reference points are highlighted. Vertical (thickness deviation) scaling is adjustable by the

operator. A "waterfall" display feature is also available through a key selection on the operator console. Up to four (4) width profiles can be displayed at once.

#### Down Length Thickness Trend

The thickness along the length of the strip/plate is displayed in a different color (trend of thickness deviation). Vertical (thickness deviation) scaling is adjustable by the operator.

#### Profile Review

The operator is able to recall any one (1) of the last ten (10) profile displays for review, thereby allowing a review of the changes in the thickness profile.

#### Included Hardware:

Pentium Based Industrial Grade Desktop Computer  
240 MByte Hard Drive (Minimum Size, actual size  
will depend on market availability)  
Ethernet® Card  
1.44 MByte, 3.5 Inch Floppy Drive  
AT Keyboard  
Industrial Mouse  
SVGA Accelerator Card  
19 Inch SVGA Industrial Desktop Monitor  
Deskjet Color Printer (Non-Industrial)  
Thicknet (IEEE 802.3) Ethernet® Transceiver  
50Ω Terminator for Transceiver  
Software Key

#### Tape Backup System

An integrated tape backup system is included that allows for backup and retrieval of hard disk data off-line.

#### Pulse Tachometer

A tachometer for customer mounting on the line provides a signal to drive displays or chart recorders at a speed proportional to that of the line.

### Included Software:

OS/2 WARP Operating System  
TCP/IP Software for OS/2  
Paragon TNT Industrial Graphics Control System  
Measurex\DMC Proprietary UOCC Software (See Software Description)

### UOCC Options:

Below is a brief list of hardware and software options available for use with the UOCC. Measurex\DMC will also design custom options to meet a client's requirements. All options are available at additional cost.

- Pass Scheduling
- Ridge Detection
- Coil Review
- Temperature Profile/Trend
- Mass Storage via a 1.2 GByte Magneto Optical Drive.

Please see inserted copies of sample video displays on the UOCC.

## 7. INTERCOMPONENT CABLING

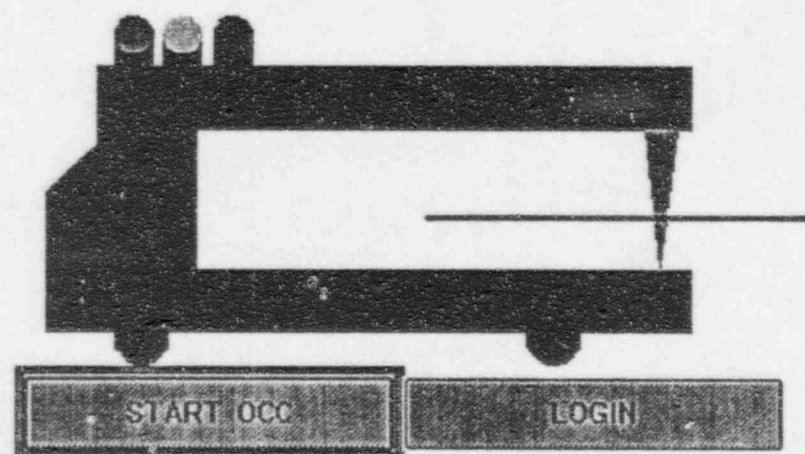
Intercomponent cabling is supplied for interconnection of all gauge elements:

- C-Frame to Mill Junction Box - As required, up to 30 Feet
- Mill Junction Box to Main Electronics Cabinet - 50 Feet
- Ethernet® Cable from Main Electronics Cabinet to Desktop PC  
Based Universal Operator's Control Console (UOCC) Color/Graphics  
Profile Display System - 50 Feet

Note: If festoon is used, the cables from C-frame to mill junction box will be provided to suit the length of the festoon itself. The standard 30 feet length will not apply in this instance.



DATA MEASUREMENT CORPORATION  
OPERATOR CONTROL CONSOLE



OFFICIAL RECORD COPY ML 10

1 2 4 0 2 5

## SETUP GENERAL

NOMINAL

0.0000

mm

ALLOY NUMBER

COIL ID

OPEN SHUTTER

CLOSE SHUTTER

GAUGE ONLINE

GAUGE OFFLINE

### NEXT PARAMETERS

NOMINAL

0.0000

mm

OVER TOLERANCE

0.0000

mm

UNDER TOLERANCE

0.0000

mm

ALLOY NUMBER

COIL ID

EXIT

Paragon TNT login

USER NAME:

PASSWORD:

OK Cancel Help

PROFILE GAUGE - ALLOY #

SETPOINT	ACTUAL
<input type="text"/>	1018
EXIT	



# FIXED GAUGE PARAMETERS

	SE TOLERANCE	IND TOL
NOMINAL	0.0000 mm	5.3500 mm
ALLOY NUMBER		1018
ALLOY FACTOR	0.0000	1.0021
OVER TOLERANCE	0.0000 mm	0.0500 mm
UNDER TOLERANCE	0.0000 mm	0.0500 mm
COIL ID		1

CALIBRATE	<input type="checkbox"/> CALIBRATE FROM MAIN WINDOW	
CURVEFIT	CURVEFIT RANGE	0.1.2.3.4.5.6.7
OPEN SHUTTER	CLOSE SHUTTER	SHUTTER
GAUGE ONLINE	GAUGE OFFLINE	OPEN
NEXT GAUGE	PREVIOUS GAUGE	EXIT

NEXT PARAMETERS

NOMINAL	0.0000 mm
OVER TOLERANCE	0.0000 mm
UNDER TOLERANCE	0.0000 mm
ALLOY NUMBER	
COIL ID	

## CONTROL DEVICE

OCC
MEC
OCC
MILL COMP

# SETUP OPTIONS

PROFILE GAUGE

FIXED GAUGE

PROFILE SETUP

OCC OPTIONS

EXIT

## PROFILE GAUGE PARAMETERS

	SETPOINT	UNIT	ACTUAL	UNIT
NOMINAL	0.5000	mm	5.3500	mm
ALLOY NUMBER			1018	
ALLOY FACTOR	1.0000		1.0021	
OVER TOLERANCE	0.0000	mm	0.0500	mm
UNDER TOLERANCE	0.0000	mm	0.0500	mm
COIL ID				

CALIBRATE	<input checked="" type="checkbox"/> CALIBRATE FROM MAIN WINDOW
CURVEFIT	CURVEFIT RANGE: 0.1.2.3.4.5.6.7
OPEN SHUTTER	CLOSE SHUTTER
GAUGE ONLINE	GAUGE OFFLINE
TEST GAUGE	PREVIOUS GAUGE
	SHUTTER OPEN
	PROFILE SETUP
	EXIT

NEXT PARAMETER	
NOMINAL	0.0000 mm
OVER TOLERANCE	0.0000 mm
UNDER TOLERANCE	0.0000 mm
ALLOY NUMBER	
COIL ID	

CONTROL DEVICE
OCC
MEC
OCC
MILL COMP



# PROFILE SETUP

SIDE SELECTION

OPSIDE  
DRIVE

PROFILE START MODE

HEAD  
COILER

PARTIAL PROFILE OFFSET

0.000

PARTIAL PROFILE WIDTH

0.000

STATIC POSITION

0.000

EDGE POSITION

0.000

CURRENT PROFILE MODE

CONTINUOUS

SINGLE

CONTINUOUS

PARTIAL

NONE

EXIT

**CURRENT ALARMS**

DMC GAUGE      Unacknowledged Active

	Descriptor	Name	Time	Date	State
<input type="checkbox"/>	TCTIP COMM LINK DOWN	CS.GAUGE1_STAT.TCPI	15:18:54	12-12-95	Active
<input type="checkbox"/>	TCTIP COMM LINK DOWN	CS.GAUGE2_STAT.TCPI	15:18:54	12-12-95	Active

ALARM HISTORY WINDOW      ACKNOWLEDGE ALARM AT GAUGE      EXIT

**PROFILE GAUGE - CONTROL DEVICE SELECTION**

CURRENT CONTROL: OCC

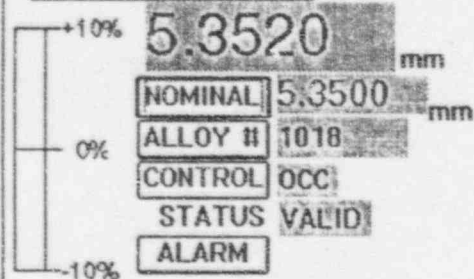
MEC      OCC      MILL COMP      EXIT

**DMC**      15:23:20      12-12-95      COIL 11

GENERAL SETUP      ALARM      PRINT     

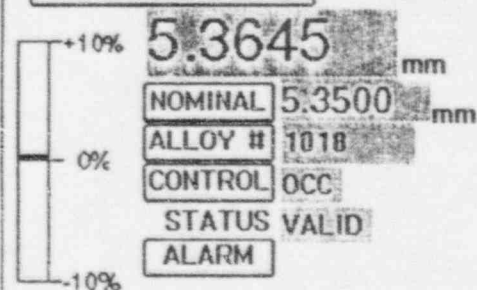
SETUP      CALIBRATE      COIL REVIEW      EXIT

# PROFILE THICKNESS



X-RAY SHUTTER PROFILE  
 ON OPEN CONTINU

## FIXED THICKNESS



X-RAY SHUTTER  
 ON OPEN

## PROFILE INFORMATION

CROWN	WEDGE
0.054	0.080
0.083	-0.211
0.000	0.000
0.000	0.000

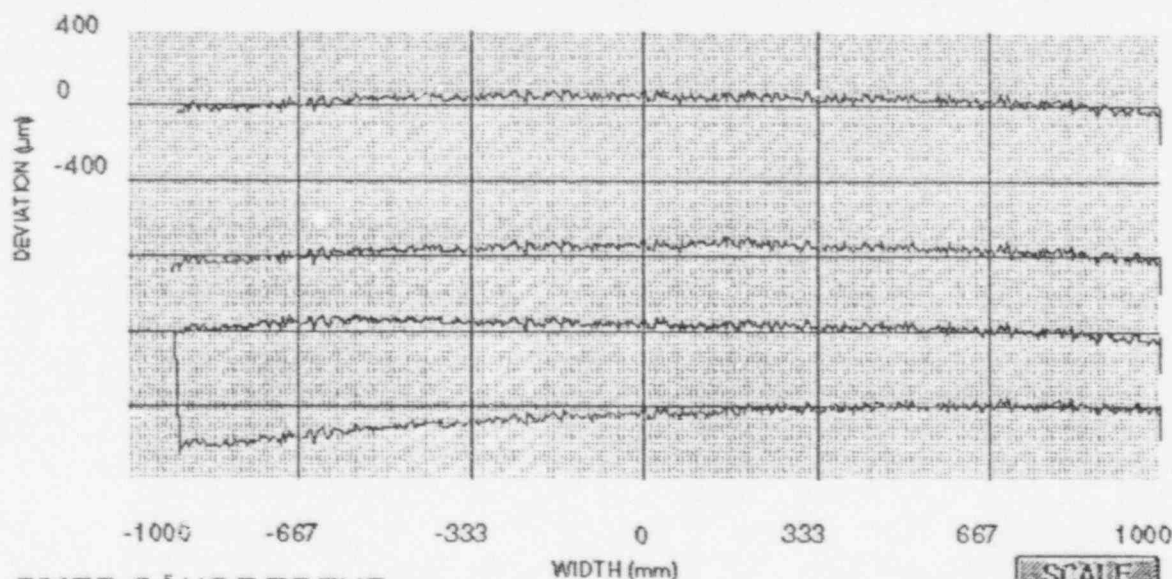
## PROFILE GAUGE - SHUTTER



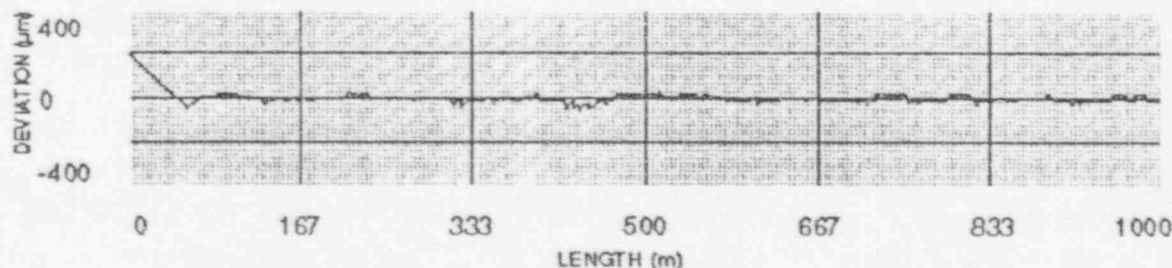


# DMC - OPERATOR CONTROL CONSOLE

## PROFILE THICKNESS DEVIATION



## FIXED GAUGE TREND



DMC 17:39:23 12-12-95 COIL : 2

TRENDS	RIDGE PROFILE	TEMPERATURE	GENERAL SETUP
CALIBRATE	ALARM	PRINT	CONTROL

## PROFILE THICKNESS

+10%	5.3550	mm
0%	NOMINAL	5.3500 mm
	ALLOY #	1018
	CONTROL	OCC
	STATUS	VALID
-10%	ALARM	

X-RAY	SHUTTER	PROFILE
ON	OPEN	CONTINU

## FIXED THICKNESS

+10%	5.3402	mm
0%	NOMINAL	5.3500 mm
	ALLOY #	1018
	CONTROL	OCC
	STATUS	VALID
-10%	ALARM	

X-RAY	SHUTTER
ON	OPEN

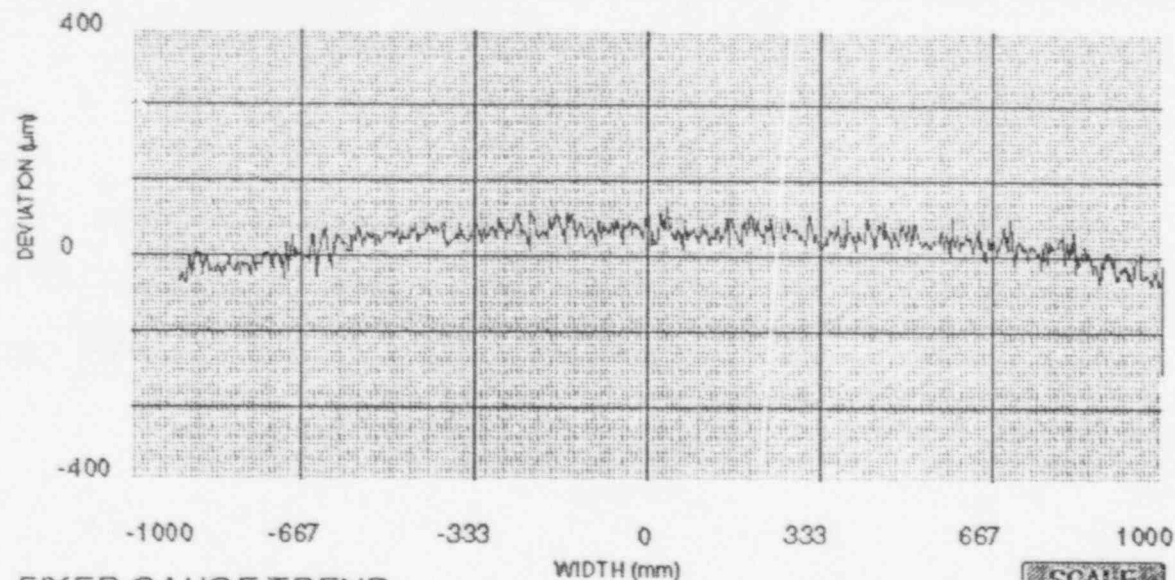
## PROFILE INFORMATION

CROWN	WEDGE
0.075	0.021
0.096	-0.01E
0.059	0.058
0.087	-0.21E

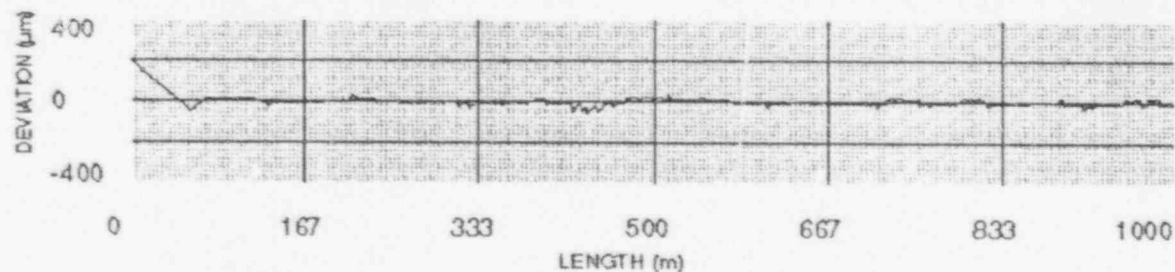


# DMC - OPERATOR CONTROL CONSOLE

## PROFILE RIDGE DISPLAY



## FIXED GAUGE TREND



DMC 17:48:18 12-12-95 COIL: 2

PROFILE	TRENDS	TEMPERATURE	GENERAL SETUP
CALIBRATE	ALARM	PRINT	CONTROL

## PROFILE THICKNESS

+10%	5.3550	mm
0%	NOMINAL 5.3500	mm
-10%	ALLOY # 1018	
	CONTROL OCC	
	STATUS VALID	
	ALARM	

X-RAY	SHUTTER	PROFILE
ON	OPEN	CONTINUE

## FIXED THICKNESS

+10%	5.3402	mm
0%	NOMINAL 5.3500	mm
-10%	ALLOY # 1018	
	CONTROL OCC	
	STATUS VALID	
	ALARM	

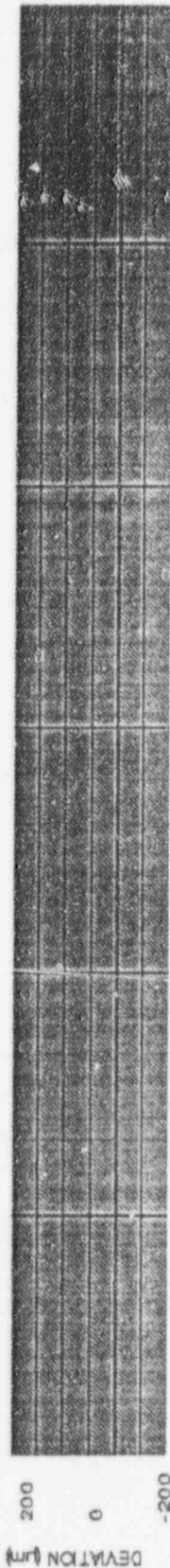
X-RAY	SHUTTER
ON	OPEN

## PROFILE INFORMATION

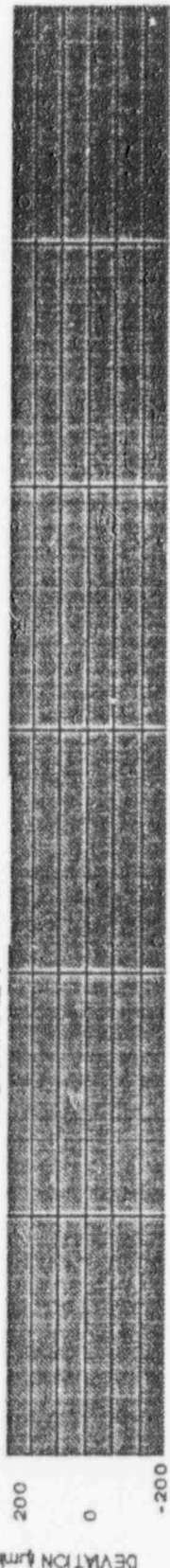
CROWN	WEDGE
0.075	0.021
0.096	-0.011
0.059	0.058
0.087	-0.211

# COIL REVIEW

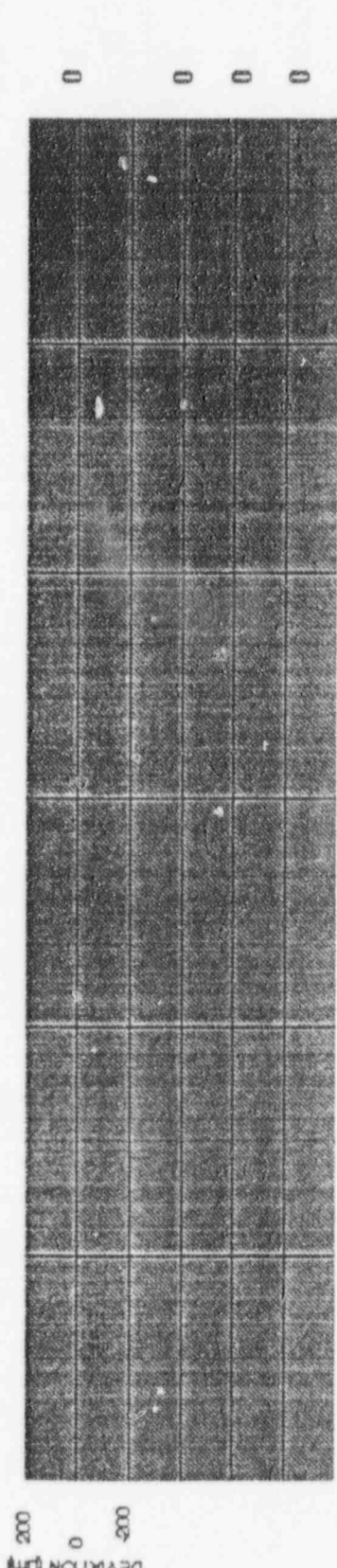
PROFILE GAUGE TREND      NOMINAL : 0.0000



FIXED GAUGE TREND      NOMINAL : 0.0000



LENGTH (m)      PROFILE NUMBER



	-1000	-667	-333	0	333	667	1000
WEDGE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CROWN	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WIDTH (m)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

DMC  
COIL REVIEW

COIL:

NEXT      PREVIOUS

SEARCH      PRINT      EXIT

THICKNESS DEVIATION PROFILE PARAMETERS	
LENGTH (X) 1000 mm	DEVIATION TYPE 0.400 mm
400m	50 $\mu$ m
800m	100 $\mu$ m
1200m	150 $\mu$ m
1600m	200 $\mu$ m
2000m	300 $\mu$ m

THICKNESS DEVIATION PROFILE PARAMETERS	
WIDTH (X) 1000 mm	DEVIATION (Y) 0.400 mm
400mm	50 $\mu$ m
500mm	100 $\mu$ m
600mm	150 $\mu$ m
700mm	200 $\mu$ m
800mm	300 $\mu$ m

COIL REVIEW OPTIONS

☐ LOG DATA ENABLE

DATA DIRECTORY: C:\COILDATA

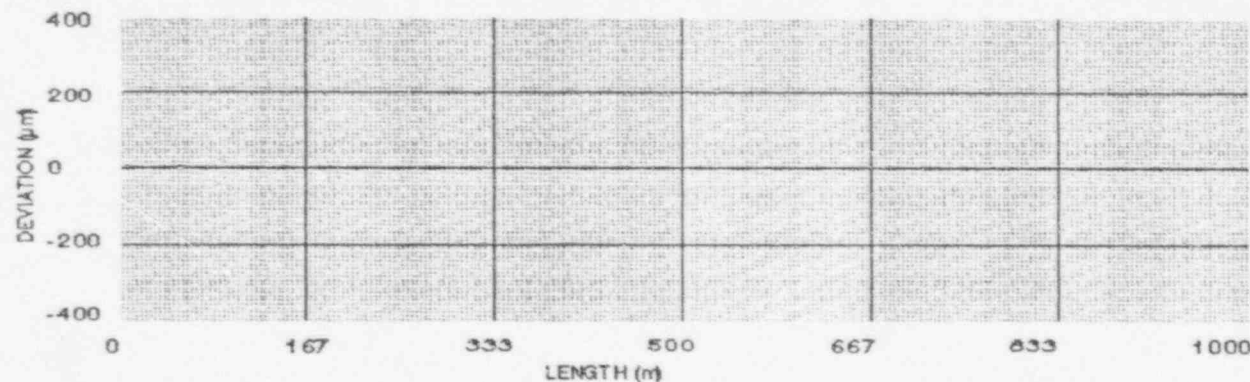
DELETE COIL DATA AFTER 7 DAYS

LOGIN	EXIT OCC
OS/2 WINDOW	EXIT

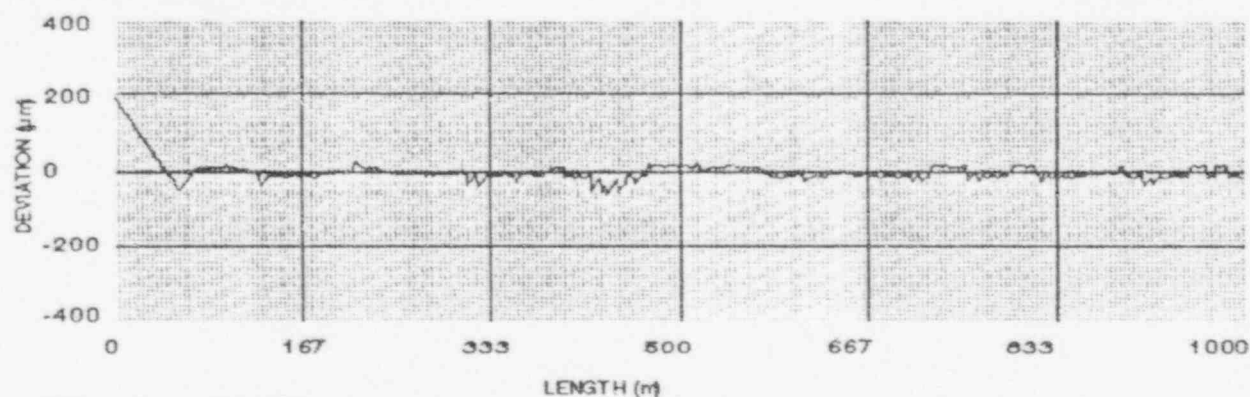


# DMC - OPERATOR CONTROL CONSOLE

## PROFILE GAUGE TREND



## FIXED GAUGE TREND



DMC 17:41:43 12-12-95 COIL : 2

PROFILE

RIDGE PROFILE

TEMPERATURE

GENERAL SETUP

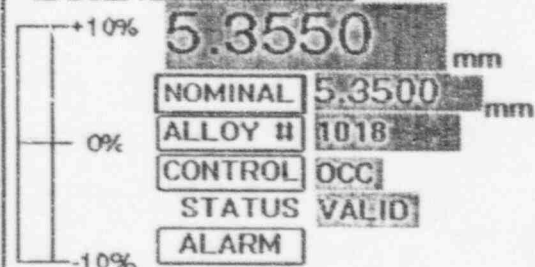
CALIBRATE

ALARM

PRINT

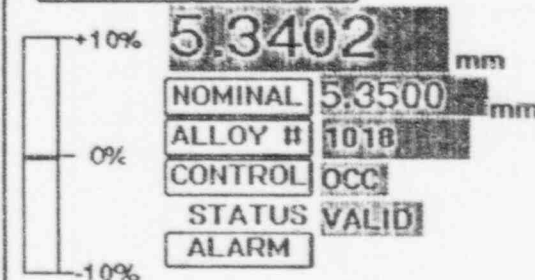
CONTROL

## PROFILE THICKNESS



X-RAY SHUTTER PROFILE  
ON OPEN CONTINUE

## FIXED THICKNESS



X-RAY SHUTTER  
ON OPEN

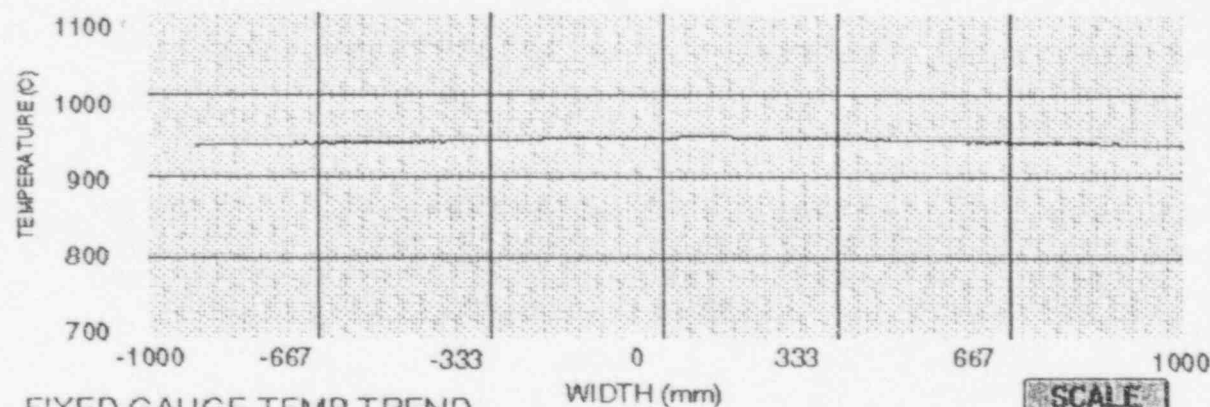
## PROFILE INFORMATION

CROWN	WEDGE
0.075	0.021
0.096	-0.01E
0.059	0.058
0.087	-0.21E

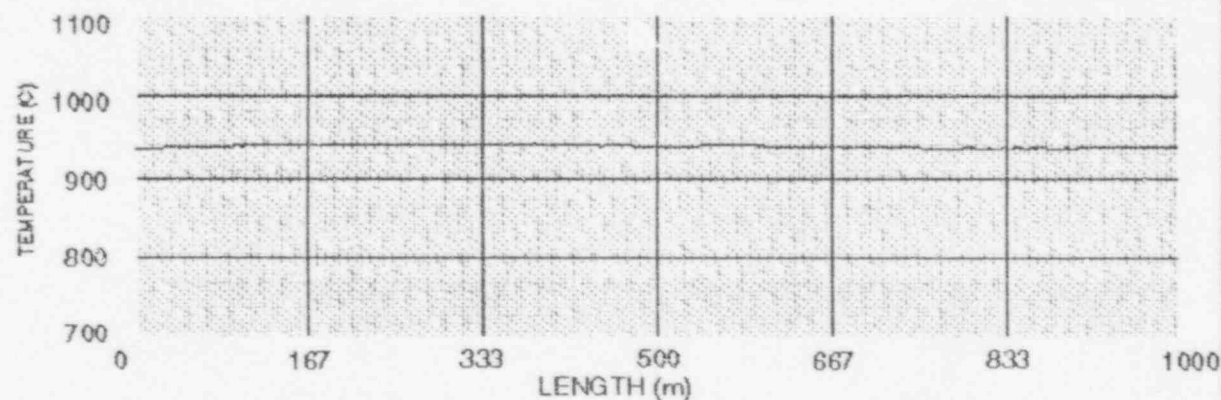


# DMC - OPERATOR CONTROL CONSOLE

## PROFILE GAUGE TEMP



## FIXED GAUGE TEMP TREND



DMC 17:51:25 12-12-95 COIL : 2

PROFILE	TRENDS	RIDGE PROFILE	GENERAL SETUP
CALIBRATE	ALARM	PRINT	CONTROL

## PROFILE THICKNESS

+10% 5.3550 mm

0% NOMINAL 5.3500 mm

ALLOY # 1018

CONTROL OCC

STATUS VALID

-10% ALARM

X-RAY SHUTTER PROFILE

ON OPEN

## FIXED THICKNESS

+10% 5.3402 mm

0% NOMINAL 5.3500 mm

ALLOY # 1018

CONTROL OCC

STATUS VALID

-10% ALARM

X-RAY SHUTTER

ON OPEN

## PROFILE INFORMATION

CROWN	WEDGE
0.075	0.021
0.096	-0.01E
0.059	0.058
0.087	-0.21C

8. TWO (2) SETS OF OPERATING AND MAINTENANCE MANUALS (DMC STANDARDS)

Custom manuals include:

