## REVISIONS

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9001

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CENTRONICS
data computer corp.
HUDSON, NEW HAMPSHIRE U.S.A.

TITLE
ENGINEERING PRODUCT SPEC
# 350 MECHANISM

| SIZE | | NUMBER | REV |
|---|---|---|---|
| A | | 80002149 | C |

SCALE NONE | DO NOT SCALE PRINT | SHEET 1 OF 19

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## 1.0 SCOPE

This specification defines the criteria for the mechanical design of the 350 mechanism.

## 2.0 RELATED DOCUMENTS

A. Centronics Engineering Standard #001
B. Centronics Engineering Standard #011
C. Centronics Engineering Standard #014
D. UL 114
E. CSA 22.2 #XX
F. VDE 0871, 0730
G. Centronics Engineering Specification 80002151-9001
H. ISO 3746 - Acoustics

## 3.0 DETAILED SPECIFICATIONS

### 3.1 MECHANICAL FRAME

#### 3.1.1 Structure

The machine frame will provide the structural support for the printer's assemblies.

The frame consists of the following major components: right and left side plates, the platen, paper guides and paper pan, front and rear carriage guide bars, and a front cross-plate.

#### 3.1.2 Side Plate

The left side plate will provide for mounting of paper movement stepper motor and for mounting an interlock switch which interfaces with the machine plastic top cover. (See Paragraph 3.13 below.)

#### 3.1.3 Platen

The platen will be made of a solid steel bar, rectangular in cross-section measuring 27 x 12 mm (1.063" x .472"). Printing surface will be protected against paper abrasion by adequate plating.

The platen will be provided with a .024 inch (.6mm) deep recess located