- Installation Information
- Circuit Diagrams
- Operation Instructions
- Maintenance Instructions

All manuals are in the DMC standard format.

The language used in all documentation is English.

9. TWO (2) SETS OF DRAWINGS ON WHITE PAPER WITH DMC TITLE BLOCKS (DMC STANDARDS)

Custom drawing package includes the following general categories:

- Assembly Drawings
- Interconnect Drawings
- Wiring Diagrams
- Circuit Board Schematics\*
- Outline Drawings

Drawings are copied on B-size (11" x 17") (280mm x 430mm) white paper.

- \* Schematics for circuit boards not produced by Measurex/DMC will be included if they are available from the vendor.

## OPTIONS

### 10. CLOSED LOOP CHILLER (AIR COOLED) FOR ONE (1) HOT PLATE MILL C-FRAME

A self-contained closed loop chiller is supplied for cooling the source and detector.

It is mounted on-line with automatic controls to assure safe and proper operation at all times.

The chiller uses a storage type cooling tank to provide close temperature control of recirculating coolants. The tank is sealed to prevent coolant evaporation and fouling and is supplied with liquid level gauge and clean out.

The pump recirculates coolant at a constant pressure and flow, which is adjustable by turning a manual bypass valve. Dial thermometer and pressure gauge are supplied on the discharge line to monitor coolant conditions leaving the chiller.

Interlocks for high temperature and low flow are provided for customer connection.

Maximum Ambient Temperature:	120°F (49°C)
Minimum Ambient Temperature:	35°F (2°C)

Coolant lines must be insulated.

The following items are included:

- a. Visual flow meters
- b. High temperature thermostat for pump cutout
- c. Low temperature option (minimum ambient down to 35°F (2°C))
- d. Special design for 80°F (26.7°C) supply water temperature
- e. Wiring of items (b) and (h) through a relay to a terminal strip, for interlock with X-ray control circuit
- f. Hand valves
- g. Two (2) separate pumping systems - one 3.5 gpm supply and one 10 gpm supply
- h. Flow switch
- i. Air cooled condenser

The following item is available at additional cost:

- A. Water cooled condenser  
Maximum Condenser Coolant Temperature: 90°F (32°C)  
Coolant Flow through Condenser: 2gpm (8 liters)

11. DMC 450 MAIN ELECTRONICS CABINET AIR CONDITIONING

An industrial side mounted 2000 BTU air conditioner extends the operating temperature range for the electronics. Power requirements will typically be matched to the attached cabinet.

12. SAMPLE STAND AND BOXED SET OF SIX (6) INCH CALIBRATION SAMPLES

A set of steel standards is provided in a wooden box in the following BCD thickness increments: 4 inch, 2 inch, 1 inch, 0.8 inch, 0.4 inch, and 0.2 inch. A sample stand for positioning the samples at the beam passline is also supplied.

13. ADDITIONAL INTERCOMPONENT CABLING

Additional intercomponent cabling is available for the interconnection of all gauging elements.

14. SET OF DRAWINGS ON AUTOCAD DISKETTES (RELEASE 12) WITH DMC TITLE BLOCKS (DMC STANDARDS)

All systems drawings are available on floppy disk for use with Autocad, Release 12, software systems. Customer to specify 5 1/4" or 3 1/2" disk formats.

Release 10, 11, and DXF formats are available at extra cost, if required.

15. TRAINING OF USER'S PERSONNEL AT MEASUREX/DMC'S FACTORY, GAITHERSBURG, MARYLAND

Training at Measurex/DMC's factory is provided for up to two (2) specialists per gauge, for a period of one (1) week (five (5) days).

The customer is responsible for all travel and living expenses as incurred.



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The customer is responsible for all travel and living expenses as incurred.

16. START-UP AND COMMISSIONING SERVICES

This start-up and commissioning quotation is for service performed in 1996. It covers twenty-three (23) eight (8) hour days of technical assistance for a base system or thirty (30) eight (8) hour days of technical assistance for a base system with Universal Operator's Control Console (UOCC). It includes hotel accommodations and meals. If with through causes outside DMC's control additional time is needed and/or additional expenses incurred, these will be invoiced at normal rates in effect at time of service.

## MEASUREX/DMC WARRANTY

### Fifteen Year Factory Support Warranty

Measurex/DMC will provide support and spare parts on its equipment for a period of 15 years from date of shipment. For spare parts normally supplied by outside vendors and no longer available, a list of alternate parts or modification kits will be provided.

Measurex/DMC will provide, at nominal charge, new copies of drawings and manuals normally sent to customers at time of original purchase.

### Two Year Warranty

New Measurex/DMC X-ray sources, when purchased as a part of a system, are warranted to be free of defects in material and workmanship for a period of two years from date of shipment provided:

1. start-up occurs within six months from date of shipment from our factory,
2. no damage results from storage prior to start-up, and
3. installation and start-up are performed in accordance with Measurex/DMC instructions.

Damage caused by physical abuse or improper operation is not covered by the Measurex/DMC warranty. X-ray sources opened by non-Measurex/DMC personnel are not covered by the Measurex/DMC warranty.

### One Year Warranty

Measurex/DMC instruments not covered by the two year warranty are covered by a one year warranty subject to the same provisions, terms and conditions as stated in the two year warranty section, with the exception of monitors, strip chart recorders, printers, and other ancillary equipment not of Measurex/DMC's manufacture, which carry on the original manufacturer's warranties.

Spare parts, including spare X-ray sources, are warranted for one year from date of shipment.

### Conditions

If repair or replacement of components is required because of defective materials or workmanship, the customer shall return the components to the factory prepaid. X-ray sources repaired or replaced under warranty are warranted for the duration of the term of the original warranty. Other components repaired under warranty are warranted for the duration of the original warranty, or ninety (90) days, whichever is later. Components under warranty shall be returned to Measurex/DMC prepaid. Measurex/DMC shall pay for the return surface freight and insurance; however, charges for overnight, express, courier, or other special services will be invoiced at cost to customer. Measurex/DMC shall return such parts for reinstallation by customer personnel.

Measurex/DMC repair or replacement of components no longer covered by original warranty is warranted for ninety (90) days from date of shipment to customer.

If the customer requests a service call, travel time, travel, and living expenses are billed to the customer, although there is no charge for the service specialist's time on-site. If it is determined that the service call was not due to a component under warranty, the customer will then be billed for the service specialist's time at Measurex/DMC's current rate.

The liability of Data Measurement Corporation is specifically limited to the replacement of components. Backcharges will not be accepted.

All necessary radiation protective measures specified by the United States government are incorporated in all Measurex/DMC radiation gauges. The leakage on all surfaces of the source tank, except in the useful beam, is below 0.002 REM/hour. Requirements in most other countries are also met, but should be communicated to us for concurrence.

Measurex/DMC instruments will operate within the stated performance specifications, under normal operator control in the environment for which they have been designed, provided that the equipment is properly installed and maintained.

This warranty is subject to service on the unit having been performed by either an authorized Measurex/DMC representative, or by a user's staff member's executing Measurex/DMC's written or oral instructions. If this condition is not met, the warranty will be void.



## DMC 450

### Communication Protocol Definition

Rev. 2.10

23 August 1993

This document describes the communication protocol between the 450 MEC (Main Electronic Cabinet) and the CMP (Mill Computer).

### 1. BASIC DEFINITION

#### 1.1 HARDWARE CONFIGURATION:

Baud Rate	=	9600
Word Length	=	8 bits
Parity	=	disabled
Stop Bits	=	one
Start Bits	=	one
RS232-C Link		

#### 1.2 PROTOCOL STRUCTURE:

stx TYPE NAME DATA etx bcc cr  
or  
stx TYPE NAME DATA / NAME DATA etx bcc cr

To facilitate easy testing, the 450 will recognize the following structure without requiring the bcc characters.

TYPE NAME DATA cr  
or  
TYPE NAME DATA / NAME DATA cr

The maximum length is 80 characters for a packet with every command less than 40 characters (so it is possible to send multiple commands in a record via the "/" delimiter). The 450 will respond with defined protocol structure and include the bcc characters.

NOTE: 1. All alarms displayed on the operator terminal will be sent to the mill computer over the serial link as they are displayed on the operator terminal.

2. To set up parameters over the serial link, the gauge has to be in computer "CMP" mode (Page 1 of operator display).

### 1.3 STRUCTURE DESCRIPTION:

Normally, the 450 can only recognize the first 3 alpha characters of a word. Allowable characters are A(41H) to Z(5AH) and a(61H) to z(7AH). For instance, the 450 will interpret the following string to be the same, "REQ" = "req" = "REQUEST" = "Require".

**TYPE:** There are nine different types of key words referred to as commands. One through five are used from an outside link to the MEC only. Six through nine are the possible commands sent out from MEC.

- (1) REQ = Request information of parameter and status
- (2) SET = Set up parameter value or data
- (3) EXE = Execute gauge function
- (4) NEX = Store next setup value or data (not currently implemented)
- (5) SRQ = Gauge status request
- (6) ACK = Acknowledge input command string
- (7) NAK = Negative acknowledge input command string
- (8) RPY = Reply information
- (9) SRY = Gauge status reply

**NAME :** Any alpha character string is up to 12 characters long. Allowable characters are from "A"- "Z" and "a"- "z" only.

**EXAMPLE:** NOMINAL, OVERTOL, SHUTTER, GRADE

**DATA:** Any alphanumeric data is up to 12 characters long or numeric data is up to 6 significant digits. Allowable characters for numeric data are all from 30H through 39H ("0"- "9") inclusive 2EH("."), 2BH("+"), and 2DH("-"). If the sign symbol is omitted, the number is assumed to be positive. Six non-numeric words are allowed "ON", "OFF", "OPEN", "CLOSED", "ONLINE" AND "OFFLINE" for the EXE command. Set command data is unrestricted alpha numeric.

**EXAMPLE:** 456.7, -43.987, 2345, AB123C, 225L, ON, OFF.

Data may not contain the delimiters " " (20H) or "/" (2FH) within the string. Strings 1 2.3 and AB/CD are non valid data. Finally, data may not contain the type keywords (i.e. REQ, SET, etc.).

bcc: Block Check Character. A 1 byte checksum is computed using an Exclusive or (XOR) bitwise operation. It starts from the first character after <stx> and ends following and including the <etx> character. The high and low nibble of the value are converted into two ASCII characters (MS followed by LS). The allowable characters are 30H to 39H("0"-"9") and 41H to 46H("A"-"F").

Example: |stx|A|C|K| |S|H|U|T|T|E|R| |O|P|E|N|etx|0|7|cr|

cr: Carriage return (ODH)

stx: Start of Text (O2H)

etx: End of Text (O3H)

#### 1.4 RECORD FORMATS:

In the following documentation, the "|" character is used as a byte delimiter and is not actually part of the transmitted record.

### 2. COMMAND DESCRIPTION

#### 2.1 REQ COMMAND: Request gauge information (TO MEC ONLY).

|stx|R|E|Q| |N|A|M|E|etx|bcc|bcc|cr|  
or  
|stx|R|E|Q| |N|E|X|T| |N|A|M|E|etx|bcc|bcc|cr|

Example:

- a) |stx|R|E|Q| |N|O|M|I|N|A|L|etx|bcc|bcc|cr|
- b) |stx|R|E|Q| |N|E|X|T| |T|C|O|N|S|T|etx|bcc|bcc|cr|
- c) |stx|R|E|Q| |O|V|E|R|T|O|L| |/| |U|N|D|E|R|T|O|L|etx|bcc|bcc|cr|

#### 2.2 SET COMMAND: Setup gauge parameter with data (TO MEC ONLY).

|stx|S|E|T| |N|A|M|E| |=| |D|A|T|A|etx|bcc|bcc|cr|  
or  
|stx|S|E|T| |N|A|M|E|=|D|A|T|A|etx|bcc|bcc|cr|

Example:

- a) |stx|S|E|T| |N|O|M|I|N|A|L| |=| |1|2|4|.5|etx|bcc|bcc|cr|
- b) |stx|S|E|T| |G|A|I|N| |=| |1|.0|2| | / | |C|O|M|P|O|S|I|T|I|O|N|  
|=| |1|.0|3|etx|bcc|bcc|cr|
- c) |stx|S|E|T| |G|R|A|D|E|=|A|B|1|2|C|etx|bcc|bcc|cr|

**2.3 EXE COMMAND:** Execute gauge function (TO MEC ONLY).

|stx|E|X|E| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|

Example:

- a) |stx|E|X|E| |S|H|U|T|T|E|R| |O|P|E|N|etx|bcc|bcc|cr|
- b) |stx|E|X|E| |C|F|R|A|M|E| |O|F|F|L|I|N|E|/|S|T|D| |O|N|etx|bcc|  
bcc|cr|

**2.4 NEX COMMAND:** Next coil setup data/execute function (TO MEC ONLY) -  
(not currently implemented)

This command is available for accepting next coil setup information. The user can send all information related to the next coil setup data through the serial link while running the current coil. To bring up all of the parameters for the next setup, either use a digital input or send "EXE ACCEPT ON" via serial link to set up the gauge. This will shorten the set up time required between the two coils. If the gauge has a length coil report option, all of the parameters for the next setup will be brought up automatically, right after the last coil report has been printed out. This command may be applied to all parameters covered by both the SET and EXE commands (Refer to summary of OPERAND list for current available parameters for this command). There are two different formats depending on the NAME. If the NAME is a "SET" type command, then "=" is required and is omitted for an "EXE" command.

|stx|N|E|X| |N|A|M|E| |=| |D|A|T|A|etx|bcc|bcc|cr|  
or  
|stx|N|E|X| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|



Example:

- a) |stx|N|E|X| |N|O|M|I|N|A|L| |=| |1|0|0|.0|etx|bcc|bcc|cr|
- b) |stx|N|E|X| |C|O|A|T| |=| |N|O|N|E|etx|bcc|bcc|cr|
- c) |stx|N|E|X| |C|F|R|A|M|E| |O|N|L|I|N|E|etx|bcc|bcc|cr|

**2.5 SRQ AND SRY COMMAND:** The system request command is a quick method to get gauge status information (TO MEC ONLY). The system reply command is a gauge response to the SRQ command. (FROM MEC ONLY)

For Single C-Frame System:

|stx|S|R|Q|etx|bcc|bcc|cr|

reply string:

|stx|S|R|Y| |X|X|X|X|R|S|O|U|M|H|X|X|X|X|etx|bcc|bcc|cr|

For Dual C-Frame System:

For gauge A status request:

|stx|S|R|Q| |G|G|A|etx|bcc|bcc|cr|

For gauge B status request:

|stx|S|R|Q| |G|G|B|etx|bcc|bcc|cr|

reply string:

|stx|S|R|Y| |X|X|X|X|C|R|S|O|U|M|H|X|X|X|X|etx|bcc|bcc|cr|

where:

XXXX is the current nominal value

C (43H) is sent if the gauge is selected

\* (2AH) is sent if the gauge is not selected

R (52H) is sent if the gauge is ready

\* (2AH) is sent if the gauge is not ready

S (53H) is sent if standardize is OK

\* (2AH) is sent if standardize is not OK

O (4FH) is sent if the gauge is over tolerance

\* (2AH) is sent if the gauge is not over tolerance

U (55H) is sent if the gauge is under tolerance

\* (2AH) is sent if the gauge is not under tolerance

M (4DH) is sent if the gauge is in measure mode

\* (2AH) is sent if the gauge is not in measure mode

H (48H) is sent if the gauge is healthy

\* (2AH) is sent if the gauge is not healthy

XXXX is the current measured thickness value

NOTE: Gauge is ready when:

- 1) Gauge power up
- 2) Gauge is standardized
- 3) There is no alarm for the gauge

Gauge is healthy when:

- 1) Gauge is ready
- 2) Gauge is in measure mode
- 3) Measured thickness is valid

Example:

- 1) For a single C-Frame System

CMP to MEC: |stx|S|R|Q|etx|bcc|bcc|cr|

MEC to CMP: |stx|1|9|5|. |0|0|R|S|\*|U|M|H|1|9|4|. |5|4|  
etx|bcc|bcc|cr|

Nominal is 195.00

Gauge is ready

Standardize is OK

Gauge is not over tolerance

Gauge is under tolerance

Gauge is in measure mode  
Gauge is healthy  
Measured value is 194.54

2) For a dual C-Frame System

CMP to MEC: |stx|S|R|Q| |G|G|A|bcc|bcc|cr|  
MEC to CMP: |stx|1|2|0|. |0|C|R|S|\*|\*|M|H|1|1|9|. |8|7|bcc|bcc|cr|

Nominal is 120.0  
Gauge is selected  
Gauge is ready  
Standardize is OK  
Measured thickness is not over tolerance  
Measured thickness is not under tolerance  
Gauge is in measure mod.  
Gauge is healthy  
Measured value is 119.87

**2.6 ACK COMMAND:** Acknowledge setup data/execute function for current or next coil parameter (FROM MEC ONLY).

|stx|A|C|K| |N|A|M|E|etx|bcc|bcc|cr|  
or  
|stx|A|C|K| |N|E|X|T| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|

Example:

- a) |stx|A|C|K| |S|H|U|T|T|E|R| |O|P|E|N|etx|bcc|bcc|cr|  
b) |stx|A|C|K| |N|E|X|T| |N|O|M|I|N|A|L| |8|0|etx|bcc|bcc|cr|

**2.7 NAK COMMAND:** Negative acknowledge setup data/execute function for current or next coil parameter is used because of receiving bad checksum, device not in control, or wrong setup value (FROM MEC ONLY).

|stx|N|A|K| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|  
or  
|stx|N|A|K| |N|E|X|T| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|

Example:

a) |stx|N|A|K| |A|R|A| |1|0|.|0|etx|bcc|bcc|cr|

b) |stx|N|A|K| |N|E|X|T| |G|R|A|D|E| |4|4|L|etx|bcc|bcc|cr|

NOTE: An "ACK" reply indicates acceptance of the command (SET, EXE or NEX). The "NAK" indicates refusal of the command.

**2.8 RPY COMMAND:** Gauge response current data in an OPERAND requested by REQ command (FROM MEC ONLY).

A request command can be made with any of the OPERANDs and the response from the gauge is the current status for that OPERAND, regardless which device is in control.(i.e., if the MEC is in control, the gauge still sends a response to a request command from the CMP).

|stx|R|P|Y| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|

or

|stx|R|P|Y| |N|E|X|T| |N|A|M|E| |D|A|T|A|etx|bcc|bcc|cr|

Example:

a) |stx|R|P|Y| |C|O|N|T|R|O|L| |M|E|C|etx|bcc|bcc|cr|

b) |stx|R|P|Y| |S|T|D| |O|N|etx|bcc|bcc|cr|

NOTE: When any alarm occurs, the alarm message is transmitted automatically. The message length may be varied. For multiple alarm conditions, user or computer has to clear current alarm first in order to see the next alarm.

|stx|R|P|Y| |A|L|A|R|M| |M|E|S|S|A|G|E|etx|bcc|bcc|cr|

|stx|R|P|Y| |A|O|N|E| |M|E|S|S|A|G|E|etx|bcc|bcc|cr|

|stx|R|P|Y| |A|T|W|O| |M|E|S|S|A|G|E|etx|bcc|bcc|cr|

Example: A typical shutter fail to open alarm

|stx|R|P|Y| |A|L|A|R|M| |4|0|6|etx|bcc|bcc|cr|

|stx|R|P|Y| |A|O|N|E| |S|H|U|T|T|E|R| |F|A|I|L|etx|bcc|bcc|cr|



|stx|R|P|Y| |A|T|W|O| |U|N|A|B|L|E| |T|O| |O|P|E|N|etx|bcc|bcc|  
cr|

To clear this alarm through the serial link, the gauge should receive the following commands:

|stx|S|E|T| |A|L|A|R|M| |=| |\_|\_|\_|etx|bcc|bcc|cr|

|stx|S|E|T| |A|O|N|E| |=| |\_|\_|\_|etx|bcc|bcc|cr|

|stx|S|E|T| |A|T|W|O| |=| |\_|\_|\_|etx|bcc|bcc|cr|

NOTE: Fatal error alarm may not be cleared until the condition is repaired. Cleared alarms will be returned within six seconds if the error condition still exists.

### 3. EXAMPLE OF SENDING COMMAND TO MEC

There are five commands the mill computer can send to the gauge :

1) SET    2) EXE    3) NEX    4) REQ    5) SRQ

- NOTE:
1. The gauge will accept the first three commands by sending back an "ACK" type string and will use the "RPY" type string of parameters in response to the command "REQ", and "SRY" to "SRQ". In general, gauge will send a "NAK" type string to refuse the command.
  2. Some of the commands listed in the following pages may not apply to your gauge, please check the options included in the system.
  3. The DATA (VALUE) field will be represented as an "XXXXX" format. This does not mean the system has to accept exactly 5 characters. The system will validate this field with respect to the OPERAND name. Some restrictions may be applied to limit the length of the DATA field for certain OPERANDs. For example, GRADE number can only go up to 6 characters because that is the limit of a filename.

### 3.1 EXAMPLE LIST:

<u>CMD</u>	<u>OPERAND</u>	<u>VALUE</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
SET	NOMINAL	= XXXXX	ACK(NAK) NOMINAL XXXXX	Set Current Nominal
	OVERTOL	= XXXXX	ACK(NAK) OVERTOL XXXXX	Set Overtol Value
	UNDERTOL	= XXXXX	ACK(NAK) UNDERTOL XXXXX	Set Underc: Value
	TCONST	= XXXX	ACK(NAK) TCONST XXXX	Set O/P Time Const(ms)
	COMPOSITION	= XXXXX	ACK(NAK) COMPOSITION XXXXX	Set Composi- tion Value
	GRADE	= XXXXXX	ACK(NAK) GRADE XXXXXX	Set Grade Nurnber
	ARA	= XXXXX	ACK(NAK) ARA XXXXX	Set Scale Factor Ch#1
	ARB	= XXXXX	ACK(NAK) ARB XXXX	Set Scale Factor Ch #2
	ARA	= XXXXX	ACK(NAK) ARA XXXXX	Set Scale Factor Ch#3
	ARB	= XXXXX	ACK(NAK) ARB XXXXX	Set Scale Factor Ch#4
	ASA	= XXXXX	ACK(NAK) ASA XXXXX	Set Analog Output Source Ch#1
	ASB	= XXXXX	ACK(NAK) ASB XXXXX	Set Analog Output Source Ch#2

<u>CMD</u>	<u>OPERAND</u>	<u>VALUE</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
	ASC	= XXXXX	ACK(NAK) ASC XXXXX	Set Analog Output Source Ch#3
	ASD	= XXXXX	ACK(NAK) ASD XXXXX	Set Analog Output Source Ch#4

(See section on analog outputs for valid sources.)

<u>CMD</u>	<u>OPERAND</u>	<u>VALUE</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
	ALARM	= ____	ACK(NAK) ALARM ____	Clear Alarm Text
	AONE	= ____	ACK(NAK) AONE ____	Clear Alarm Text
	ATWO	= ____	ACK(NAK) ATWO ____	Clear Alarm Text
	CONTROL	= MEC	ACK(NAK) CONTROL MEC	Set MEC in Control
		= OCC	ACK(NAK) CONTROL OCC	Set OCC in Control
		= CMP	ACK(NAK) CONTROL CMP	Set CMP in Control
	GAIN	= XXXXX	ACK(NAK) GAIN XXXXX	Set Gain Value
	TIME	= XXXX	ACK(NAK) TIME XX:XX	Set System Time
EXE	NEWALLOY	ON	ACK(NAK) NEWALLOY ON	New Alloy Function
	STD	ON(OFF)	ACK(NAK) STD ON(OFF)	Standardize Function

<u>CMD</u>	<u>OPERAND</u>	<u>VALUE</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
	CFRAME	ONLINE (OFFLINE)	ACK(NAK) CFRAME ONLINE	C-Frame Control
	SHUTTER	OPEN (CLOSED)	ACK(NAK) SHUTTER OPEN (CLOSED)	Shutter Function
(NEX not currently implemented.)				
NEX	NOMINAL	= XXXXX	ACK(NAK) NEXT NOMINAL XXXXX	Next Nominal Setup
	OVERTOL	= XXXXX	ACK(NAK) NEXT OVERTOL XXXXX	Next Overtol Value
	COMPOSITION	= XXXXX	ACK(NAK) NEXT COMPOSITION XXXX	Next Composition Value

<u>CMD</u>	<u>OPERAND</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
REQ	NOMINAL	RPY NOMINAL XXXXX	Nominal Value
	OVERTOL	RPY OVERTOL XXXXX	Over Tolerance Value
	UNDERTOL	RPY UNDERTOL XXXXX	Under Tolerance Value
	TCONST	RPY TCONST XXX	Time Constant Setting
	ARA	RPY ARA XXXXX	Analog Ch#1 Scale
	ARB	RPY ARB XXXXX	Analog Ch#2 Scale
	COMPOSITION	RPY COMPOSITION XXXXX	Composition Value Setting
	GRADE	RPY GRADE XXXXXX	Grade Number in Use
	NEWALLOY	RPY NEWALLOY ON(OFF)	New Alloy Function
	STD	RPY STD ON(OFF)	Standardize Function
	SHUTTER	RPY SHUTTER OPEN (CLOSED)	Shutter Status



<u>CMD</u>	<u>OPERAND</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
	CONTROL	RPY CONTROL MEC (OCC,CMP)	Controlling Device
	ALARM	RPY ALARM XXXXXXXXXXXX	Alarm Text
	AONE	RPY AONE XXXXXXXXXXXX	Alarm Text
	ATWO	RPY ATWO XXXXXXXXXXXX	Alarm Text
	ALARM	RPY ALARM ____	No Alarm
	AONE	RPY AONE ____	No Alarm
	ATWO	RPY ATWO ____	No Alarm

(See section on operator alarms, clearing alarms, and repeating alarms.)

<u>CMD</u>	<u>RESPONSE</u>	<u>FUNCTION</u>
SRQ	SRY XXXXXRSOUMHXXXXX	System Status Request for Single C-Frame System
SRQ GGA(GGB)	SRY XXXXXCRSOUMHXXXXX	System Status Request for Dual C-Frame System

### 3.2 DETAIL AND SPECIAL FUNCTION SAMPLES:

(A) To set up nominal to 120.00 the command should be:

SET NOMINAL = 120.00

MEC will respond if target is accepted:

ACK NOMINAL 120.00

o.w.

NAK NOMINAL XXXXX

(B) Perform close shutter operation, the command is:

EXE SHUTTER CLOSED

MEC responds with one of the following:

ACK SHUTTER CLOSED

O.W.

NAK SHUTTER CLOSED

(C) Request measure thickness value, the command is:

REQ THICKNESS

MEC responds with:

RPY THICKNESS 119.87

If thickness value is 119.87

#### **SPECIAL FUNCTIONS:**

1. To set up time to 1:30pm, the command should be:

SET TIME = 1330

MEC will respond if the command is accepted:

ACK TIME 13:30

O.W.

NAK TIME 1330

To request time, the command should be:

REQ TIME

MEC will respond:

RPY TIME 13:30

2. To set up date to October 22, 1991, the command should be:

SET DATE = 102291

MEC will respond if the command is accepted:

ACK DATE October 22, 1991

O.W.

NAK DATE 102291

To request date:

REQ DATE

MEC will respond:

RPY DATE October 22, 1991

3. To set up coating type to zinc, the command should be:

SET COAT = ZINC

MEC will respond if the command is accepted:

ACK COAT ZINC

O.W.

NAK COAT ZINC

To request coating type:

REQ COAT

MEC will respond:

RPY COAT ZINC

NOTE: Coating type could be "NONE" or any type available on the operator's terminal.

4. To set up motion mode to scan, the command should be:

SET MMODE = SCAN

MEC will respond if the command is accepted:

ACK MMODE SCAN

O.W.

NAK MMODE SCAN

To request motion mode:

REQ MMODE

MEC will respond:

RPY MMODE SCAN

NOTE: Motion mode could be any type available on the operator's terminal. An online command must be executed to start the motion mode.

5. In dual C-frame system, only one gauge could be selected for parameters setup purpose. To select gauge A to be controlled, the command should be:

SET SELECT = GAUGE\_A

MEC will respond if the command is accepted:

ACK SELECT GAUGE\_A

O.W.

NAK SELECT GAUGE\_A

All commands following this command will refer to gauge A until a new SET SELECT command is sent.

To request gauge in control:

REQ SELECT

MEC will respond:

RPY SELECT GAUGE\_A

NOTE: Gauge could be selected between "GAUGE\_A" and "GAUGE\_B".

6. To save current setup into grade number "450DMC", the commands should be:

STEP 1: Enter the password

SET SAVE = 64794



MEC will reply if the command is accepted:

ACK SAVE NEWGR

O.W.

NAK SAVE 54794

STEP 2: Enter the new grade name

SET SAVE = 450DMC

MEC reply if the command is accepted:

ACK SAVE 450DMC

7. To display grades available, the command should be:

EXE GLIST ON

MEC will respond if the command is accepted:

ACK GLIST ON

RPY GLIST ON

RPY GLIST *grade1 name*

RPY GLIST *grade2 name*

.....

RPY GLIST OFF

#### 4. SUMMARY OF OPERANDS

OPERAND NAME	DESCRIPTION	SEND TO GAUGE				GAUGE RESPONSE	
		SET	EXE	REQ	NEXT	RRY	ACK/NAK
<b>BASIC TAC GAUGE:</b>							
NOMINAL	Nominal thickness value	X		X		X	X
OVERTOL	Over tolerance value	X		X		X	X
UNDERTOL	Under tolerance value	X		X		X	X
THICKNESS	Current thickness value			X		X	
COMPOSITION	Composition value	X		X		X	X
TCONST	Time constant value	X		X		X	X
GAIN	Gain value	X		X		X	X
ABSDEV	Absolute deviation value			X		X	
PERDEV	Percent deviation value			X		X	
ARA	Analog O/P #1 scaling factor	X		X		X	X
ARB	Analog O/P #2 scaling factor	X		X		X	X
ARC	Analog O/P #3 scaling factor	X		X		X	X
ARD	Analog O/P #4 scaling factor	X		X		X	X
ARE	Analog O/P #5 scaling factor	X		X		X	X
ARF	Analog O/P #6 scaling factor	X		X		X	X
ASA	Analog O/P #1 source	X		X		X	X
ASB	Analog O/P #2 source	X		X		X	X
ASC	Analog O/P #3 source	X		X		X	X
ASD	Analog O/P #4 source	X		X		X	X
ASE	Analog O/P #5 source	X		X		X	X
ASF	Analog O/P #6 source	X		X		X	X
GRADE	Grade number	X		X		X	X
CONTROL	Current control device	X		X		X	X
STATUS	Gauge status			X		X	X

: Optional function  
 Note: Next feature is not currently implemented.

OPERAND NAME	DESCRIPTION	SEND TO GAUGE				GAUGE RESPONSE	
		SET	EXE	REQ	NEXT	RPY	ACK/NAK
X-Ray Gauge	Last ACE time			X		X	X
SDTIME	Last standardization time			X		X	
X-Ray Gauge	Last ACE date			X		X	
SDDATE	Last standardization date			X		X	X
ALARM	Alarm code	X		X		X	X
AONE	Alarm message 1			X		X	X
ATWO	Alarm message 2			X		X	X
TIME	Gauge current time	X		X		X	X
DATE	Gauge current date	X		X		X	X
SAVE	Save current setup into grade	X					X
SHUTTER	Shutter status (OPEN/CLOSED)		X	X		X	X
CFRAME	C-Frame status (ONLINE/ OFFLINE)		X	X		X	X
STD	Standardization status (ON/OFF)		X	X		X	X
NEWALLOY	New alloy function status (ON)		X	X		X	X
GLIST	Display grade (ON)		X			X	
<u>WITH LENGTH</u>							
<u>COIL REPORT</u>							
<u>OPTION:</u>							
OPNUM	Operator's number	X		X		X	X
COILNUM	Coil number	X		X		X	X
DSCALE	Deviation scaling factor	X		X		X	X
HSCALE	Histogram scaling factor	X		X		X	X
TSCALE	Trend scaling factor	X		X		X	X
TACHRATE	Tachometer convert ratio	X		X		X	X
MXSPEED	Maximum line speed			X		X	
SPEED	Current line speed			X		X	
<u>X-RAY GAUGE:</u>							
ACE	A.C.E. process status (ON/OFF)		X	X		X	X
BEAM	X-Ray beam status (ON/OFF)			X		X	

OPERAND NAME	DESCRIPTION	SEND TO GAUGE				GAUGE RESPONSE	
		SET	EXE	REQ	NEXT	RPY	ACK/NAK
<u>WITH COATING COMPENSATION OPTION:</u>							
COAT	Coating type	X		X		X	X
CWEIGHT	Coating weight	X		X		X	X
<u>WITH PROFILING C-FRAME CONTROL:</u>							
MMODE	Motion mode	X		X		X	X
FORWARD	Forward limit	X		X		X	X
REVERSE	Reverse limit	X		X		X	X
FIXED	Static position (in fixed mode)			X		X	X
HEAD	Current head position			X		X	
<u>WITH LOW RESOLUTION PROFILE GRAPHICS:</u>							
PXREV	Min. head position for display	X		X		X	X
PXFWD	Max. head position for display	X		X		X	X
PXCNTR	Center of profile display			X		X	
PYMAX	Max. positive deviation for profile	X		X		X	X
PYNEG	Max. negative deviation for profile			X		X	
<u>WITH TEMP COMP:</u>							
AIRTMP	Airtemp compensation (ON/OFF)		X	X		X	X
<u>DUAL C-FRAME SYSTEM:</u>							
SELECT	Gauge select to be controlled	X		X		X	X

Note: Next feature is not currently implemented.



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MEASUREX/DMC

## INSTALLATION REQUIREMENTS -- ON-LINE GAUGING SYSTEMS

Measurex/DMC process gauging and control systems are designed to give many years of reliable service in the harshest of environments.

The following rules are intended to ensure that provisions made in the equipment design are not jeopardized by incorrect installation. These rules relate to the problems of electrical environment. Experience has shown that the equipment will perform optimally only if these rules are strictly observed.

### Main Electrical Supply

The equipment must be connected to a clean and continuous alternating current (AC) supply, on its own or with other electronics equipment or computers. It must not share a supply with electrical machines, switchgear, or any other possible source of noise or discontinuity.

The supply must conform to the following standards:

1. Variations in voltage (R.M.S. value) from the stated required voltage must not exceed +10%, -15%.
2. Variations in supply frequency from the stated required frequency must not exceed  $\pm 5\%$ .
3. Maximum peak voltage of the supply must not exceed the stated required voltage (R.M.S. value) by more than 50% of the R.M.S. value.
4. Transient surges on the supply must not exceed a pulse width of 2 to 5 milliseconds.
5. The supply must not be subject to discontinuity of more than one half cycle every 500 cycles (i.e. 10 milliseconds in every 10 seconds).
6. Waveform distortions should not exceed 10% total harmonic content.

### Grounding

Two grounding lugs are provided inside the equipment cubicles. One of these is a power ground lug directly mounted to the cubicle which should be connected to a



grounding cable. A separate signal ground should be provided, consisting of a pattern of copper rods sunk into the earth near the equipment. Resistance to ground of these rods should not exceed 15 ohms. All signal cable shields should be connected to this ground as should the logic number OV line of the digital system. All ducts and cable trays should be grounded at a single point, preferably at the signal ground.

All shields should be grounded at the Main Electronics Cabinet only. The opposite end should be trimmed back neatly at the field junction box terminal block so as to minimize unshielded conductors.

### Cabling

Input and output cabling should be as specified in the cable list supplied with the equipment. For signal and high voltage cables, no substitutions will be permitted without Measurex/DMC's review and written approval.

Signal cables should be run separately from power cables and should cross them at 90°. Insulation tests should show greater than 10 MOhms leakage to ground on any separate loop.

No intermediate terminal boxes not specifically shown in Measurex/DMC's documentation and drawings will be allowed without written permission of Measurex/DMC.

### Equipment Locations

Equipment cubicles should not be located adjacent to heavy electrical equipment, switchgear, or any source of strong electrical or magnetic fields. Optionally, special provisions can be made inside cubicles where such a location is unavoidable. Measurex/DMC should be consulted for guidance in these circumstances prior to installation.

Care must be taken to level each cabinet and isolate the cabinet from sources of mechanical vibration.

## CUSTOMER REFERENCE LIST

### CESIUM GAUGES

<u>CUSTOMER/LOCATION</u>	<u>DESCRIPTION</u>
<b>AN YANG</b> China	1 - 450 TCC, Cs137
<b>ALTOS HORNOS DE MEXICO</b> Monclova, Coahuila, Mexico	1 - 420 TCC 30 Curie, Cs137
<b>BETHLEHEM STEEL CORPORATION</b> Sparrows Point, MD, USA	1 - 750 TCC, Cs137
<b>ERDEMIR</b> Eregli, Turkey	2 - 450 TCC, Cs137
<b>POSCO</b> Korea	3 - 420 TCC, Cs137
<b>ROCKWELL INTERNATIONAL</b> Idaho Falls, ID, USA	2 - 420 TCC, Cs137
<b>SSAB</b> Oxelösund, Sweden	1 - Three Point Gauge, Cs137
<b>TATA STEEL</b> India	1 - 450 TCC, Cs137
<b>WUYANG</b> China	1 - 450 TCC, Cs137

**CUSTOMER REFERENCE LIST**  
**DMC 450/460/480**

**CUSTOMER**

**GAUGE TYPE**

**ACEREX S.A. de C.V.**, Mexico  
through Worthington Industries/Hylsa

2-450 Isotope; Slitter and  
Cut-to-Length Lines

**ACERINOX**, Spain  
through Hitachi

2-450 X-ray; Sendzimir #3  
Reversing Cold Strip Mill

**ACESITA**, Brazil

2-450 **Dual** Gauge X-ray; Sendzimir  
Cold Mill #1/2  
1-480 **Dual** X-ray Gauge; Sendzimir  
Reversing Cold Strip Mill

**AHMSA**, Mexico  
through Delta Brands

1-450 **Dual** Gauge Isotope; Entry  
1-450 Isotope; Exit Gauge  
Zinc Coating Line  
1-450 **Dual** Gauge Isotope; Entry Point Line

**ALCOA**, Davenport, IA, USA

1-450 Isotope; Hot Mill

**ALGOMA STEEL**  
Sault Ste. Marie, Canada

1-480 X-ray with UOCC  
4-Hi Plate Mill

**ALGOMA STEEL**, Canada

1-480 X-ray (240KV); Plate Mill

**ALLEGHENY LUDLUM**, Brackenridge, PA, USA

1-450 Isotope

**ALLEGHENY LUDLUM**, Leechburg, PA, USA

2-450 Isotope  
3-450 Isotope; Cold Mills

**ALLEGHENY LUDLUM**, Vandergrift, PA, USA

1-450 Isotope

**ALLEGHENY LUDLUM**, Wallingford, CT, USA

1-450 X-ray (ACE)  
1-450 Isotope; Annealing Line

**ALUMINUM INDUSTRIES OF MALAYSIA**  
Malaysia

1-450 Isotope; Tension Levelling Line

**ANONYMOUS END USER**, India  
through Mino Italy

1-450 **Dual** Gauge Isotope; Reversing Mill

**ANSHAN IRON AND STEEL CORP.**  
Anshan Liaoning, China

3-450 Isotope

**AN YANG**, China

1-450 Isotope; Plate Mill

## CUSTOMER

ARMCO, Mansfield, OH  
through Davy International

ARMCO, Middletown, OH, USA

ARMCO ADVANCED MATERIALS, Butler, PA, USA

ARMCO ADVANCED MATERIALS, Zanesville, OH,  
USA

ARPCO, Iran

ARVIN, Fayette, AL, USA

ASIL/FROELING, India

AVESTA, Sheffield, U.K.

BAOSHAN, China  
through Siemens, Germany

BAOSHAN, China  
through Nippon Steel, Japan

BAOSHAN, China  
through Littell, USA

BENXI IRON & STEEL, China

BENXI TOOL CO., China  
through Steel Technologies

BERLIN METALS, INC.  
Hammond, IN, USA

BETHLEHEM STEEL CORP., Burns Harbor, IN, USA

BETHLEHEM STEEL CORP., Lackawanna, NY, USA

## GAUGE TYPE

1-480 Dual Gauge X-ray; Cold Tandem Mill

2-450 X-ray; Temper Mill

2-450 Isotope; 4 Stand Cold Tandem Mill  
1-450 Isotope; CR & O Line

2-450 Isotope; Pickle Line

1-4500 X-ray (ACE); Hot Mill

1-450 Isotope; Slitting Line

2-450 Isotope; 4 Hi Reversing Cold Mill

2-450 Isotope; Cold Reversing Mill  
2-450 Isotope; Sendzimir Mill

1-450 Dual Gauge Isotope; Reversing Mill  
4-480 X-ray; Cold Tandem Mill

3-450 Isotope; Continuous Annealing  
and Pickling Line

5-450 Isotope; Tin Lines

3-450 Isotope; Cold Mill  
1-450 Isotope; Recoil Line  
1-450 Isotope; Shear/Galvanizing Line  
1-450 Isotope; Skin Pass Mill

1-450 Dual Gauge Isotope; Reversing Mill

1-450 Isotope

3-450 Isotope; Galvanizing Line  
1-450 Isotope; Rewind Line  
1-450 Dual Gauge Isotope; Heat Treat  
Line, Entry End  
1-450 Isotope; Heat Treat Line, Delivery End  
1-480 X-ray; Combo Line

1-450 Dual Gauge Isotope; Galvanizing Line



## CUSTOMER

**BETHLEHEM STEEL CORP.**, Sparrows Point, MD, USA

**BHP COATED STEEL PRODUCTS**, Kalama, WA, USA  
through Danieli Wean, USA

**BHP - THAILAND**, Thailand  
through Danieli Wean, USA

**BHUSHAN STEEL**, India  
through Hitachi, Japan

**BRITISH STEEL CORP.**, Llanwern, U.K.

**BRITISH STEEL CORP.**, Shotton Works, U.K.

**BRITISH STEEL CORP.**, Whitehead, U.K.

**CANFOR**, Burnaby, BC, Canada

**CHANGSHU ALUMINUM**, China

**CHINA STEEL CORPORATION**, Taiwan  
through Siemens, Singapore

**CHOIL ALUMINUM**, Korea  
through Clecim

**CINTACERO**, Mexico  
through Hryb Controls, USA

**CIRCUIT FOIL USA, INC.**, Bordentown, NJ, USA

**COLLADO**, Mexico  
through Monarch Stamco

**COLD METAL PRODUCTS**, Hamilton, Ontario, Canada

**COLD METAL PRODUCTS**, New Britain, CT  
through Hryb Controls

## GAUGE TYPE

1-450 X-ray; #5 Trimmer Line  
1-450 Dual Gauge Isotope  
1-450 Isotope; #4 Hot Dip Coating Line  
1-450 Isotope; Skin Pass Mill  
1-450 Isotope; #3 Skin Pass Mill

1-450 Dual Gauge Isotope; Galvanizing Line

1-450 Dual Isotope; Galvanizing Line

2-480 X-ray; Cold Mill

1-450 Isotope  
2-450 Isotope; Zodiac Hot Dip Galvanizing  
Line, Delivery End

1-450 Isotope; Temper Mill  
2-450 Isotope; Galvanizing Line

2-450 Isotope  
1-450 Dual Gauge Isotope; Cold Reversing  
Mill

2-450 Isotope; MDF Line

1-450 X-ray (ACE)

1-480 X-ray; #3 Temper and Recoiling Line

1-480 X-ray; Aluminum Cold Reversing Mill

1-450 Dual Gauge Isotope; Reversing Mill

2-450 Isotope

1-450 Isotope; Slitter

1-450 Dual Gauge Isotope; Reversing Mill

1-450 Dual Gauge Isotope; Reversing Mill

## CUSTOMER

COLUMBUS STEEL, South Africa  
through Davy McKee

DAI YANG METAL, Korea

DNN (Dofasco-National-NKK), Ontario, Canada

DNN, Ontario, Canada

DIETRICH INDUSTRIES, Hicksville, OH, USA

DIETRICH INDUSTRIES, Hammond, IN, USA

DIETRICH INDUSTRIES, Warren, OH, USA

ENSIDESA, Spain

EREGLI IRON & STEEL WORKS, Eregli, Turkey

ESSAR DANAN JAYA, Indonesia  
through Hitachi

ETIBANK, Turkey

FALCK NASTRI SRL, Italy

FIRST COPPER AND IRON, Taiwan  
through Sundwiger

FRASER RIVER FIBREBOARD, Canada

GALVTECH, Pittsburgh, PA, USA

GOULD, INC., Eastlake, OH, USA

GOULD, INC., McConnellsville, OH, USA

GREAT LAKES STEEL, Ecorse, MI, USA  
through G.E.

GUANGZHOU TINPLATE, China  
through CNT

## GAUGE TYPE

2-450 X-ray (ACE); Sendzimir Mill  
2-450 X-ray (ACE); 4-Hi Mill  
3-450 Isotope; Process Lines

1-450 Dual Gauge Isotope

3-450 Dual Gauge and one Isotope;  
Galvanizing Line

1-450 Isotope; Slitting Line

3-450 Isotope; Stitcher Lines

3-450 Isotope; Stitcher Lines  
1-450 Dual Gauge X-ray; Cold Mill

1-480 Dual Gauge X-ray; Cold Mill

3-450 X-ray (ACE); Galvanizing Line

2-450 Cesium Isotope; Heavy Gauge Lines/  
Slitter Lines  
2-450 Isotope; Pickling and Tandem Cold  
Mill

2-450 Isotope; Cold Reversing Mill

2-450 X-ray (ACE)

1-450 X-ray (ACE)

2-450 X-ray

1-450 Isotope; MDF Line

1-450 Isotope; Galvanizing Line

3-450 Isotope; Slitters

1-450 Isotope; Slitter

1-450 Isotope

2-450 Isotope; Tin Line

## CUSTOMER

HANBO, Korea  
through Siemens, Germany

HANBO, Korea  
through MHI, Japan

HEIDTMAN STEEL, Crawfordsville, IN, USA  
through Pro Eco, Canada

HENGSHUI, China  
through MINO

HITACHI METAL, Japan

HS PROCESSING (Heidtman), Butler, IN  
through ProEco, Canada

HUNTCO STEEL, Blythesville, AK, USA  
through MECO

HUNTCO STEEL, Blythesville, AK, USA

HYLSA, Mexico

HYUNDAI, Korea  
through Monarch Stamco, USA

ILVA NOVI LIGURE, Italy

IMSA, Mexico

IMSA, Mexico  
through ADS Machinery

INDAL, India

I/N KOTE, New Carlisle, IN  
through Precision Strip Technologies

J&L SPECIALTY PRODUCTS, PA  
through Hess Engineering

JINDAL STRIPS\*, India

## GAUGE TYPE

7-480 X-ray; Cold Tandem Mill  
1-450 Dual Gauge Isotope; Pickle Line  
2-450 Triple Head Isotope; Pickle Line  
2-450 Triple Head Isotope; Skin Pass Mill

2-450 Isotope; Entry and Delivery Side of  
RCL - Recoiling Line  
2-450 Isotope; PGL - Pickling and  
Galvanizing Line  
1-450 Isotope; No. 2 RCL - Recoiling Line

1-450 X-ray; Pickle Line

1-450 Dual Gauge Isotope; Reversing Mill

2-450 X-ray; Cold Mill

1-480 X-ray; Pickle Line

1-450 Dual Gauge X-ray; Cold Mill Reversing  
Mill  
1-450 Isotope; Temper Mill

1-450 Isotope; Pickling Line

1-450 Isotope; Skin Pass Mill

1-450 Isotope; Shear Line

3-450 X-ray

1-460 Isotope; Paint Measurement

1-450 Dual Gauge Isotope; Galvanize  
Line Entry Section

1-450 X-ray; Cold Mill

1-450 Isotope; Inspection Line

3-480 X-ray; Continuous Cold Mill

2-450 Isotope

## CUSTOMER

LEE STEEL STRIP  
Sheffield, U.K.

LTV STEEL COMPANY, Cleveland, OH, USA

LTV STEEL COMPANY, Cleveland, OH, USA  
through Pro Eco, Canada

MABATI ROLLING MILLS, Kenya, Africa

MASONITE, Laurel, MS, USA

MASONITE, Towanda, PA, USA

MEXINOX, Mexico  
through Cegelec

MEYER ALUMINUM, Hong Kong

NAMSUM, Korea, through Mino SpA, Italy

NATIONAL STEEL (Granite City), IL, USA  
through Danieli-Wean

NEXTECH, Turtle Creek, PA, USA

NICHOLS HOMESHIELD, Davenport, IA, USA

NICHOLS HOMESHIELD, Chicago, IL, USA

NIPPON DENRO ISPAT, India

NIPPON STEEL CORP. (Nagoya Works)  
Japan

NORTH AMERICAN STAINLESS, Ghent, KY, USA

NOVO LIPETZ, USSR  
through Sacma Machine

NUCOR STEEL, Crawfordsville, IN, USA

PANZHIHUA, China  
through Mitsubishi

## GAUGE TYPE

1-450 Isotope; FZ3 Mill  
(Dual Head - (2) 6 Curie)

1-450 Isotope; Continuous  
Annealing Line

2-480 X-ray; Push-Pull Pickle Line

1-450 Isotope; 4-Hi Reversing Mill

1-450 Isotope; Dry Line #3

1-460 Isotope; MDF Line

1-450 Dual Gauge Isotope; Sendzimir  
Cold Reversing Mill

1-450 Isotope; Cold Mill

1-450 Isotope; Aluminum Cold Mill

3-450 Isotope; Galvanizing Line

1-450 Dual Gauge Isotope; Galvanizing Line

1-450 Isotope; Aluminum Hot Mill

1-450 Isotope; Aluminum Cold Mill

2-450 Isotope; Hitachi Mill

1-480 X-ray; Temper Mill

1-450 Dual Gauge Isotope; Reversing Mill

1-450 X-ray; Cold Mill

1-450 Dual Gauge Isotope; Galvanizing Line

1-450 Isotope; Skin Pass Mill

1-450 Isotope; Pickling Line

2-450 Isotope; Galvanizing Line/Shear Line

1-450 Isotope; Recoiling Line



## CUSTOMER

PANZHIHUA, China  
through UNICO

PECHINEY/RHENALU, France

PIVENSA, Venezuela

POSCO, Korea through Davy McKee

POSCO, Korea through MHI

POSCO, Korea

POSCO, Korea  
through Cegelec

POSCO, Korea  
through SamBo Engineering

PRECISION SPECIALTY METALS, Los Angeles, CA, USA

PRECISION STRIP TECHNOLOGIES, Minster, OH, USA

PROCESS TECHNOLOGIES INC., Perrysburg, OH, USA

QUINGHAI, China  
through Mino SpA, Italy

RAVENSWOOD ALUMINUM, Ravenswood, WV, USA

REYNOLDS METALS, Richmond, VA, USA

RUSSELL STANLEY, Woodbridge, NJ, USA

SAHAVIRIYA STEEL, Thailand  
through Hitachi, Japan

SAMMI STEEL, Korea

## GAUGE TYPE

1-450 Isotope; Galvanizing Line

2-450 Isotope (Sr90, Alum.); Cold Mill

1-450 Isotope (Sr90, Alum.); Cold Mill

1-450 X-ray; Hot Mill

1-450 Isotope; Cold Mill, #2 Recoiling Line

2-450 Isotope; 1 Entry, 1 Delivery Gauge  
K3C #2 Recoiling Line

2-450 Isotope; 2-Upgrades 420 to 450  
Sendzimir Reversing Cold Strip Mill

1-450 Isotope; #2 RCL Cold Rolling Mill

1-480 X-ray; #2 Cold Rolling Mill

3-450 Isotope; 2 Entry, 1 Exit Gauge  
Galvanizing Line

1-450 Isotope; HCL Silicon Steel Mill

1-450 Isotope; Tension Leveller

3-450 Dual Head (Sr90 and Am241)  
Isotope; Slitting Line

1-450 X-ray (ACE)

1-480 X-ray; Aluminum Cold Mill

1-450 Isotope; Cold Tandem Mill

1-450 X-ray; Drag Caster

1-450 Isotope; Cut-to-Length Line

3-480 X-ray; No. 5 Tandem Cold Mill and  
Recoil Line

4-450 Isotope; No. 5 Tandem Cold Mill  
and No. 1 Recoil Line

1-450 Dual Gauge Isotope; Reversing Mill

## CUSTOMER

**SAMMI STEEL**, Korea  
through Waterbury Farrell

**SAM YANG**, Korea

**SHANGHAI YI CHANG**, China

**SHUIXI**, China  
through Mino, Italy

**SIAM TINPLATE**, Thailand

**SIDBEC DOSCO**, Quebec, Canada

**SIDERCROM (Siderar)**, Argentina

**SIDMED**, Spain

**SOLLAC DESVRES**, France

**SOUTH CHINA ALUMINUM**, China

**STEEL TECHNOLOGIES**, Canton, MI, USA

**STEEL TECHNOLOGIES (MI-TECH Division)**  
Louisville, KY, USA

**STEEL TECHNOLOGIES (MI-TECH Division)**  
Greensburg, IN, USA

**STEEL TECHNOLOGIES**, Louisville, KY, USA

**STEEL TECHNOLOGIES**, Portage, IN, USA

**STEEL TECHNOLOGIES**, Monterrey, Mexico

**STEEL WAREHOUSE**, South Bend, IN, USA

**TANG SHAN HENG TONG**, China  
through Steel Technologies

**TATA STEEL**, India

**TAI GANG**, China  
through Cegelec

## GAUGE TYPE

1-450 Dual Gauge Isotope;  
#3 Reversing Mill

1-450 Dual Gauge Isotope

1-450 Isotope; Tinning Line

1-480 X-ray; Aluminum Foil Mill

1-450 Isotope; Scroll Line

1-450 Dual Gauge Isotope; Reversing Mill  
1-450 Isotope; Temper Mill

1-450 X-ray; Tinplate Line

1-480 X-ray; 80 Inch Cold Temper Mill

1-450 Isotope; Profiling

4-450 X-ray; Cold Mill

1-450 X-ray (ACE); Slitter Line  
1-450 Dual Gauge Isotope; Cold Mill

1-450 Isotope; Slitter Line

1-450 Isotope; Slitter Line

2-450 X-ray; Cold Mill

1-450 Isotope; Slitting Line  
1-450 Isotope; Slitting Line

1-450 Dual Gauge Isotope; Cold Mill

2-450 X-ray

1-450 Dual Gauge Isotope

1-450 Cesium Isotope; Hot Mill

1-450 Dual Isotope; Sendzimir Cold Mill

## CUSTOMER

TAYLOR STEEL, Niles, OH, USA

TAYLOR STEEL, Stoney Creek, Ontario, Canada

TCT STAINLESS STEEL, INC., Sterling Heights, MI, USA

TIAN JIN, China

TELEDYNE RODNEY METALS, New Bedford MA, USA  
through Hryb Controls

TELEDYNE WAH CHANG ALBANY, Albany, OR, USA

TITANIUM METALS (TIMET), Toronto, OH, USA

TON YI, Taiwan  
through Nissho Iwai

TON YI, Taiwan for China  
through World Machinery, Japan

TUNG MUNG, Taiwan

UGINE S.A., Gueugnon, France

UGINE ISBERGUES, France

UNION STEEL MANUFACTURING CO. LTD.,  
Pusan, Korea

UNIVERSITY OF WOLLONGONG, Australia

U.S. STEEL, Fairless Works, PA, USA

U.S. STEEL, Fairfield, AL, USA  
through ADS Machinery

WATERBURY FARREL, Cheshire, CT, USA

WHATMAN PAPER, LTD., Maidstone, Kent, UK

## GAUGE TYPE

2-450 Isotope; Slitter and Tension Leveler

1-450 Isotope; Slitter

1-450 Dual Gauge Isotope

1-480 X-ray; Aluminum Cold Mill

1-450 Dual Gauge Isotope;  
(Sr90, Titanium)  
Reversing Rolling Mill  
1-450 Dual Gauge Isotope; (Am241, Steel)

1-450 X-ray; Reversing Mill  
IsoProof™ SQC Package

1-450 Dual Gauge Isotope (with profiling);  
Reversing Mill

3-450 Isotope; Continuous Annealing Line  
2-450 Isotope; Tandem Cold Mill  
2-450 Isotope; Temper/Processing Line  
1-450 Isotope; Coil Preparation Line

1-450 Isotope; ETL - Electrolytic Tinning  
Line

1-450 X-ray (ACE); Annealing Line

3-450 Isotope  
2-480 X-ray; Sendzimir 06 Mill

1-450 Dual Gauge Isotope; Reversing Mill

2-450 X-ray (ACE); 4-Hi Reversing Mill

1-450 Isotope; Hot Mill

1-450 Isotope; Galvanizing Line  
1-450 Isotope; DCR Mill

1-450 Dual Gauge Isotope;  
Hot Dip Galvanizing Line, Entry

2-450 Isotope

1-450 Isotope (Krypton); Paper Line

## CUSTOMER

WHEELING PITTSBURGH STEEL, Allenport, PA, USA

WORTHINGTON INDUSTRIES, Columbus, OH, USA  
through Herr Voss

WORTHINGTON INDUSTRIES, Columbus, OH, USA

WORTHINGTON INDUSTRIES, Delta, OH, USA

WORTHINGTON INDUSTRIES, Louisville, KY

WORTHINGTON INDUSTRIES, Porter, IN, USA

WORTHINGTON INDUSTRIES, Rock Hill, SC, USA

WORTHINGTON SPECIALTY PROCESSING  
Jackson, MI, USA

WUHAN IRON AND STEEL (WISCO), China

WUYANG, China

WUXI, China  
through TonYi, Taiwan

XIAN STEEL STRIP PLATING, China

XINAN, China

YIEH PHUI, Taiwan  
through Hitachi, Japan

YIEH SHING, Taiwan

ZUNHUA, China

## GAUGE TYPE

1-450 X-ray; Temper Mill

1-450 Isotope; Cold Mill; Slitter

1-480 X-ray; Temper Mill

1-450 Dual Isotope Gauge System;  
Galvanize Line

1-450 Isotope; Slitter

1-450 Isotope; Pickle Line

1-450 Isotope; Slitter

1-450 Isotope; Narrow Cold Mill

1-450 Isotope; Slitting Line

1-450 Isotope

1-450 Dual Gauge Isotope;  
#2 Silicon Line

Hitachi Reversing Mill

2-450 Isotope; #5 Silicon

Continuous Annealing Line

1-450 Isotope (Cs 137); Plate Mill

3-450 Isotope; Electrolytic Tinning Line

1-450 Dual Gauge Isotope;  
4-Hi Reversing Mill

1-450 Dual Gauge Isotope; Reversing Mill

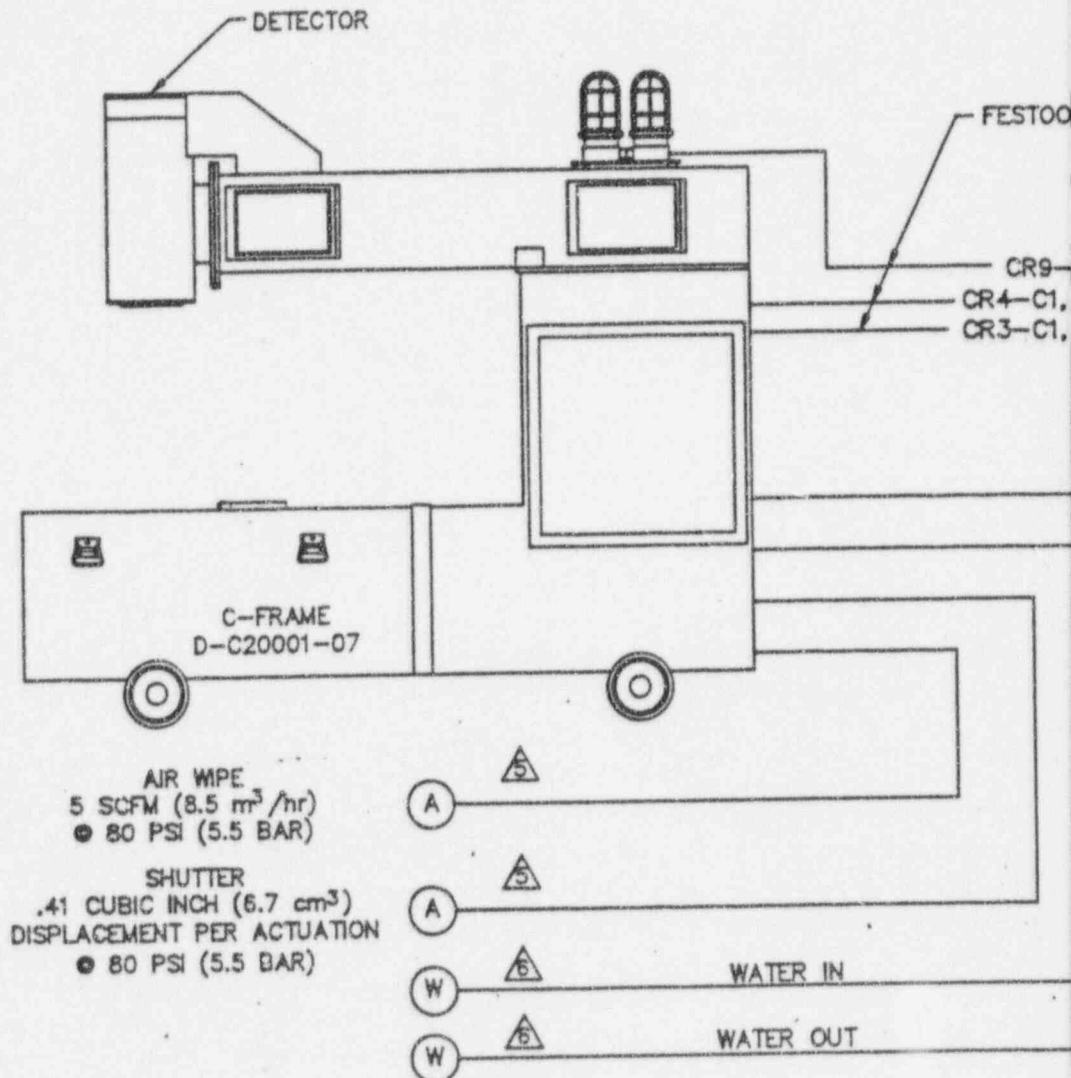
1-450 Dual Gauge Isotope; Reversing Mill

1-450 Dual Gauge Isotope; Reversing Mill

1-450 Dual Gauge Isotope; Reversing Mill

\* Manufactured in India by ACON under license from DMC.  
Dual: One (1) Main Electronics Cabinet with two (2) C-frames



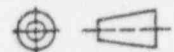


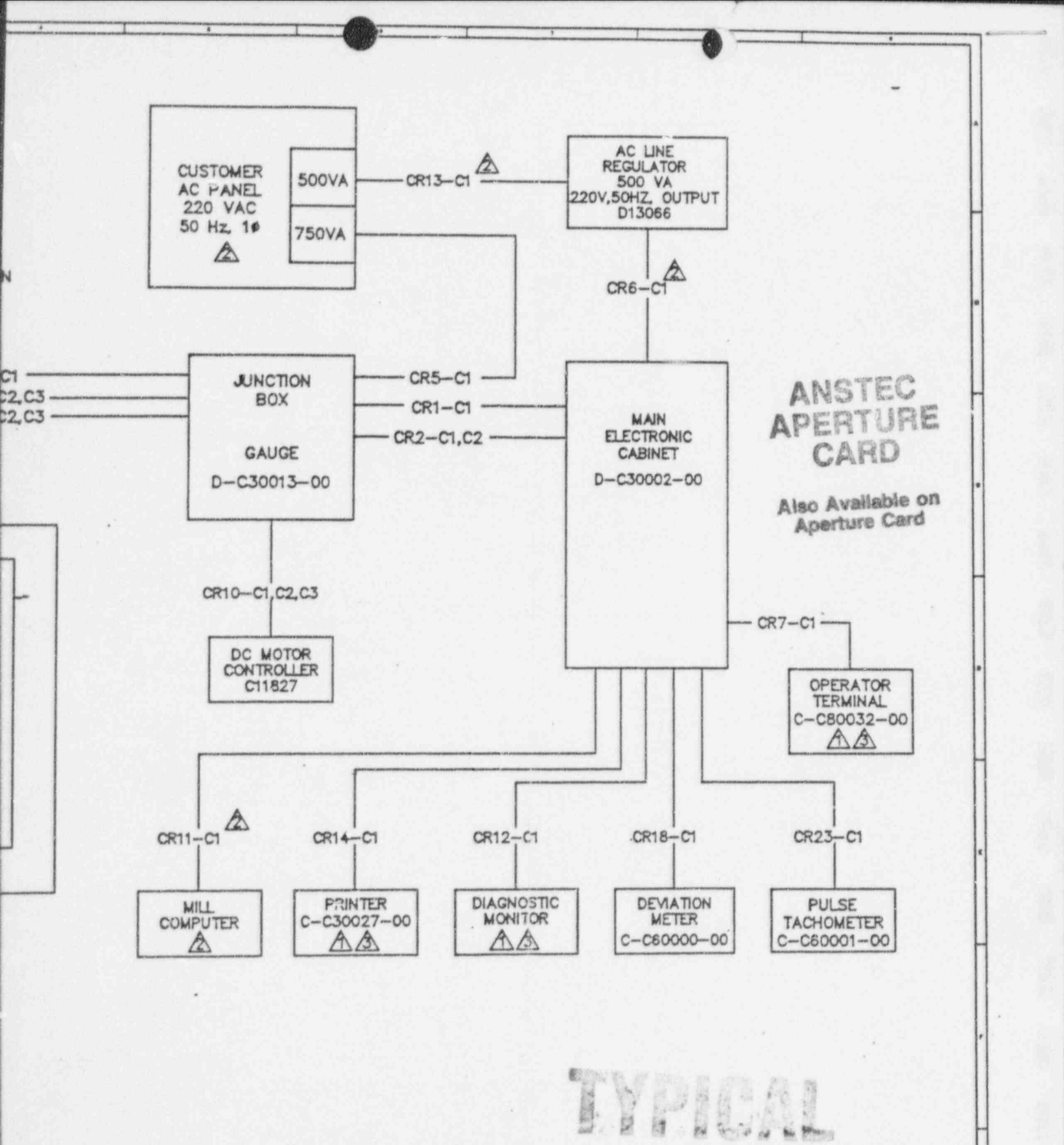
## NOTES:

- ① 3 FEET/1 M POWER CABLE SUPPLIED WITH EQUIPMENT. REQUIRES LOW POWER, 220-240 VAC, 50Hz, 1ϕ.
- ② CUSTOMER SUPPLIED
- ③ MUST BE FILTERED AC SUPPLY SUITABLE FOR COMPUTER EQUIPMENT
4. DMC JOB NO. 938026. SEE A-C11022-01 FOR INTERCONNECT CABLE LIST.
- ⑤ AIR QUALITY- CLEAN AND FILTERED TO 50 MICRONS WITH A DEW POINT OF 35°-42°F (1.7°-5.6°C) MAX. TEMPERATURE 100°F (38.7°C).
- ⑥ WATER- COOLANT FLOW RATE 3 TO 4 GPM 11.36 - 15.14L @30 PSI (206.84 KPa) 70°F (21.11°C) 3/8" HOSE (12.7mm) 7/8" O/D (22.4mm)

TOLERANCES  
OTHERWISE  
LINEAR DIM  
4 DEC. PLACE  
3 DEC. PLACE  
2 DEC. PLACE  
FRACTION  
APPROX.

PROJECTION





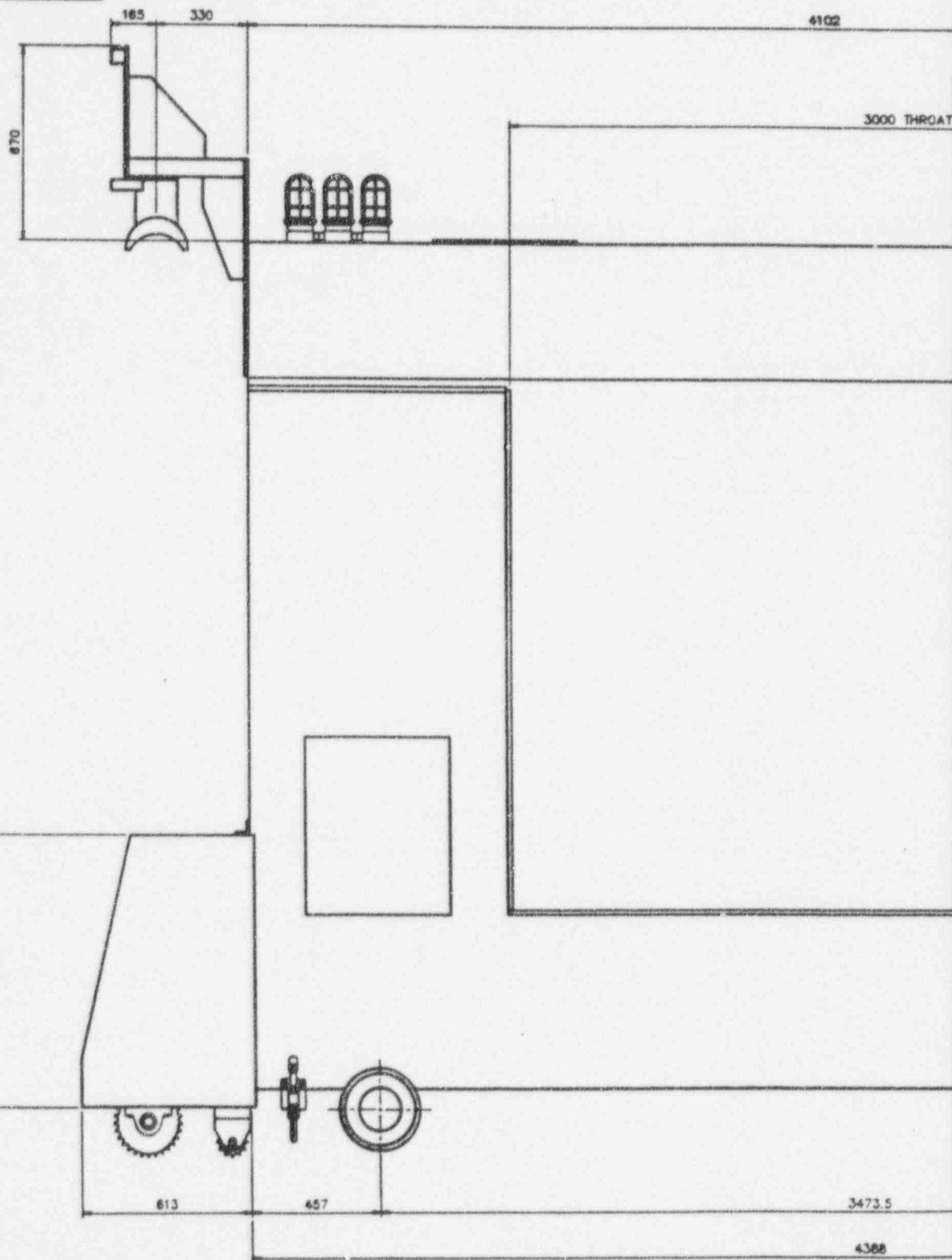
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SCALE: H/A DATE: 6-14-93 TITLE: 450 TCC SYSTEM BLOCK DIAGRAM (MOTOR DRIVE) FILE # 93092600 SIZE C DRAWING # C70022-01 SHEET 1 of 1	APPROVED BY: <i>Matt Magdol</i> DRAWN BY: C.W. REVISED:	KEY: A 93-1682 C.W. 6/14/93	

9704150016 - 01

124025

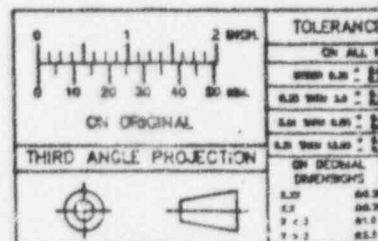
DEC 16 1996

D-C20001-07

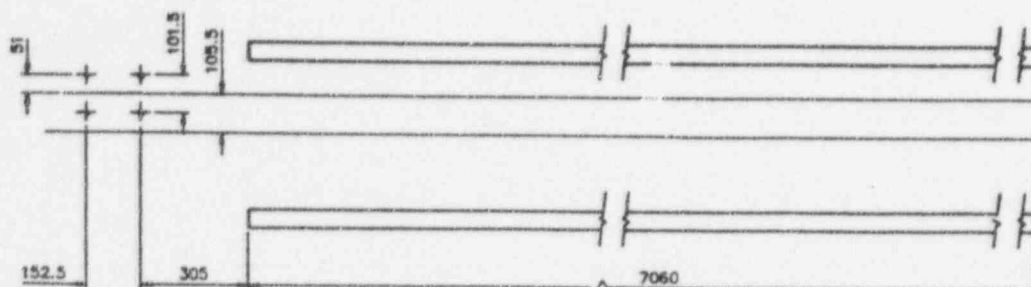


- NOTES :
1. WHEEL SPECIFICATIONS : 285mm FLANGE O.D.  
250 mm TREAD
  2. RECOMMENDED CLEARANCE BETWEEN RAIL  
AND WHEEL FLANGE IS 4.5mm

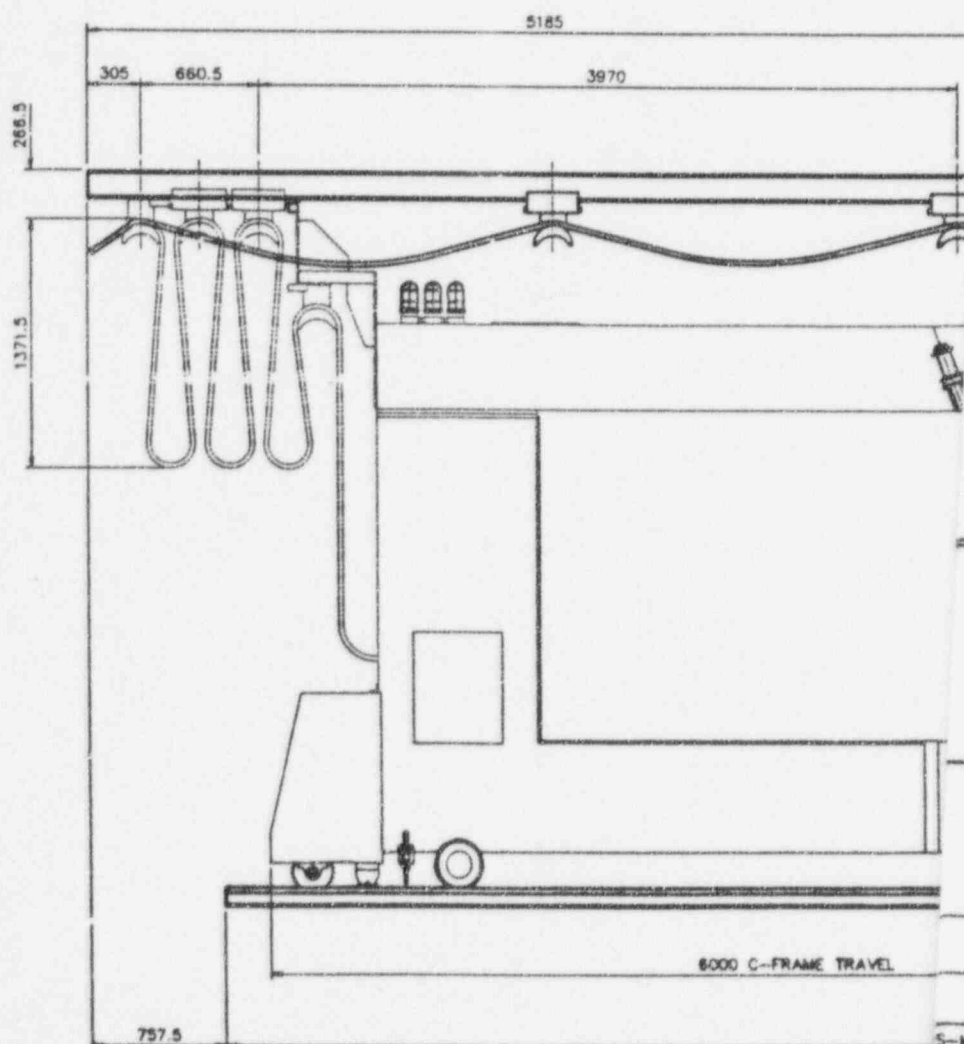
TYPICAL



D-C20001-07



CHAIN MTG. DETAILS  
SCALE: 1=10



5-MILLIMETRE

OLE DIMENSIONS

1	MAX. DIA. DIA.	0.05
2	MAX. DIA. DIA.	0.05
3	MAX. DIA. DIA.	0.05
4	MAX. DIA.	0.05
5	MAX. DIA.	0.05
6	MAX. DIA.	0.05
7	MAX. DIA.	0.05
8	MAX. DIA.	0.05
9	MAX. DIA.	0.05
10	MAX. DIA.	0.05
11	MAX. DIA.	0.05
12	MAX. DIA.	0.05
13	MAX. DIA.	0.05
14	MAX. DIA.	0.05
15	MAX. DIA.	0.05
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92	MAX. DIA.	0.05
93	MAX. DIA.	0.05
94	MAX. DIA.	0.05
95	MAX. DIA.	0.05
96	MAX. DIA.	0.05
97	MAX. DIA.	0.05
98	MAX. DIA.	0.05
99	MAX. DIA.	0.05
100	MAX. DIA.	0.05

NOTICE

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OR BY ANY INFORMATION STORAGE AND  
RETRIEVAL SYSTEM, WITHOUT THE  
WRITTEN PERMISSION OF DATA MEASUREMENT  
CORPORATION.

C	84-2
B	83-2
A	83-1
REV	E.C.



3000 THROAT

938.5

613

457

3473.5

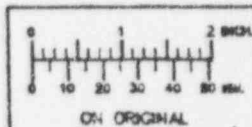
4388

NOTES :

NOTES :

1. WHEEL SPECIFICATIONS : 283mm FLANGE O.D.  
250 mm TREAD
2. RECOMMENDED CLEARANCE BETWEEN RAIL  
AND WHEEL FLANGE IS 4.5mm

# TYPICAL



THIRD ANGLE PROJECTION



## TOLERANCE

CIN ALL, P

00000 0.35 = 1

0.25 WIND 1.0 = 1

0.01 0.05 0.50 1

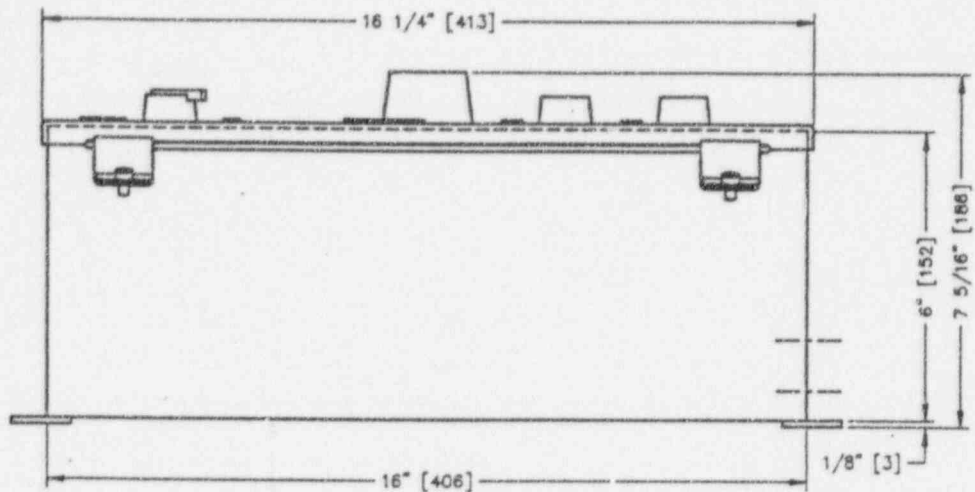
IN YOUR 12.00

ON DEMAND.

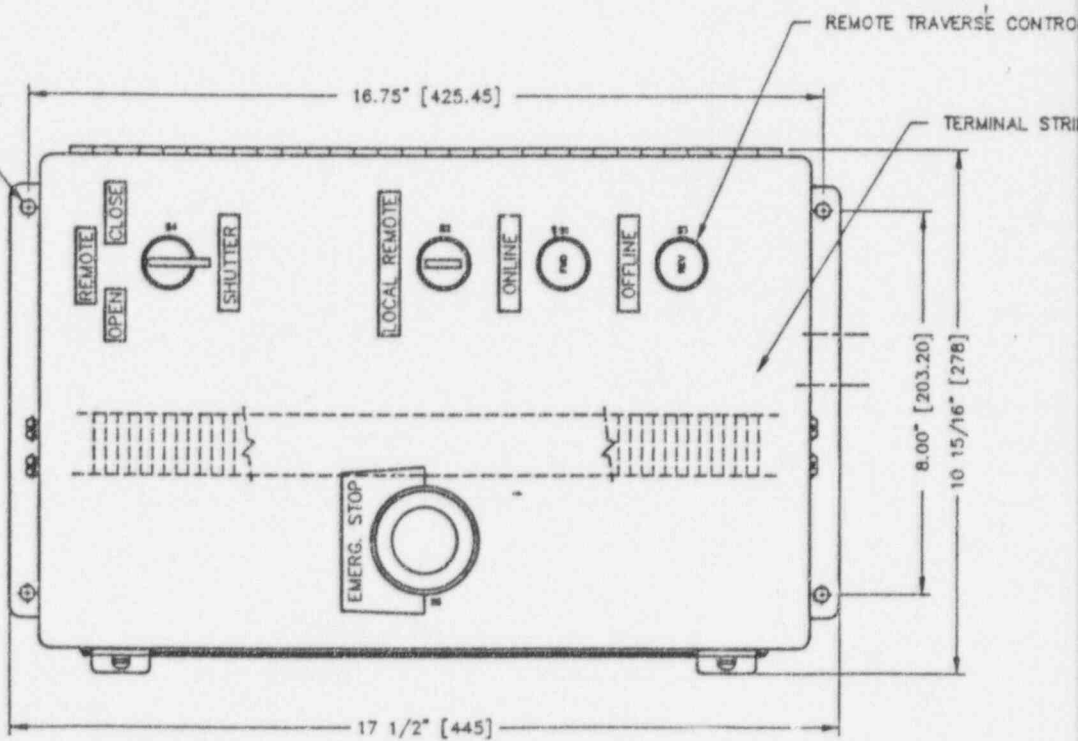
LEI 64.3

8.3	94.7
8.4	91.9

703	0.5.5
-----	-------

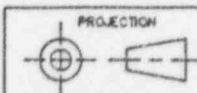


0.31" [7.9] DIA.  
4X.

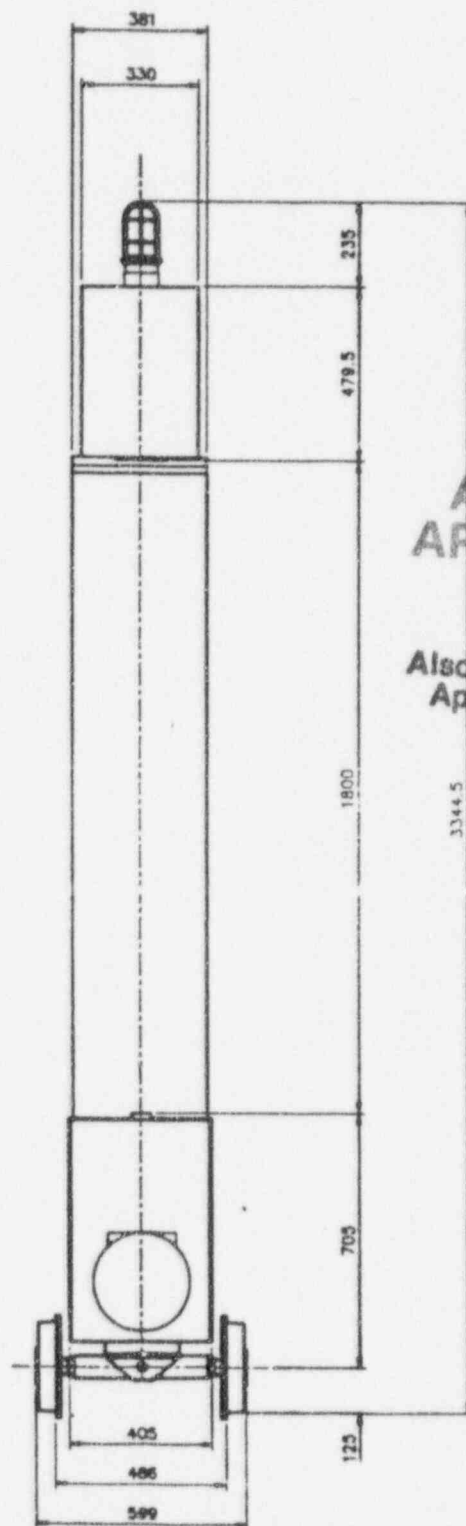
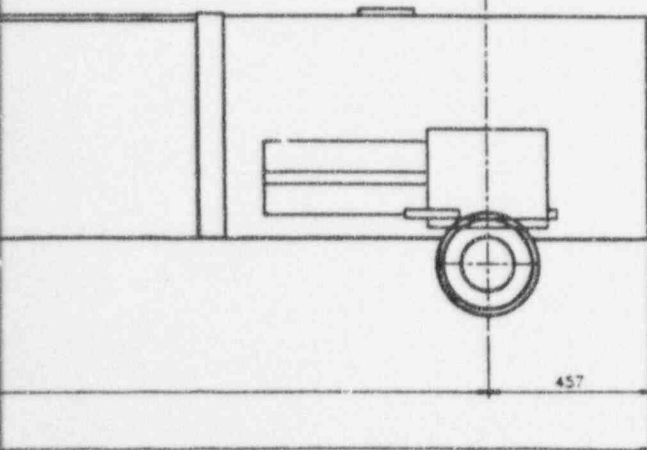
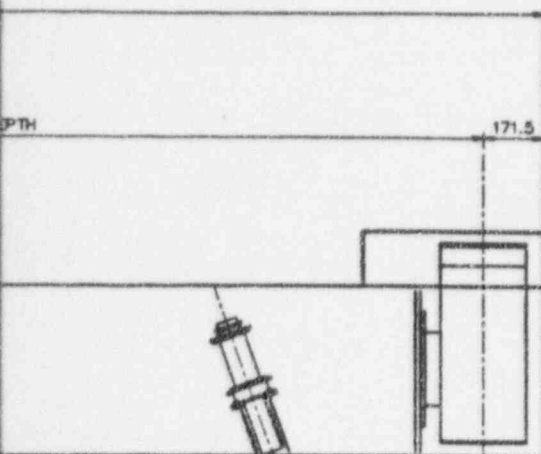


NOTES:

1. HOFFMAN NEMA 12 ENCLOSURE #A-16106CH.
2. DIMENSIONS IN [ ] ARE IN MILLIMETERS.



TOLERANCES  
OTHERWISE  
LINEAR  
4 DEC. PL.  
3 DEC. PL.  
2 DEC. PL.  
FRACTIONAL  
AN



**ANSTEC  
APERTURE  
CARD**

Also Available on  
Aperture Card

MILLIMETRE		NOTICE				DATA MEASUREMENT	
1/16" = 1.5875 1/8" = 3.175 3/16" = 4.7625 1/4" = 6.35 5/16" = 7.9375 3/8" = 9.525 7/16" = 11.1125 1/2" = 12.7 9/16" = 14.2875 5/8" = 15.875 11/16" = 17.4625 3/4" = 19.05 13/16" = 20.6375 7/8" = 22.225 15/16" = 23.8125 1" = 25.4		THIS DRAWING AND THE SUBJECT MATTER HEREON IS THE PROPERTY OF DATA MEASUREMENT CORPORATION. IT MUST NOT BE USED OR COPIED IN ANY WAY EXCEPT IN CONNECTION WITH THE INSTALLATION OR ORDER FOR WHICH IT WAS SUPPLIED. IT MUST NOT BE LOANED TO OTHER PARTIES WITHOUT THE WRITTEN AUTHORIZATION OF DATA MEASUREMENT CORPORATION.		SCALE 1 : 10 DATE 1 JUN 93 TITLE		APPROVED BY: <i>[Signature]</i> DRAWN BY: I.H. REVISED:	
		C 94-2232 I.H. B 93-2487 I.H. A 93-1805 I.H.		HOT MILL 450 TCC GAUGE OUTLINE			
		REV E.C.M.		DRAWN BY DATE APPROVED BY		FILE # 95086301 SIZE D DRAWING # C20001-07 SHEET 1 OF 2	

9704150016-02

124025

J. CASANOVA

3000 THROAT

930.5

613

457

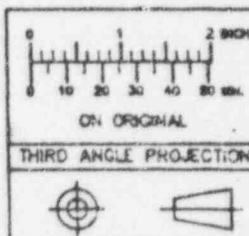
3473.5

4388

NOTES :

1. WHEEL SPECIFICATIONS : 285mm FLANGE O.D.  
250 mm TREAD
2. RECOMMENDED CLEARANCE BETWEEN RAIL  
AND WHEEL FLANGE IS 4.5mm

# TYPICAL

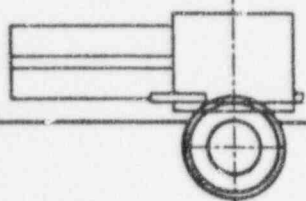


TOLERANCES	
ON ALL DIMENSIONS	
UNLESS SHOWN	± 0.005
0.005 TO 0.010	± 0.002
0.010 TO 0.020	± 0.001
0.020 TO 0.050	± 0.0005
0.050 TO 0.100	± 0.0002
ON DECIMAL DIMENSIONS	
0.01	± 0.001
0.1	± 0.003
1	± 0.010
10	± 0.030



DEPTH

171.5



457

381

330

235

478.5

1800

705

125

405

486

599

ANSTEC  
APERTURE  
CARD

Also Available on  
Aperture Card

3344.5

<p>MILLIMETRE</p> <p>CONVERSION TABLE</p> <p>INCHES TO MILLIMETRES</p> <p>1/16" = 1.5875</p> <p>1/8" = 3.175</p> <p>3/16" = 4.7625</p> <p>1/4" = 6.35</p> <p>5/16" = 7.9375</p> <p>3/8" = 9.525</p> <p>7/16" = 11.1125</p> <p>1/2" = 12.7</p> <p>5/8" = 15.875</p> <p>3/4" = 19.05</p> <p>7/8" = 22.225</p> <p>1" = 25.4</p>		<p>NOTICE</p> <p>THIS DRAWING AND THE SUBJECT MATTER ILLUSTRATED IS THE PROPERTY OF DATA MEASUREMENT CORPORATION. IT MUST NOT BE USED OR COPIED IN ANY WAY EXCEPT IN CONNECTION WITH THE INSTALLATION OR ORDER FOR WHICH IT WAS SUPPLIED. IT MAY NOT BE DIVULGED TO OTHER PARTIES WITHOUT THE WRITTEN AUTHORIZATION OF DATA MEASUREMENT CORPORATION.</p>		<p>DATA MEASUREMENT</p> <p>SCALE: 1" = 10"</p> <p>DATE: 1 JAN 82</p> <p>TITLE: HOT MILL 450 TCC GAUGE OUTLINE</p> <p>FILE NO: 93086301</p> <p>DRAWING NO: D</p> <p>REV: E.C.R.</p> <p>DRAWN BY: DATE: APPROVED BY:</p>		<p>APPROVED BY: <i>John Hunt</i></p> <p>DRAWN BY: I.M.L.</p> <p>REVISED:</p> <p>C20001-07</p> <p>SHEET 1 OF 2</p>	
C	84-2232	I.H.					
B	83-2487	I.H.					
A	93-1805	I.H.					

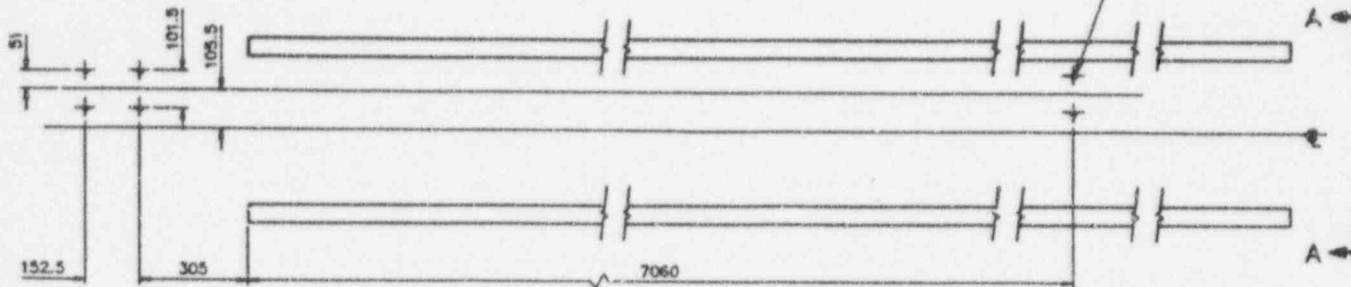
9704150016-02

124025

D-C20001-07

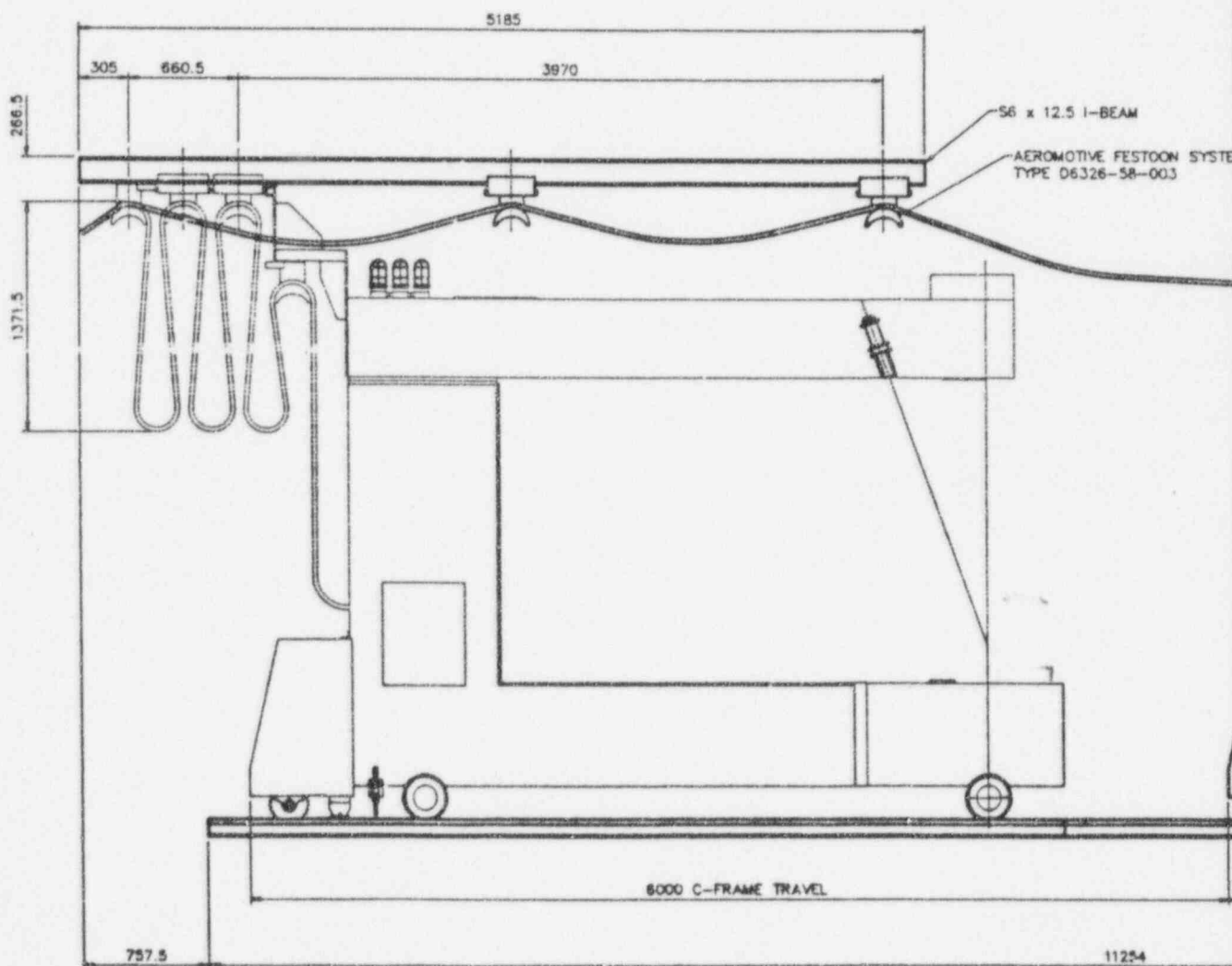
DRAWING NO.

DRILL & TAP 3/8-16,  
GRADE 5 SAE HEX BOLTS  
TYPICAL 6 PLACES

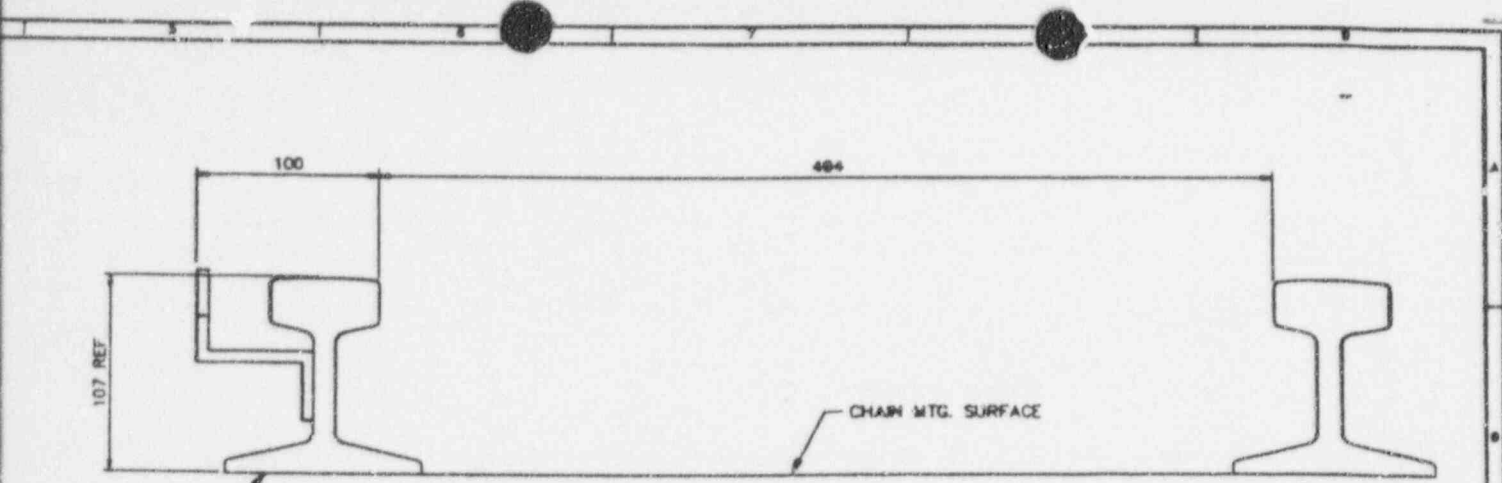


### CHAIN MTG. DETAILS

SCALE: 1=10



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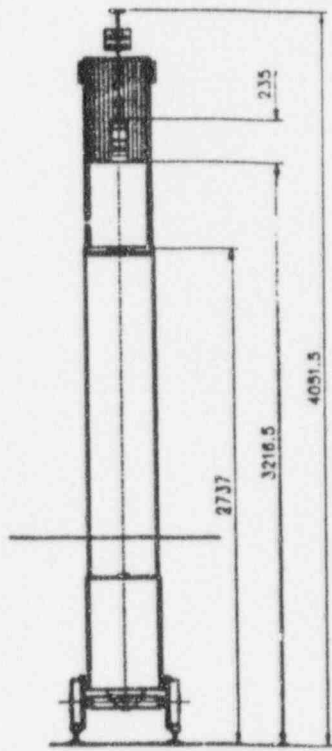
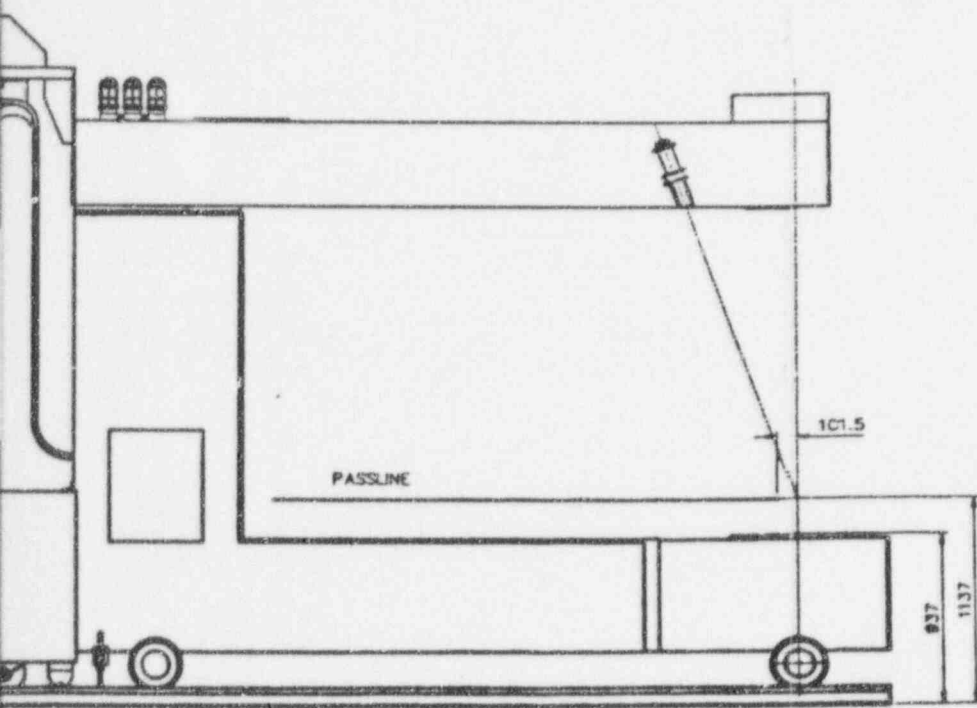


24 Kg/m LIGHT RAIL  
OR EQUIVALENT  
(CUSTOMER SUPPLIED)

VIEW A-A  
SCALE: 1=2

**ANSTEC  
APERTURE  
CARD**

Also Available on  
Aperture Card

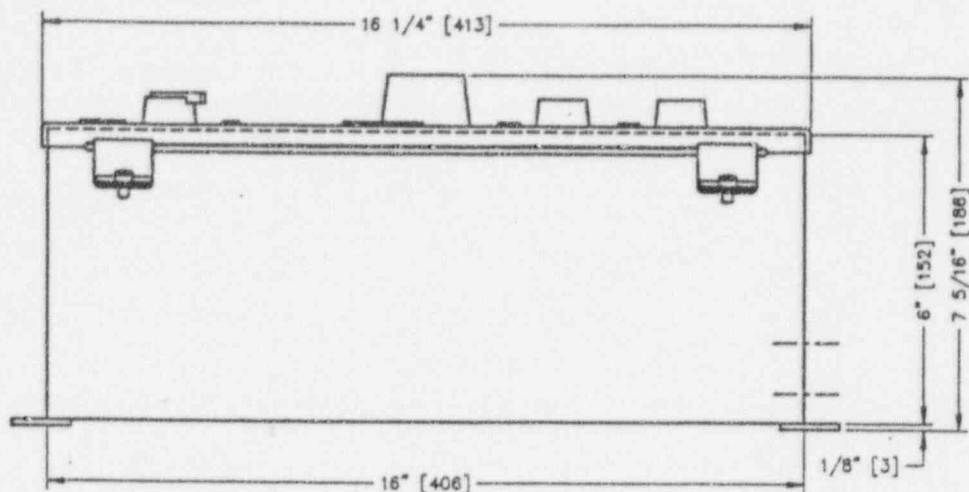


**TYPICAL**

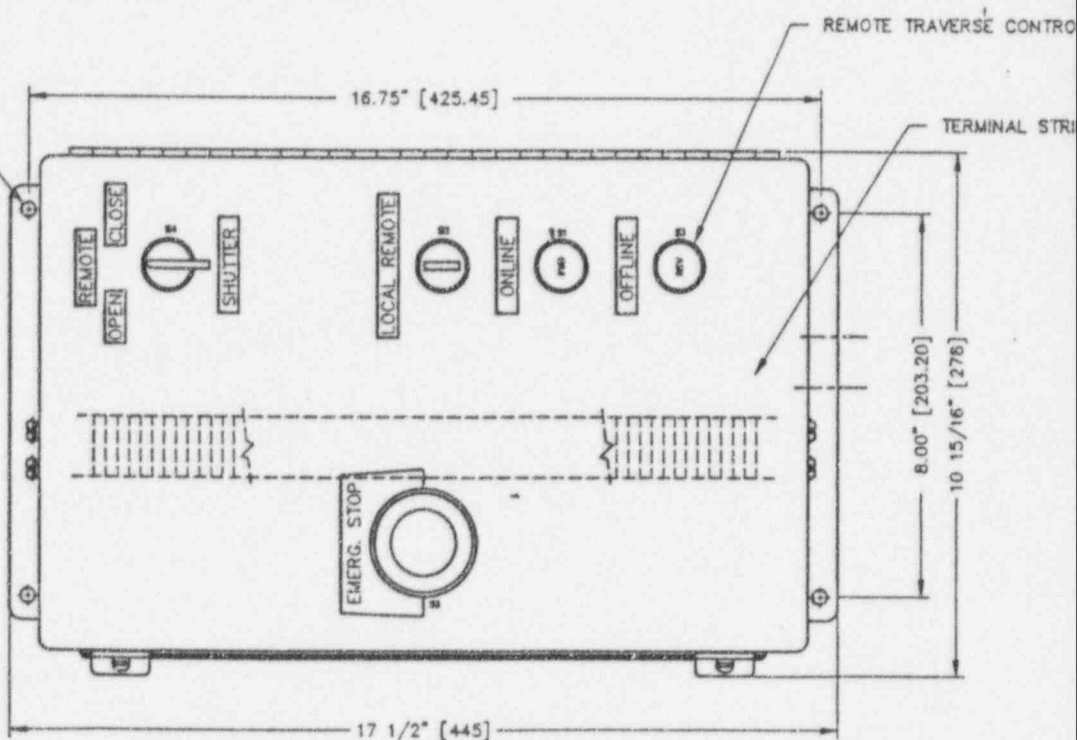
NOTICE		DATA MEASUREMENT				
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		C	94-2232	L.H.		
		B	93-2487	L.H.		
		A	93-1805	L.H.		
<p>SCALE: 1:20 DATE: 1 APR 83 FILE:</p>		<p>APPROVED BY: <i>Ch. Hart</i> HOT MILL 450 TCC GAUGE OUTLINE C20001-07</p>				

9704150016-03

24025



0.31" [7.9] DIA.  
4X.



NOTES:

1. HOFFMAN NEMA 12 ENCLOSURE #A-16106CH.
2. DIMENSIONS IN [ ] ARE IN MILLIMETERS.



TOLERANCES  
OTHERWISE  
LINEAR  
4 DEC. PL.  
3 DEC. PL.  
2 DEC. PL.  
FRACT.  
A



9/16" [14]

10 1/4" [261]

R10 1/4" [260]

10" [254]

**ANSTEC  
APERTURE  
CARD**

Also Available on  
Aperture Card

**TYPICAL**

UNLESS SPECIFIED		NOTICE					DATA MEASUREMENT																		
TOLERANCES		THIS DRAWING AND THE SUBJECT MATTER ILLUSTRATED IS THE PROPERTY OF DATA MEASUREMENT CORPORATION. IT MUST NOT BE USED OR COPIED IN ANY WAY EXCEPT IN CONNECTION WITH THE INSTALLATION OR ORDER FOR WHICH IT WAS SUPPLIED. IT MAY NOT BE DIVULGED TO OTHER PARTIES WITHOUT THE WRITTEN AUTHORIZATION OF DATA MEASUREMENT CORPORATION.					<table border="1"> <tr> <td>SCALE: 1/2=1</td> <td>APPROVED BY:</td> <td>DRAWN BY: C.W.</td> </tr> <tr> <td>DATE: 8-23-93</td> <td><i>[Signature]</i></td> <td>REVISED:</td> </tr> <tr> <td colspan="3">TITLE: DRIVE AND CUTOUT STATION OUTLINE</td> </tr> <tr> <td>FILE #</td> <td>SIZE</td> <td>DRAWING #</td> </tr> <tr> <td>93099400</td> <td>D</td> <td>D-C30006-02 SHIT 1 of 1</td> </tr> </table>				SCALE: 1/2=1	APPROVED BY:	DRAWN BY: C.W.	DATE: 8-23-93	<i>[Signature]</i>	REVISED:	TITLE: DRIVE AND CUTOUT STATION OUTLINE			FILE #	SIZE	DRAWING #	93099400	D	D-C30006-02 SHIT 1 of 1
SCALE: 1/2=1	APPROVED BY:	DRAWN BY: C.W.																							
DATE: 8-23-93	<i>[Signature]</i>	REVISED:																							
TITLE: DRIVE AND CUTOUT STATION OUTLINE																									
FILE #	SIZE	DRAWING #																							
93099400	D	D-C30006-02 SHIT 1 of 1																							
± 0.005		C	94-3891	JLT	10/14	2 7.4'																			
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± 0.030		A	93-1843	C.W.		7																			
± 0.06		REV.	E.C.N.	DRAWN BY	DATE	APPROVED BY																			
± 1"																									

9704150016-04

124025

## NOTES:

ELECTRICAL

1. POWER REQUIREMENTS — 110/120 VAC, 4.0 AMPS, NOMINAL (3.0 AMPS MIN.) 50/60 Hz OR 220/240 VAC, 2.0 AMPS, NOMINAL (1.5 AMPS MIN.) 50/60 Hz  
(SEE SYSTEM BLOCK DIAGRAM FOR PROPER POWER REQUIREMENTS.)
2. POWER REGULATION — UNINTERRUPTED, FILTERED AND REGULATOR POWER ( $\pm 10\%$ ), SUITABLE FOR COMPUTER EQUIPMENT.
3. POWER CONNECTION — SCREWDOWN TERMINAL BLOCKS.
4. INTERCONNECTIONS — SCREWDOWN TERMINAL BLOCKS.
5. CABLE ENTRANCE THRU REMOVABLE, GASKETED GLAND PLATE ON BOTTOM OF CABINET.

ENVIRONMENTAL

1. TEMPERATURE —  
OPERATING — 32° F TO 80° F (0° C TO 26.7° C)  
NON-OPERATING — -40° F TO 140° F (-40° C TO 60° C)
2. HUMIDITY — 5 TO 80% RELATIVE, NON-CONDENSING
3. SHOCK (11 MSEC. DURATION, SINGLE PULSE)

## MAIN ELECTRONICS CABINET

OPERATING: — 10.0 g MAX.  
NON-OPERATING: — 25.0 g MAX.

4. VIBRATION (@ 57Hz)

## MAIN ELECTRONICS CABINET

OPERATING: — 1.0g [0.006 IN/0.15 mm PEAK-PEAK] MAX.  
NON-OPERATING: — 2.5g [0.015 IN/0.38 mm PEAK-PEAK] MAX.

MECHANICAL

1. TOTAL WEIGHT OF THE CABINET IS 550 LBS. [249 Kg.].
2. DOOR HINGES MAY BE MOUNTED ON EITHER SIDE OF EQUIPMENT.
3. SIDE PANELS ARE REMOVABLE.

4. FRONT AND REAR ACCESS REQUIRED FOR FULL ACCESS TO ALL COMPONENTS. CONSULT DMC ENGINEERING FOR SPECIAL ACCESS REQUIREMENTS.

R23 17/32" [598] CLEARANCE  
FOR FRONT

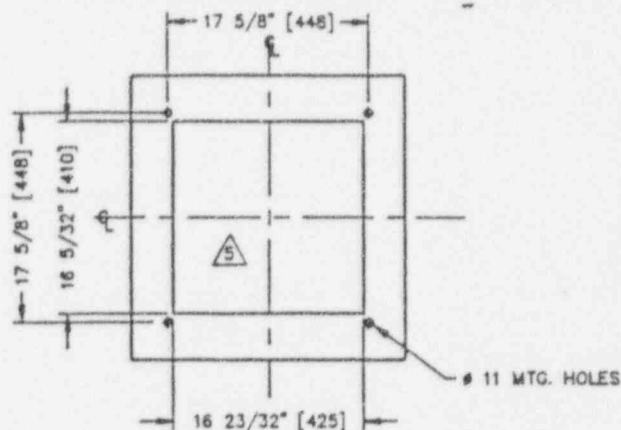
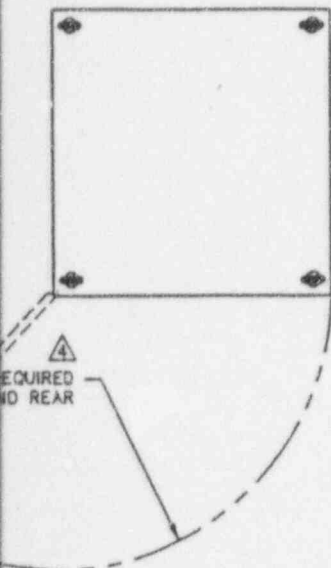
OPERATOR TERMINAL —  
CAN BE RACK MOUNTED  
IN SPACE PROVIDED.

IBM COMPATIBLE INDUSTRIAL —  
COMPUTER

FRONT DOOR REMOVED —  
FOR CLARITY



TOLERANCE  
OTHER  
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2 DEC

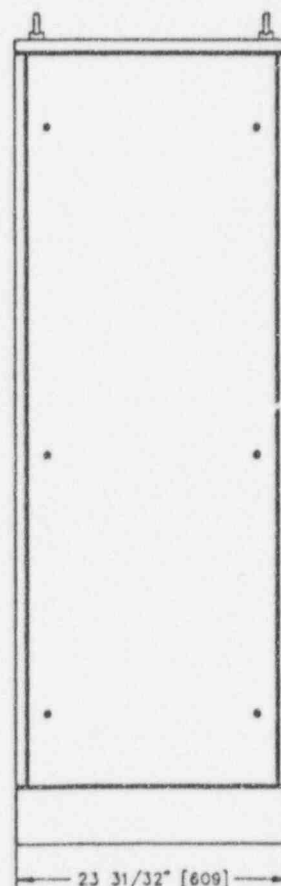
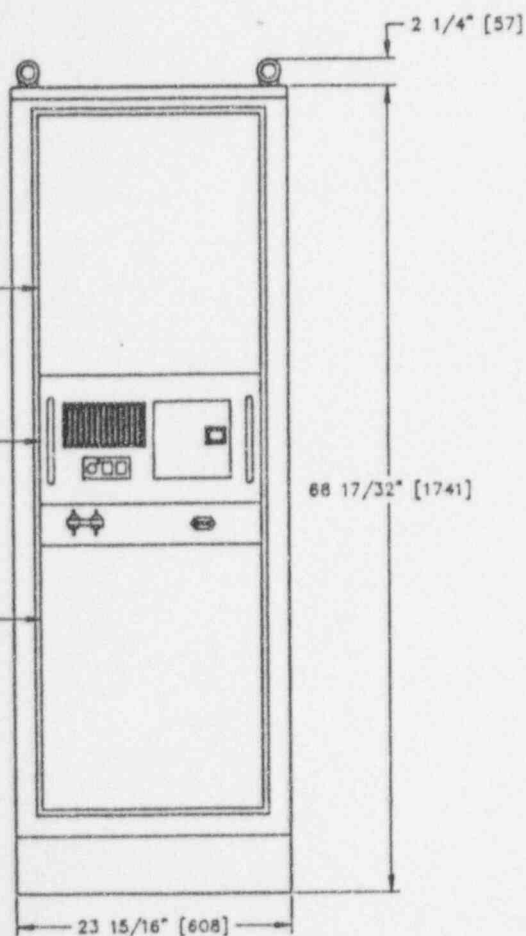




BOTTOM VIEW

ANSTEC  
APERTURE  
CARD

TYPICAL

Also Available on  
Aperture Card



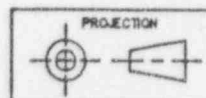
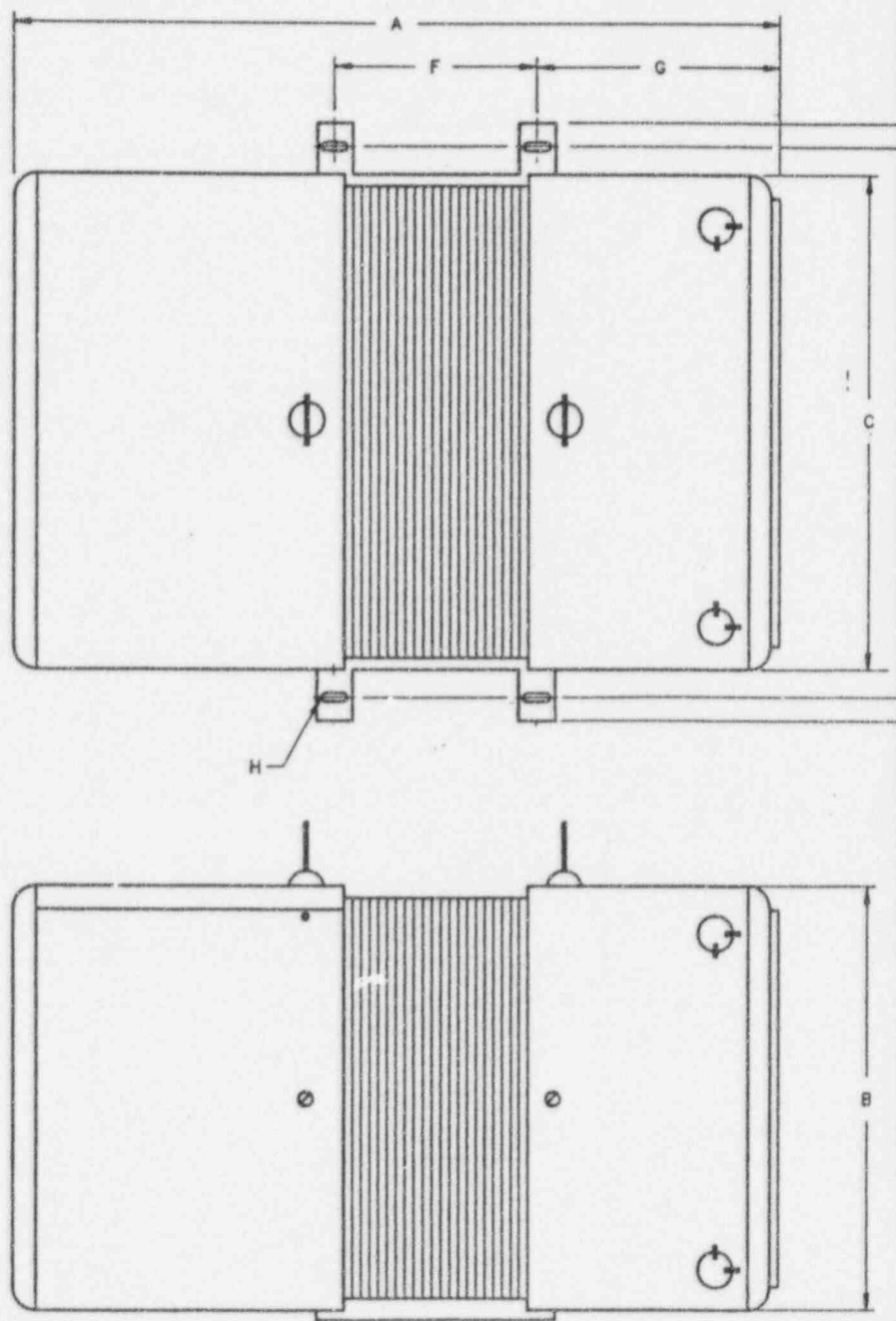
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							DATE: 2-16-94	REVISED:		
							TITLE: MAIN ELECTRONIC CABINET OUTLINE			
							FILE N° 94021700	SIZE D	DRAWING N° C30002-09	SHT 1 of 1
DIMENSIONS										
SIZES	± 0.005									
SIZES	± 0.010									
SIZES	± 0.030	B	95-5424	JT	11/13/95	A - 				
CTIONS	± 0.08	A	94-0685	C.HUNT						
ANGLE	± 1°	REV.	E.C.N.	DRAWN BY	DATE	APPROVED BY				

9704150016-05

124025

D13066

DRAWING NO.



TOLERA  
OTHERW  
LINEA  
4 DEC. P  
3 DEC. P  
2 DEC. P  
FRA



APPROXIMATE SHIPPING WEIGHT (LBS) (Kg)	MAXIMUM OUTPUT VA RATING	FREQUENCY (Hz)	NOMINAL OUTPUT VOLTAGE (VAC)	INPUT VOLTAGE RANGE (VAC)	DMC NUMBER	DIMENSIONS IN INCHES AND [MM]							
						A	B	C	D	E	F	G	H
39.8 [18.0]	500	50 Hz	110 X 120 X 220 X 240	110-120 X 220-240 X 380-415	18048-002	13.25 [336.6]	6.38 [162.1]	7.74 [196.7]	9.00 [228.6]	8.12 [206.24]	5.82 [142.74]	3.59 [91.2]	.31 X .81 [7.9 X 20.57]
37 [16.8]	500	60 Hz	120 X 208 X 240	95-130 X 175-235 X 190-260 X 380-520	18052-001	12.69 [322.32]	6.44 [163.57]	7.78 [197.81]	9.00 [228.6]	8.12 [206.24]	5.82 [142.74]	3.06 [77.72]	.38 X .81 [9.65 X 20.57]

NOTES:

1. SINGLE PHASE.
2. OPERATING TEMPERATURE RANGE:  
-20°C TO +50°C  
-4°F TO 122°F

**ANSTEC  
APERTURE  
CARD**

Also Available on  
Aperture Card

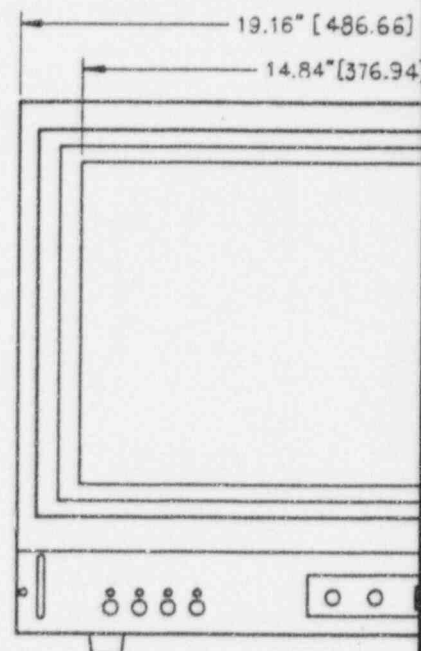
**TYPICAL**

DIMENSIONS UNLESS SPECIFIED DIMENSIONS .005 .010 .030 .06 1"	<b>NOTICE</b> THIS DRAWING AND THE SUBJECT MATTER ILLUSTRATED IS THE PROPERTY OF DATA MEASUREMENT CORPORATION. IT MUST NOT BE USED OR COPIED IN ANY WAY EXCEPT IN CONNECTION WITH THE INSTALLATION OR ORDER FOR WHICH IT WAS SUPPLIED. IT MAY NOT BE DIVULGED TO OTHER PARTIES WITHOUT THE WRITTEN AUTHORIZATION OF DATA MEASUREMENT CORPORATION.				<b>DATA MEASUREMENT</b>			
	E	94-4117	RAA	11/4/94	SCALE: 1/2"=1"		APPROVED BY: <i>[Signature]</i>	DRAWN BY: C.W.
	D	94-3044	RAA	8/1/94	DATE: 10-24-90		REVISED:	
	C	94-2364	RAA	4/1/94	TITLE: INSTALLATION OUTLINE SOLA LINE VOLTAGE REGULATOR (500 VA)			
	B	93-3163	JJT		FILE # 90101000 SIZE D DRAWING # 13066			
A	90-1565	C.W.		SHEET 1 OF 1				
REV.	E.C.N.	DRAWN BY	DATE	APPROVED BY				

9704150016-06

124025

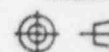
00-9600SY 0



NOTES:

1. AYDIN CONTROLS PATRIOT MODEL 9001/9003.
2. SPECIFICATIONS:
  - RESOLUTION UP TO 800 X 600 (SUPER VGA).
  - 20" [508MM] CRT
  - 15 TO 38KHz AUTO-SYNC HORIZONTAL SCAN.
  - 40 TO 120KHz AUTO SYNC VERTICAL SCAN.
  - 90 TO 264VAC, 47 TO 63Hz, 120 WATTS.
  - OPERATING TEMPERATURE 0° TO 50°C
  - STORAGE TEMPERATURE -30°C TO +60°C.
  - RELATIVE HUMIDITY 0 TO 95% NO CONDENSATION.
  - WEIGHT: 60LBS [27.2K].
3. [ ] IN MILLIMETERS.

PROJECTION



Also Available on  
Aperture Card



9704150016-017

1 2 4 0 2 5

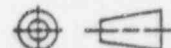
## NOTES:

## ELECTRICAL

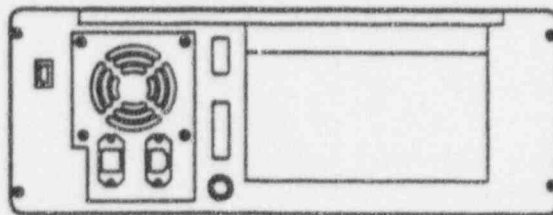
	OPERATING	NON-OPERATING
TEMPERATURE	0° TO 45° (32° TO 113°F)	0° TO 70° (32° TO 158°F)
HUMIDITY	10% TO 90%, NON-CONDENSING	5% TO 95%, NON-CONDENSING
SHOCK	1G @ 11MS DURATION	10G @ 11MS DURATION
VIBRATION	.5G @ 5-200 Hz	2G @ 5-200 Hz
ALTITUDE	0 TO 15,000 FT. (3000m)	0 TO 50,000 FT.
POWER	N/A	230VAC/115VAC, 1Φ 500VA PEAK, 300VA TYPICAL

TOLERANCES  
OTHERWISE SPECIFIED
 LINEAR DIMENSIONS  
 4 DEC. PLACES  
 3 DEC. PLACES  
 2 DEC. PLACES  
 FRACTIONS  
 ANGLES

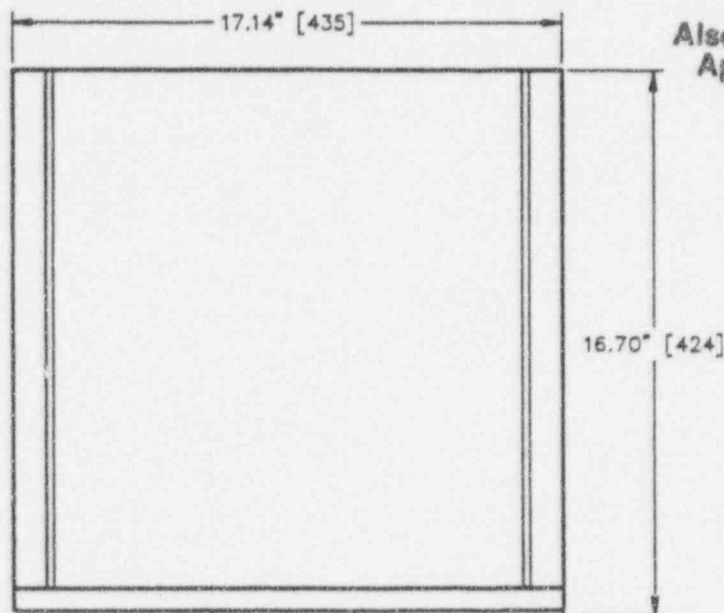
PROJECTION



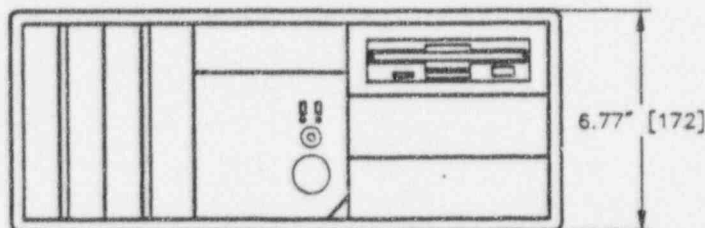




# ANSTEC APERTURE CARD



Also Available on  
Aperture Card



## TYPICAL

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							SCALE: 1/4"=1"		APPROVED BY: <i>[Signature]</i>		DRAWN BY: J.T.	
							DATE: 06-09-95				REVISED:	
							TITLE: COMPUTER OUTLINE (DESKTOP)					
	A 95-2514 J.T. <i>[Signature]</i>						FILE # 95081600		SIZE C		DRAWING # A30116-02	
REV.		E.C.A.		DRAWN BY		DATE		APPROVED BY		SHT 1 of 1		

9704150016-08

124025

C-A30115-00

NOTES:

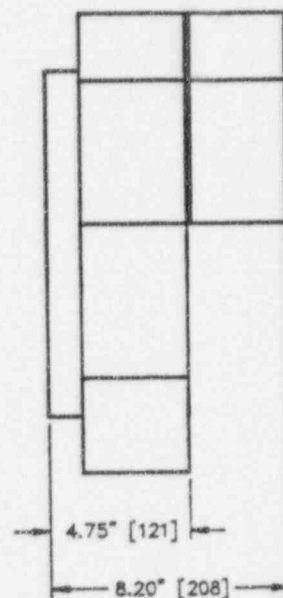
OPERATING ENVIRONMENT

MAXIMUM OPERATING TEMPERATURE:  
41° (5°C) TO 104°F (35°C)

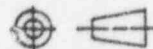
RECOMMENDED OPERATING FOR BEST PRINT QUALITY:  
59°F (15°C) TO 95°F (35°C)

STORAGE TEMPERATURE: -40°F (-40°C) TO 140°F (60°C)

HUMIDITY: 10-80% RH NON-CONDENSING

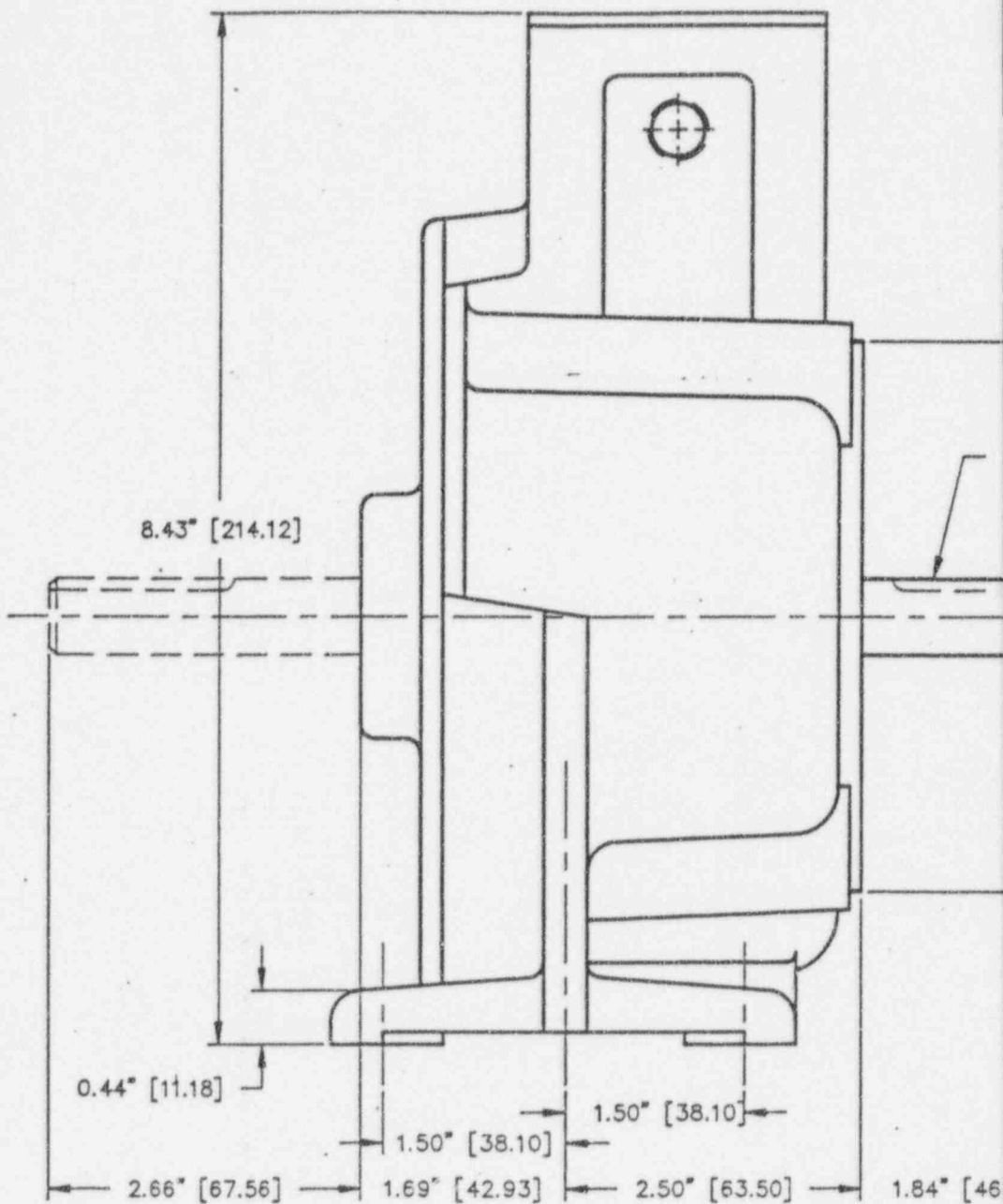


PROJECTION



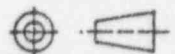
TOLERANCE  
OTHER  
DIMENSIONS  
UNLESS  
SPECIFIED  
4.00  
3.00  
2.00





NOTE: HEAVY DUTY FOOT MOUNT  
(COMPATIBLE WITH NEMA 56 AND 56C HARDWARE.)  
DIMENSION IN [ ] ARE METRIC

PROJECTION



TOLERANCE  
OTHERWISE  
UNLESS OTHERWISE  
SPECIFIED  
4 DEC. PL.  
3 DEC. PL.  
2 DEC. PL.  
PRACTICE  
AND



1/2 PIPE TAP FOR LEAD OUTLET-  
STANDARD ON ALL UNITS

**ANSTEC  
APERTURE  
CARD**

Also Available on  
Aperture Card

3/8 16 x .82 [15.7] DEEP  
4 MTG. HOLES ON  
8 7/8 [149.2] DIA CENTER

88 x .094, KEYWAY  
4.8 x 2.4]

4.50" [114.30] DIA

0.6246" [15.86]  
DIA

3.50" [88.90]

4 SLOTS,  
.34 [8.6] W. x .90 [22.9] LG.

2.50" [63.50]

2.50" [63.50]

6.66" [169.16]

**TYPICAL**

# NOTICE

UNLESS  
SPECIFIED  
TOLERANCES  
ARE:

±0.005  
±0.010  
±0.030  
±0.06  
±1"

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REV.	A	91-0261	C.W.	DATE	APPROVED BY

## DATA MEASUREMENT

SCALE: 1=1	APPROVED BY: <i>[Signature]</i>	DRAWN BY: C.W.
DATE: 2-15-91	REVISED:	
TITLE: PULSE TYPE TACHOMETER INSTALLATION OUTLINE		
FILE # 91015600	SIZE C	DRAWING # C60001-00
		SHEET 1 OF 1

9704150016-10

124025

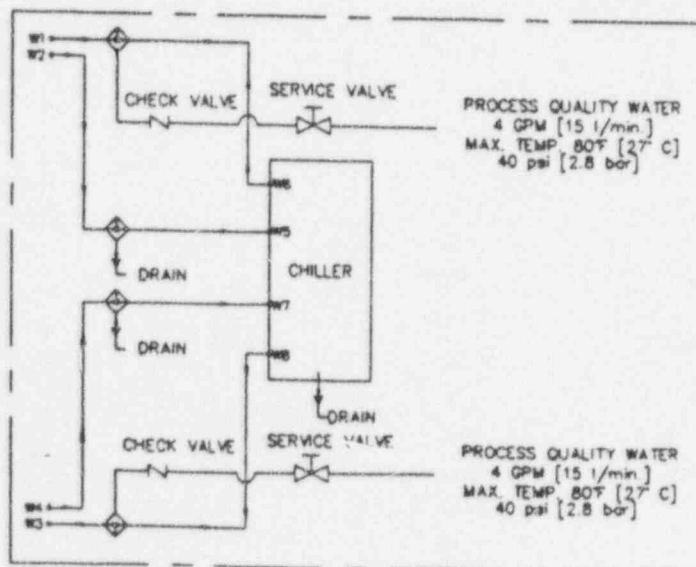
## NOTES:

1. COOLING CAPACITY BASED ON 65°F [18°] SUPPLY WATER TEMPERATURE AND 80°F [27°] AMBIENT AIR TEMPERATURE
2. A. COOLANT FLOW SUPPLY AT ANY PRESSURE 15-95 PSI [1.0-6.6 BAR] 210 GPM [795 LPH] PER CIRCUIT FOR SOURCE AND OR DETECTOR COOLING SUPPLY & RETURN CONNECTION SIZE: 1/2" NPTF FOR SOURCE AND DETECTOR  
B. COOLANT FLOW SUPPLY AT ANY PRESSURE 15-95 PSI [1.0-6.6 BAR] 550 GPM [2088 LPH] FOR C-FRAME COOLING JACKETS IF REQD. SUPPLY & RETURN CONNECTION SIZE: 3/4" NPTF FOR C-FRAME COOLING JACKETS
3. PROPER MAINTENANCE, INSPECTION, AND FILLING OF COOLANT TANK REQUIRES ACCESS TO THE TOP OF THE TANK. THIS SHOULD BE KEPT IN MIND WHEN CHOOSING LOCATION. A MINIMUM SPACING OF 12" (305) FROM OBSTRUCTIONS, FRONT AND BACK, IS RECOMMENDED FOR OPTIMUM PERFORMANCE.
4. THIS DRAWING SHOWS OPTIONS FOR TWO SEPARATE COOLING CIRCUITS
5. AMBIENT OPERATING TEMP.  
45°F - 120°F [7.1-49°C] MAX. STD.  
35°F - 120°F [1.6-49°C] MAX. OPTIONAL LOW TEMP UNIT
6. STANDARD POWER, 208/230 VOLTS 1 PHASE (EXCEPT R250 - R750 208/230 OR 460 VOLTS 3 PHASE) CONSULT DMC FOR 50 HZ.
7. NON-FERROUS MATERIALS SHOULD BE USED FOR ALL COMPONENTS IN COOLING SYSTEM. PIPING SHOULD BE INSULATED TO PREVENT HEAT LOSS OR GAIN TO THE CHILLER. A FLEXIBLE CELLULAR SLIDE-ON TUBING SUCH AS "ARMAFLEX" (MFG. BY ARMSTRONG) IS RECOMMENDED
8. A CONTACT RELAY FOR FLOW SWITCH AND OVER TEMP. THERMOSTAT ARE AVAILABLE FOR CUSTOMER USAGE BY WIRING TO A TERMINAL BLOCK INSIDE CONTROL BOX. SEE CHILLER MANUAL FOR ADDITIONAL INFORMATION.
9. ALL CHILLERS ARE SPECIALLY DESIGNED TO SUPPLY 80°F [27°] COOLANT TO PREVENT CONDENSATION, AND ARE SHIPPED AT THIS TEMPERATURE SETTING. THIS SETTING SHOULD NOT BE CHANGED UNLESS REQD.
10. EACH CHILLER IS DESIGNED TO SUIT A PARTICULAR INSTALLATION. THEREFORE COOLANT CONNECTION POINTS, CONTROL LOCATIONS, AND FUNCTIONS MAY VARY. IT IS RECOMMENDED THAT FINAL PIPING CONNECTION POINTS BE VERIFIED ON SITE.
11. FOR WATER COOLED CHILLERS:
  - A. FOR CITY WATER, THIS UNIT REQUIRES WATER PRESSURE BETWEEN 25 AND 125 PSIG [1.72 - 8.61 BAR] AT THE UNIT. AN OPEN DRAIN CONNECTIONS SHOULD COMPLY WITH APPLICABLE LOCAL CODES. WATER CONSUMPTION WILL BE LEAST WHEN WATER IS COLDEST, GREATER WHEN WATER IS WARMER. INSTALL A HAND VALVE IN AN ACCESSIBLE LOCATION IN THE CITY WATER SUPPLY LINE FOR SERVICE. A PLUMBING "Y" STRAINER IS ALSO ADVISABLE, SUCH AS 80 MESH, TO PREVENT LARGE PARTICLES OF DIRT FROM ENTERING THE VALVE OR CONDENSER.
  - B. FOR COOLING TOWER OR CLOSED LOOP AS A SOURCE OF CONDENSER WATER, THIS UNIT REQUIRES A PRESSURE DIFFERENTIAL OF AT LEAST 25 PSI [1.72 BAR] FROM "IN" TO "OUT". A HIGH INITIAL PRESSURE ALONE WILL NOT PROVIDE ADEQUATE FLOW.
  - C. WATER FLOW THROUGH THE CONDENSER WOULD NORMALLY BE:
 

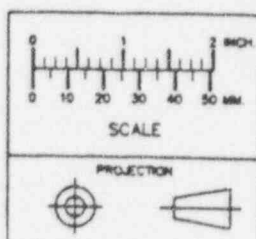
FOR 85°F [29.5°C] SOURCE: 3 GPM [11.4 LPM] PER COMPRESSOR HORSEPOWER, WHEN RUNNING.

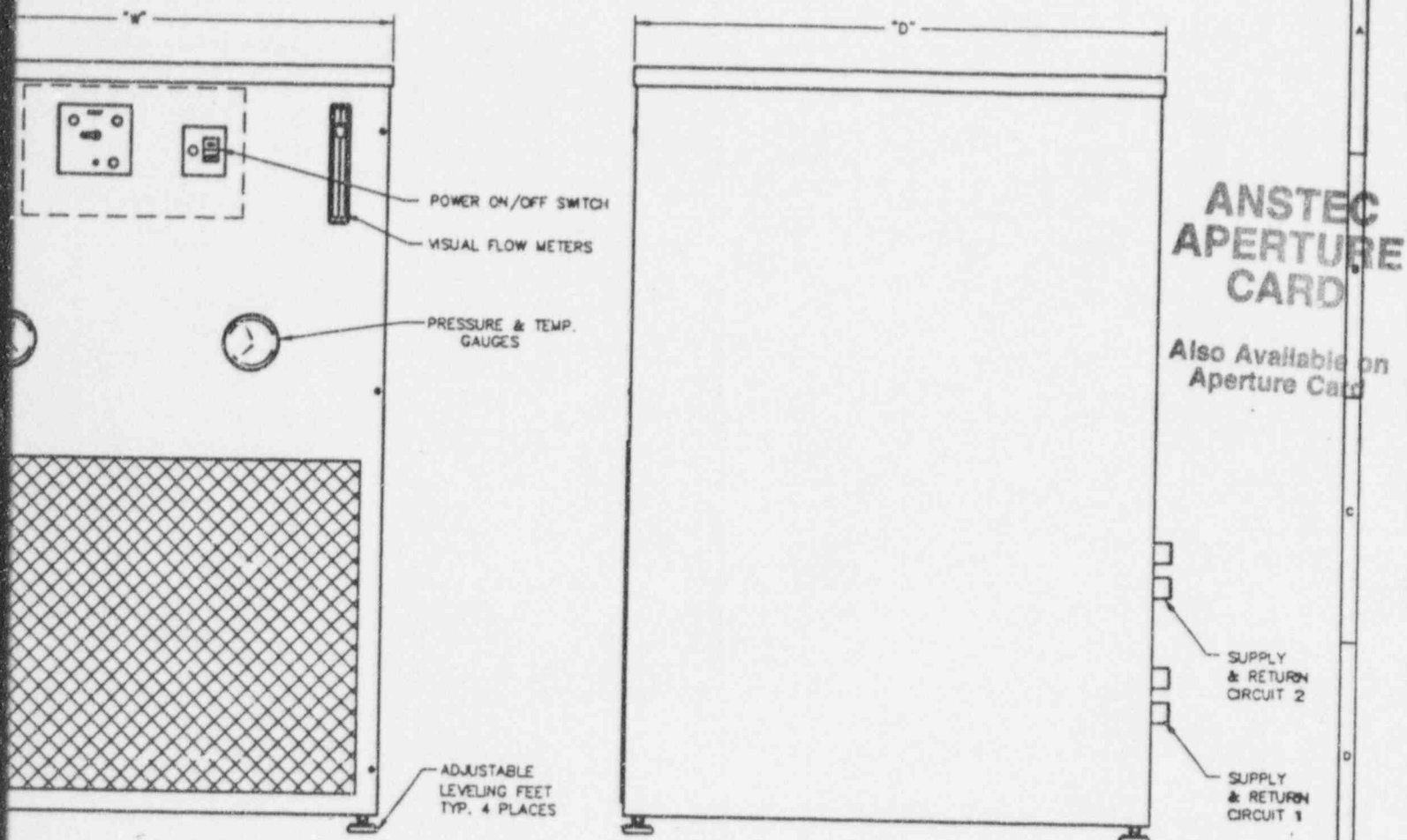
FOR 75°F [24°C] SOURCE: 1-1/2 GPM [5.7 LPM] PER COMPRESSOR HORSEPOWER, WHEN RUNNING.

FOR 65°F [18.5°C] SOURCE: 1 GPM [3.8 LPM] GPM PER COMPRESSOR HORSEPOWER, WHEN RUNNING.
12. IF HIGH AMBIENT OPTION IS INSTALLED IN THE CHILLER, THE NEXT SIZE UP CHILLER DIMENSION WILL NEED TO BE USED.



SUGGESTED INSTALLATION USING 1 CHILLER WITH 2 C-FRAMES  
 \* CUSTOMER TO SUPPLY ALL INTERCONNECT HARDWARE





	DIMENSIONS-INCHES [MM]			RESEVOIR VOLUME GALLONS [LITERS]	COOLING CAPACITY BTU/hr [WATTS]	PUMP MOTOR PER CIRCUIT (HP)	COMPRESSOR HORSEPOWER (HP)	APPROX. SHIPPING WT. LBS. [Kgs]
	W	D	H					
R050	18" [457]	27" [685]	29" [736]	5 [19]	4775 [1400]	1/3	1/2	225 [102]
R075	21" [533]	29" [736]	32" [812]	6 [23]	7500 [2200]	1/3	3/4	325 [147]
R100	21" [533]	29" [736]	32" [812]	6 [23]	10740 [3150]	1/3	1	325 [147]
R175	27" [685]	26" [660]	35" [889]	9 [34]	18750 [5500]	1/3	1.75	425 [193]
R250	35" [889]	36" [914]	49" [1244]	30 [113]	28875 [7500]	1/3	2.5	675 [307]
R300	35" [889]	36" [914]	49" [1244]	30 [113]	32400 [9500]	3/4	3.0	700 [317]
R400	47" [1193]	48" [1219]	56" [1422]	30 [113]	42625 [12500]	1	4.0	725 [329]
R500	47" [1193]	48" [1219]	56" [1422]	30 [113]	52850 [15500]	1	5.0	750 [340]
R750	47" [1193]	43" [1092]	66" [1676]	50 [189]	78425 [23000]	1.5	7.5	900 [408]

TYPICAL

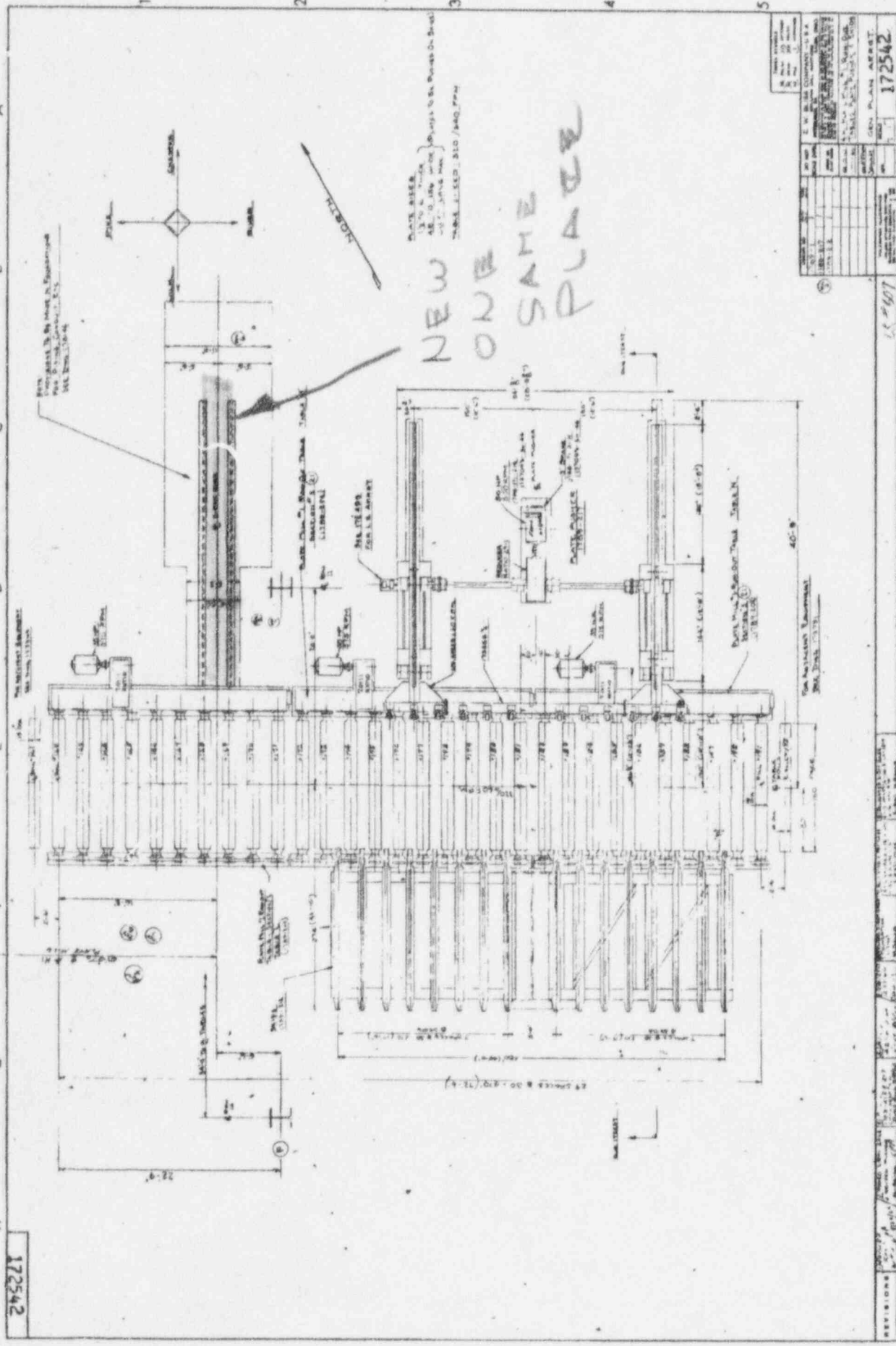
DIMENSIONS UNLESS OTHERWISE SPECIFIED  ALL DIMENSIONS PLACES ± 0.003 PLACES ± 0.010 PLACES ± 0.030 ACTIONS ± 0.01 ANGLE 0.1°	NOTICE		F	94-3065	LG.			<b>DATA MEASUREMENT</b>  SCALE: 3/16" = 1" DATE: 30 AUG. 93 TITLE: CHILLER OUTLINE FILE # 93126400 SIZE D DRAWING # A20006-01 SHEET 1 OF 1
	THIS DRAWING AND THE SUBJECT MATTER ILLUSTRATED IS THE PROPERTY OF DATA MEASUREMENT CORPORATION. IT MUST NOT BE USED OR COPIED IN ANY WAY (EXCEPT IN CONNECTION WITH THE INSTALLATION OF ORDER FOR SAME) IF WAS SUPPLIED IT MAY NOT BE DRAGGED TO OTHER PARTS WITHOUT THE WRITTEN AUTHORIZATION OF DATA MEASUREMENT CORPORATION.		E	94-1143	C.HUNT			
			D	93-3802	C.W.			
			J	95-3001	R.A.A.			
			H	95-0867	J.T.			
		G	94-3491	J.T.				
		REV	E.C.H.	DRAWN BY	DATE	APPROVED BY		

9704150016-11

124025  
DEC 16 1996

A B C D E F G H

172542



1 DEC 06 2005  
DEC 16 1996





DRILL & TAP 3/8-16,  
GRADE 5 SAE HEX BOLTS  
TYPICAL 6 PLACES

51 101.5 105.5

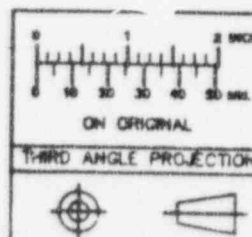
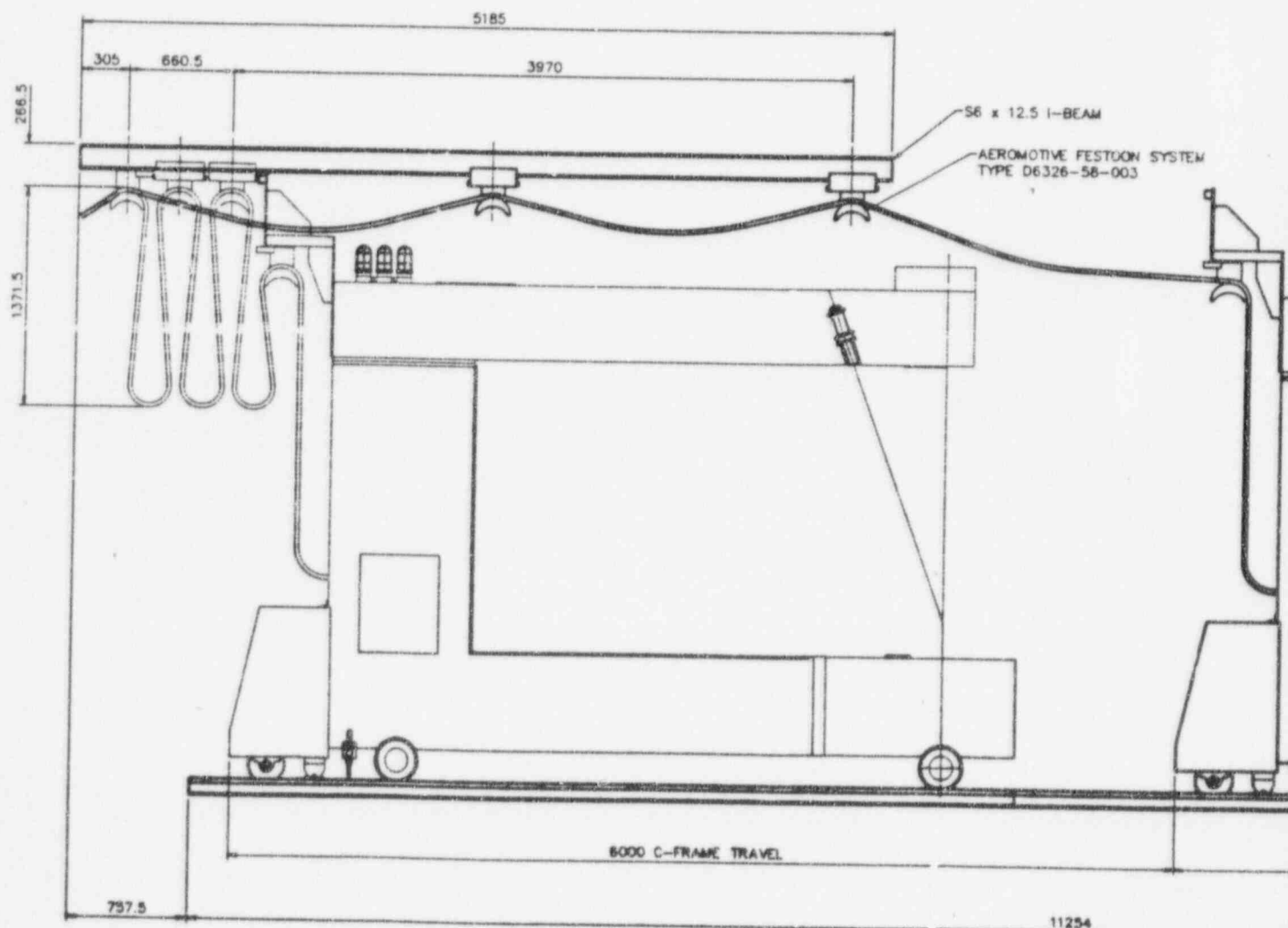
152.5 305 7060

A-A

CHAIN MTG. DETAILS

SCALE: 1"=10'

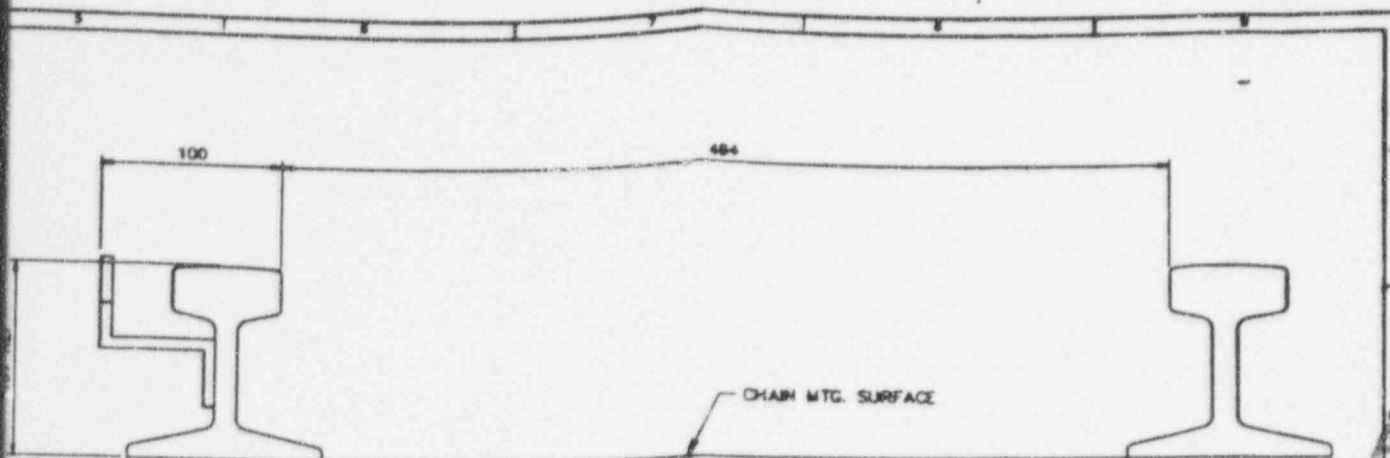
24 Kg/m  
OR  
(CUSTOMER



TOLERANCES—MILLIMETRE			
ON ALL HOLE DIMENSIONS			
0.000-0.025	0.025-0.075	0.075-0.150	0.150-
0.00	0.01	0.02	0.03
0.00-0.150	0.150-0.375	0.375-0.625	0.625-
0.01	0.02	0.03	0.04
0.00-0.500	0.500-1.000	1.000-1.500	1.500-
0.02	0.03	0.04	0.05
0.00-1.000	1.000-2.000	2.000-3.000	3.000-
0.03	0.04	0.05	0.06
0.00-2.000	2.000-5.000	5.000-10.000	10.000-
0.04	0.05	0.06	0.07
ON INTERNAL SPHERICAL SURFACES		ON ANGULAR SURFACES	
F.R.	RAL.80	MINIMUM	MAXIMUM
F.2	0.010	0.005-0.010	0.010-0.020
F.3	0.015	0.010-0.015	0.020-0.030

1 2 4 0 2 5

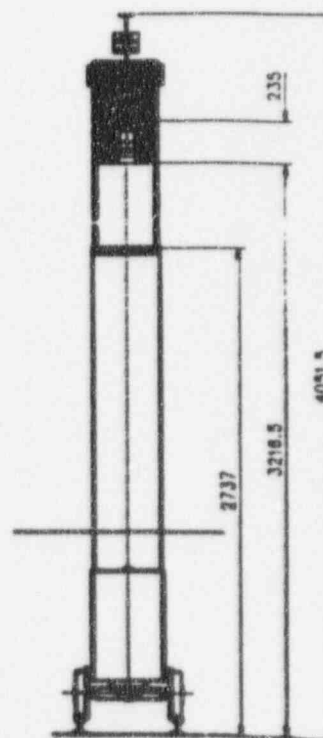
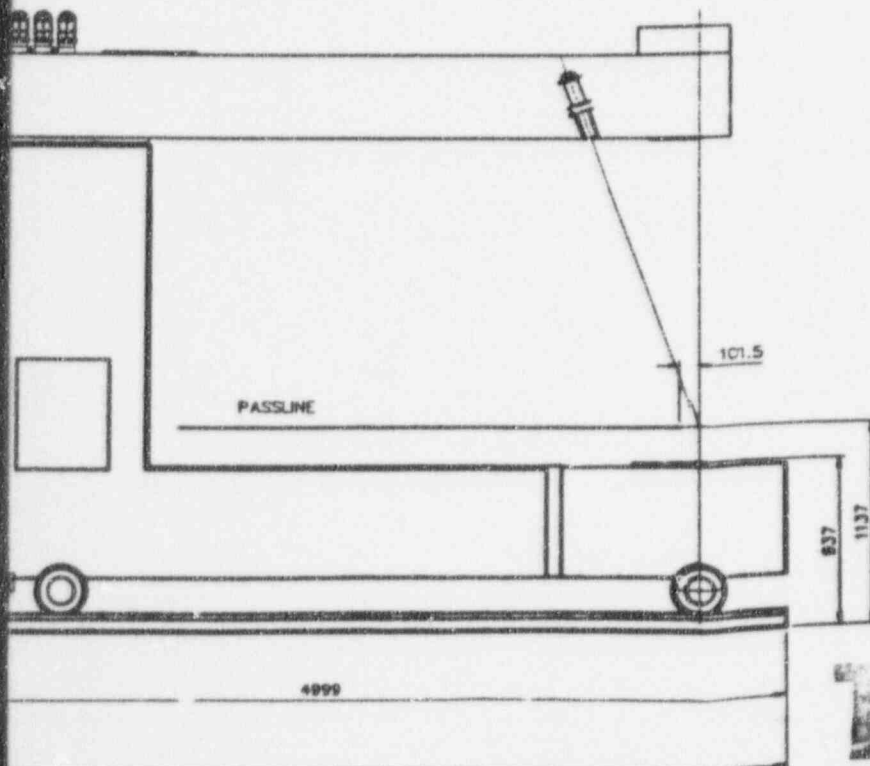
DEC 16 1996



VIEW A-A  
SCALE: 1=2

ANSTEC  
APERTURE  
CARD

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Aperture Card



TYPICAL

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REV	E.C.A.	DRAWN BY	DATE	APPROVED BY
C	94-2232	I.H.		
B	93-2487	I.H.		
A	93-1005	I.H.		

DATA MEASUREMENT

SCALE: 1 = 20	DATE: 1 APR 63	FILE: 93083305	REVISION: D	PROJECT: C20001-07
HOT MILL 450 TOC GAUGE OUTLINE				

9704150016-12 NEW 9.1

100-443887-100

ML

9704150016 \*

\*\*\*\*\* AVAILABLE THROUGH PAC FILE CENTER \*\*\*\*\*

\*\*\*\*\*

97041500 16-13-14

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are organized into three vertical columns. Each column contains eight evenly spaced horizontal lines, providing a template for handwriting practice or note-taking. There are no margins, text, or other markings on the page.



World's No. 1 Supplier  
of Non-Contact Gauges  
to the Metals Industry

**DATA  
MEASUREMENT  
CORPORATION**

# DMC 450

**Radiation Thickness and  
Basis Weight Gauges**

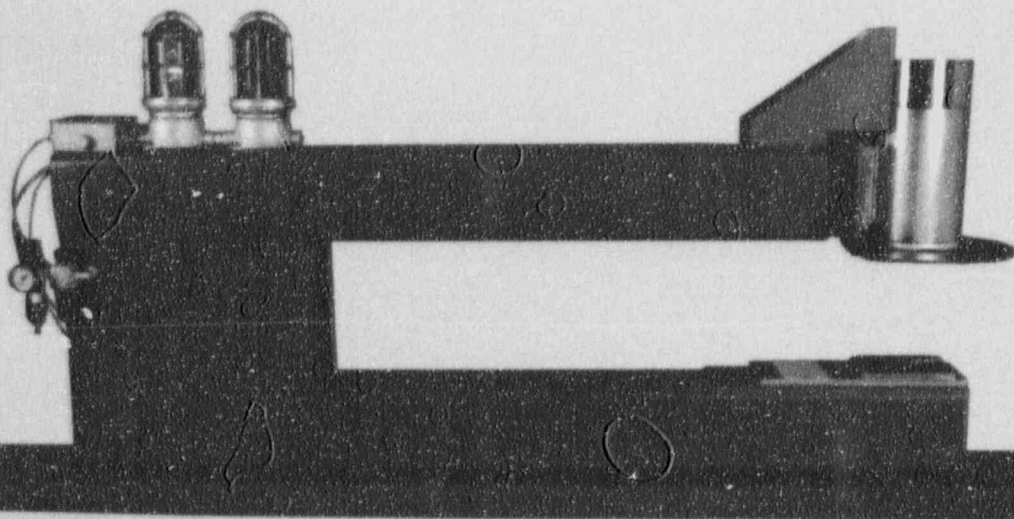


**for  
Metals**

- steel
- aluminum
- copper/brass
- coatings

**Non-Metals**

- wood fiber
- plastics
- paper
- rubber



124025



# DMC 450

## Radiation Gauging Systems

These versatile gauges are equally at home in a steel mill as on a paper line. For metals industry applications, they provide an on-line measurement of thickness of steel, aluminum and copper/brass alloys. Basis weight measurements are for non-metals applications and some coatings. The DMC 450 features a 80486DX processor on all systems.

### Principle of Measurement

#### Features include:

- *Non-contact, non-destructive continuous measurement*
- *High reliability*
- *Easy operation and maintenance*
- *Rugged construction*
- *Full width scanning or single-point measurement*
- *Simple automatic control for some processes*

The basic principle of measurement relies on the fundamental physical property of all materials in that they absorb or reflect suitably chosen radiation in certain proportions depending on the nature and thickness of the material. The choice of source and the mode of use (transmission or backscatter), depends on the nature of the material to be measured and the application requirements.

**Transmission mode** is selected where access to both sides of the material is possible. A source of radiation is placed on one side of the material and a detector on the opposite side. As the thickness of the material increases, more radiation is absorbed in the product, with a consequent reduction in the radiation falling on the detector.

A C-frame mounted on-line provides a means of moving measuring heads across the full sheet width to allow variations in thickness or basis weight across the sheet to be measured and displayed. Alternatively, an O-frame may be used. For applications with space limitations, the measuring heads are supplied for mounting in a fixed position.

Coatings can be measured by using two transmission systems, one measuring base material, the other coated material, operating differentially, with a continuous memory for transport lag delay compensation.

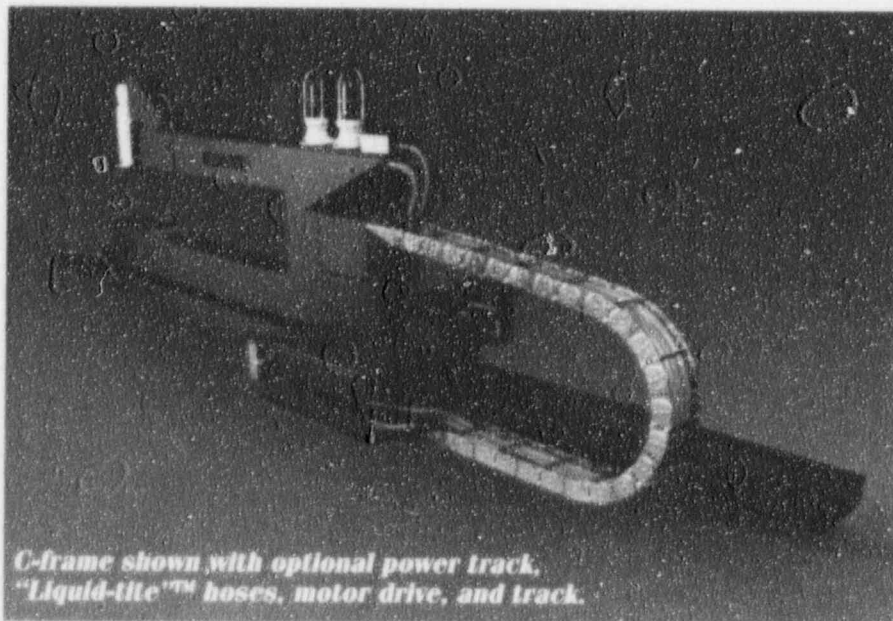
**Backscatter** mode is most suitable where access is only available to one side of the material, such as on a calender roll. Both the source and detector are mounted on the same side of the product in such a way that the detector only receives the radiation which has been reflected, or backscattered, from the product. The intensity of the radiation received by the detector varies with the thickness of the product.

Backscatter heads are supplied for fixed position mounting.

In coating and laminating applications, the amount of radiation backscattered is related to both the atomic number and thickness of the material and there is, therefore, a difference in the amount of radiation backscattered from the uncoated base material and the same material when coated. The amount of radiation backscattered will decrease as the thickness of the coating increases when the coating material has a lower atomic number than the base, and will increase when the coating has a higher atomic number than the base.

The detected radiation is converted into an electrical signal which is then processed by the microprocessor. The instrument is calibrated in terms of the product being measured.

# Metals DMC 450



*C-frame shown with optional power track, "Liquid-tite"™ hoses, motor drive, and track.*

## C-Frames

For process lines, slitting lines, cut-to-length lines, service centers and other less severe environments, DMC offers a standard heavy duty C-frame to house the radiation detector unit and the source holder. Various drive systems are available to move the measuring frame on- or off-line as required. A source air wipe and an air pressure regulator are supplied as standard items along with Liquid-tite™ cable and hose protection.

Air gaps and throat depths can often be tailored to meet specific space requirements, although this can affect gauge performance. In certain situations, the detector and source holder may be supplied loose for customer mounting, but DMC advises that the factory applications' engineers be consulted first. For demanding environments, a sealed heavy duty frame can be supplied which is more suited to the severe conditions encountered in these applications.

### Optional Features for C-frames are:

- Stationary chain motor drives for positive positioning
- Edge-to-edge profile scanning with C-frame position feedback
- Power track cable carrier or festoon systems for cables
- Rails for C-frame travel
- Air dryers
- Air wipes for detector windows
- Water cooling of heads where ambient temperatures exceed 65°C/149°F

## Radiation Sources

These sources are carefully chosen to suit the specific application. Among the radiation sources offered are:

**Americium 241:** 1 Curie, 3 Curie and 4.8 Curie activity

**Cesium 137:** 10 Curie and 30 Curie activity

**Strontium 90:** 20 millicurie, 50 millicurie and 100 millicurie activity

**Krypton 85:** 100 millicurie activity

**X-ray (D.C.):** various energy levels to suit specific requirements — 40, 80, 160 and 200 KV DC X-ray sources are available for applications where radioisotopes are not suitable.

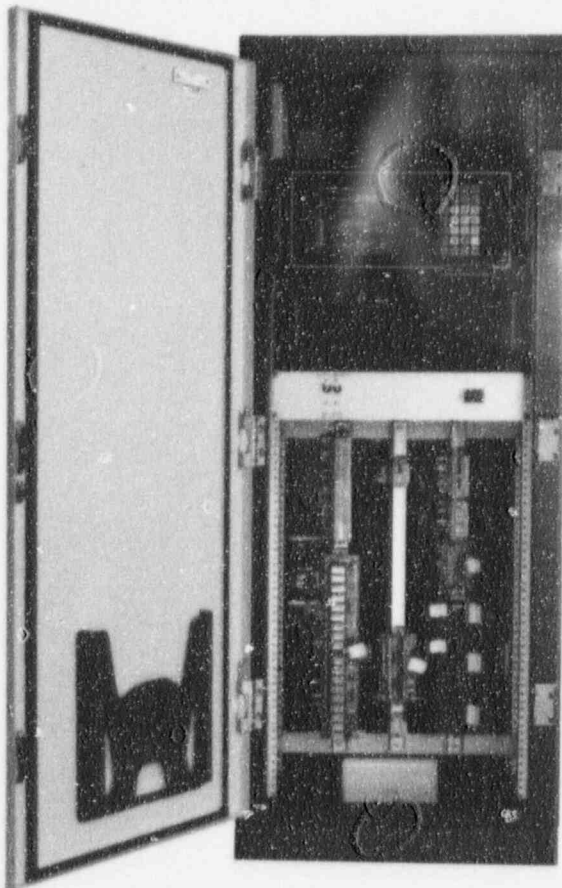
## Radiation Detectors

For most applications, DMC provides an extremely stable, highly efficient ionization chamber detector complete with a built-in, high-gain electrometer preamplifier which virtually eliminates noise and temperature drift.

### Note:

While most commonly used in metals applications, the DMC 450 is suitable for use on other materials in applications requiring the use of high precision C-frame or O-frame scanning drive systems.

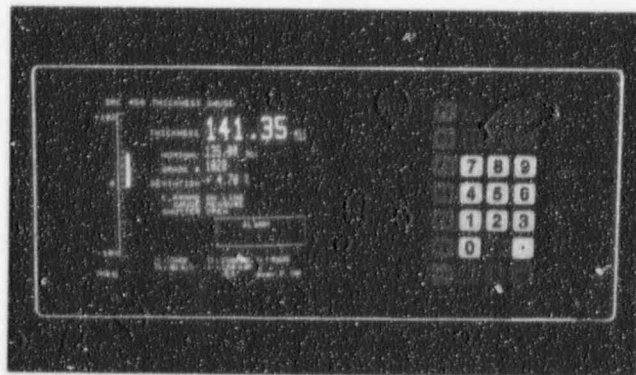
# Main Electronics Cabinet



The rugged NEMA 12/IP 55 main electronics cabinet is intended for use in severe environments. An optional air conditioning package is available for applications where ambient temperature exceeds 35°C/95°F.

Inside the cabinet is an industrial grade computer to give maximum on-line reliability. The 32-bit processor also has a 1.44 MB floppy disk drive plus 2 MB of RAM, ensuring sufficient capabilities for almost all applications. An analog input card with 16-bit resolution assures maximum resolution of measurement and high accuracies at all thicknesses. In addition, this system has sufficient flexibility to operate with two sets of sensors/measuring frames for reversing mills or differential measurements. Digital I/O and relay outputs are designed for easy maintenance and rapid replacement.

Analog output of  $\pm 10$  volts deviation from setpoint can be scaled by a technician/operator to any desired value without expensive reprogramming. In fact, even the type of data used for each analog output can be selected to meet changing requirements.

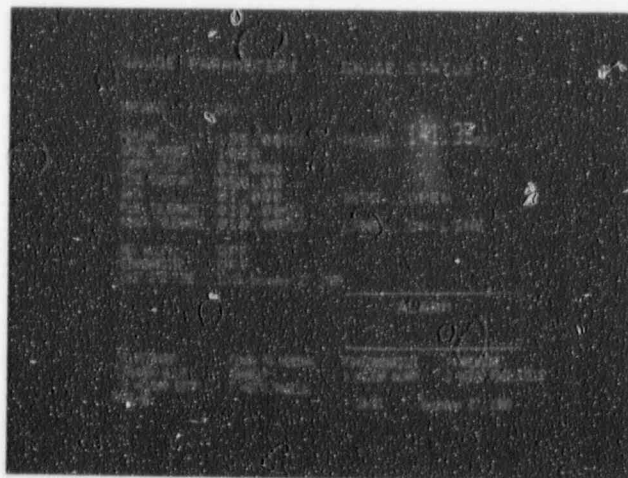


## Operators' Terminal

This industrial grade terminal features a 9 inch/ 225mm diagonal screen together with a sealed membrane keypad. The front panel of this unit is rated NEMA 4/IP 66. Two display screens are available to the operator.

**Display Page:** This page displays deviation from setpoint in bar graph format, plus actual measured thickness or basis weight. These are displayed in large, bold characters for high visibility. Also included are setpoint and grade which can be entered using this page without going to the second parameter setup page.

**Parameter Setup Status Page:** Typical entry parameters include nominal value, grade, composition factor, gain, time constant and plus/minus tolerance values (upper and lower limits). Time of last standardization is also shown. System status is clearly displayed together with useful parameters such as detector output voltage. An alarm field alerts the operator in the event a system malfunction is detected.





# DMC 450

## Optional Features

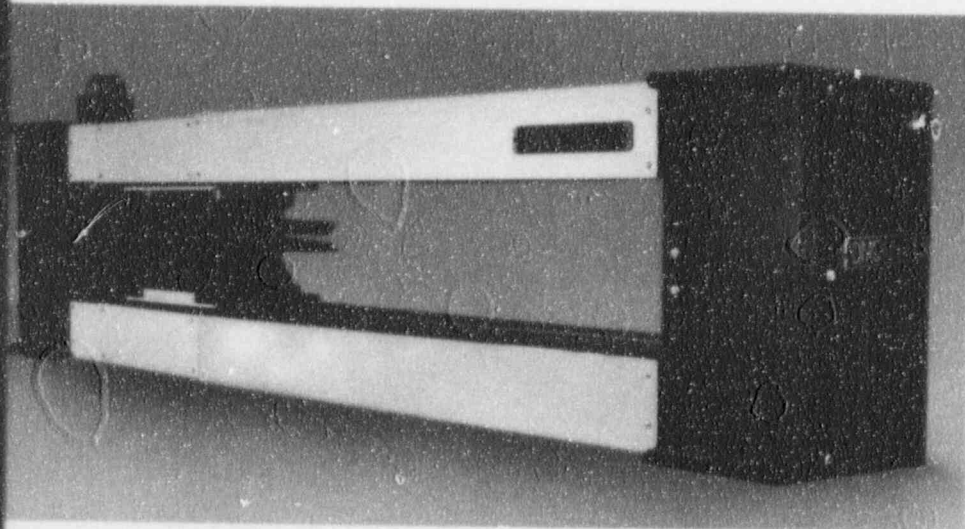
The DMC 450 is flexible enough to accommodate many standard and customized optional features. Some of the most commonly requested options are:

- **Production Reports**—a real-time printout is generated showing length thickness profile, histogram, statistical data plus date and time.
- **Cross Strip/Web Profiling**—this optional feature includes scanning across the product to determine thickness/basis weight variations. Printout and display options are also available.
- **Dual Heads/Measuring Frames**—many applications require two measuring heads. In many cases, only one set of DMC 450 electronics is required, reducing the overall price of the measuring system.
- **Serial Data Link to Host Computer**—an RS232C serial port allows the customer's host computer to transmit setup parameters to the gauge and sample measurement data from the gauge using a standard protocol. An engineering charge is made for special protocols.
- **X-ray Sources**—for some special applications where isotope sensors are not suitable, DMC can supply 40, 80, 160 and 200KV DC X-ray sources. In these cases, a simple standards magazine containing two or three calibration standards is also supplied, together with an X-ray source driver cabinet. To maintain long-term accuracy, the ACE (Automatic Correction of Energy) feature is included (patent applied for).
- **Isolated Analog Outputs**—the  $\pm 10$  volt output signals can be isolated from the DMC 450 electronics by the use of optional analog isolation amplifiers which provide up to 2500 volts of signal isolation.
- **C-frame Motor Drive**—a stationary chain, anchored at both ends, allows the measuring frame to be driven reliably without slippage and parked at any point across the strip or web.
- **C-frame Pneumatic Drive**—a pneumatic cylinder moves the measuring head on-line and off-line.
- **Power Track/Cable Carrier**—carries C-frame cables and hoses, preventing accidental damage and keeping them away from grease and solvents.
- **Rails**—a simple track can be supplied for a C-frame.
- **Air Dryers**—this optional item is used to condition the air supplied to the pneumatic safety shutter.
- **Air Conditioning**—for areas where ambient temperature for the main electronics cabinet exceeds 35°C/95°F, an air conditioner will allow operation up to 50°C/122°F.
- **Voltage Regulator/Power Conditioner**—where AC power variations can occur, this unit regulates voltage to within  $\pm 1\%$  and eliminates AC supply spikes which will cause unreliable operation. This unit is always supplied with X-ray systems.
- **Strip Chart Recorders**—a variety of strip chart recorders are available. Since prices vary considerably according to type, size and quality, the customer may specify manufacturer and model, or DMC will make recommendations.
- **Diagnostics**—a separate monitor and keyboard can be provided with disks containing extensive diagnostic software.
- **Low Resolution Profile Display**—The terminal display has low resolution graphics capability for simple representation of thickness measurement across the width of the product.
- **Coating Compensation**—entry of coating weight and type permits accurate measurement of coated products.



**Wood Fiber,  
Plastics,  
Paper,  
Rubber and  
Other  
Non-Metals**

# DMC 450



## **C-Frames, O-Frames and Single-Sided Scanning Frames**

Various frames are available according to application and budget. Measuring heads can also be supplied loose for customer mounting in accordance with DMC's specifications and recommendations.

## **C-Frames**

For beta sensors, air gaps are limited to between 12mm to 50mm (according to isotope), and throat depths restricted due to stringent rigidity requirements. Gamma sensors allow larger air gaps and throat depths. Motor and pneumatic drives can be accommodated.

## **O-Frames**

The DMC OSP-20 scanner is most commonly used for beta transmission sensors and features precision servo motors with a low maintenance timing belt drive for precise sensor alignment and positioning. A high speed dedicated digital signal processor maintains precision control. Optional features include a hazardous environment package and air gap temperature compensation. For applications requiring larger air gaps, such as those using gamma radiation sensors, a larger version of the OSP-20 scanner is available.

## **Single-Sided Frame**

Applications utilizing backscatter sensors require special rigid single-sided frames which precisely maintain an accurate measuring position while scanning across a calender roll.

## **Differential Measurement**

The DMC 450 features differential measurement capabilities. For example, to measure coatings or other laminated products, a basis weight measurement is made on the substrate material, and then the second measurement is made of substrate plus coating. Subtracting the two measurements gives the coating thickness after allowance for transport delays and same-spot measurement.

## **Radioisotope Sources**

Source	Half Life	Radiation	Energy	Transmission Mode Max. Weight	Backscatter Mode Max. Weight
Pm147	2.6 yr.	Beta	225 KeV	150gsm	75gsm
Kr85	10.7 yr.	Beta	672 KeV	1000gsm	500gsm
Sr90	29.6 yr.	Beta	2.27 KeV	7000gsm	3500gsm
Cm244	17.8 yr.	Gamma	17.5 KeV	Consult Factory	—
Am241	433 yr.	Gamma	59.5 KeV	Consult Factory	—
Cs137	30 yr.	Gamma	660 KeV	Consult Factory	—

**Response times (typical):** 0.015 to 9.9 seconds.

### **Typical Applications:**

#### **Transmission Systems**

Calendered and extruded sheets  
Coatings and laminates  
Cast and blown films  
Paper, board and textiles  
Carpet backing

#### **Backscatter Systems**

Tire cord calenders  
Coatings and laminates  
Textiles  
Blown Film  
Paint on Metals

# DMC 450

## Optional Features for Non-Metals Applications

Almost all of the options available for metals are available for non-metals. Some additional features often required for non-metals applications are described below:

- Air gap temperature correction, most frequently needed when measuring thin films or coatings.
- Low resolution, low cost, cross web profile display on operator's terminal.
- Simple, single loop control of nip, etc.
- Same-spot measurement for dual scanner, differential measurement applications.

# DMC 450

## Operating Modes

- **Standby Mode:** When no measured material is in the beam, the system will automatically close the radiation shutter. Highly visible red and green lintern lights indicate shutter status.
- **Measure Mode:** With material in the beam, measured values are shown on the operator's terminal.
- **Standardize Mode:** With no material in the measuring beam, the system automatically standardizes at two points, open shutter and closed shutter, in just a few seconds.
- **New Alloy/Grade:** Placing a precisely known calibration sample in the measuring beam allows automatic determination and storage of a correction factor for future use.

The product code (grade) feature allows storage of correction factors, target values, tolerance settings, response times and other variables for up to 100 products.

## General Performance Characteristics

Sampling Rate:	15,535 samples/second total for 4 or 8 channels
Update Rate:	every 5.15 milliseconds for analog outputs; once per second for operator terminal screen
Response Time:	10 to 1,000 milliseconds
Analog Outputs:	Two (2) per measuring head (configurable) ±10 volts = XXX mils/mm/gsm deviation 0-10 volts = nominal/target value
Analog Input Resolution:	16 bits
Analog Output Resolution:	12 bits
Output Contacts:	Thick/Heavy Thin/Light Gauge Healthy Gauge Ready
Contact Rating:	115 VAC, 1 Amp/30VDC, 1 Amp
Ambient Temperature (MEC):	35°C/95°F without air conditioning 50°C/125°F with air conditioning
Ambient Temperature (Head):	65°C/150°F without cooling
Power Requirements:	220/240 VAC or 110/120 VAC, 50/60 Hz
Power Supply Variations:	+15%, -10% voltage (using voltage regulator), ±5% frequency
Air:	4 - 6 Bars (60 - 80 psi) cool, dry and clean





In the interest of development, we reserve the right to modify the specification and design of the equipment without prior notice.  
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2/94

## **DMC**Products

*DMC provides a complete line of measurement and control products for the metals and non-metals industries, including:*

- Model 800 ultra high speed X-ray thickness gauges
- Coating weight gauges (X-ray and isotope) for coatings of tin, zinc, zinc/aluminum, zinc/iron, zinc/nickel, chromium, terne, on steel or copper/brass, with composition measurement
- Coating weight gauges for paints and organic/inorganic coatings on metals
- Zinc/iron coating gauge for measurement of galvanneal coating and percent iron
- Measurement and closed loop control systems
- Pinhole detectors, weld code detectors
- Single sheet classifier control unit for cut-to-length lines
- Closed loop control systems for air knives and electroplating
- SQC reporting packages.

## **DMC**Worldwide Sales and Service

DMC is committed to working in a global economy. Sales offices, sales representatives, and service are available in the Americas, Europe, Far East, South Africa and Australia. DMC provides support at all levels — sales, engineering, and maintenance.

### **Headquarters:**

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France  
Telephone: 33-1-39.56.53.26  
Fax: 33-1-39.56.53.05

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM  
AND  
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)  
INFORMATION FROM LTS

PROGRAM CODE: 03120  
STATUS CODE: 3  
FEE CATEGORY: \_\_\_\_\_  
EXP. DATE: 0 \_\_\_\_\_  
FEE COMMENTS: \_\_\_\_\_  
DECOM FIN ASSUR REQD: \_\_\_\_\_  
.....

LICENSE FEE TRANSMITTAL

A. REGION

1. APPLICATION ATTACHED

APPLICANT/LICENSEE: CITISTEEL USA, INC.  
RECEIVED DATE: 961216  
DOCKET NO: 3034313  
CONTROL NO.: 124025  
LICENSE NO.:  
ACTION TYPE: NEW LICENSEE

1997 JAN -2 AM 11:25

2. FEE ATTACHED

AMOUNT: \$550.00  
CHECK NO.: 025250

3. COMMENTS

SIGNED  
DATE

*R. J. Brown*  
*12/26/96*

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED ☒)

1. FEE CATEGORY AND AMOUNT:

*3P* *\$550*

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:

AMENDMENT \_\_\_\_\_  
RENEWAL \_\_\_\_\_  
LICENSE ☒ \_\_\_\_\_

3. OTHER

SIGNED  
DATE

*SC*

*1/2/97*

JAN 02 1997

Log	<i>Jan 1</i>
Remitter	
Check No.	<i>25250</i>
Amount	<i>\$550</i>
Fee Category	<i>3P</i>
Type of Fee	<i>App</i>
Date Check Rec'd	<i>1/2/97</i>
Date Completed	<i>1/2/97</i>
By:	<i>SC</i>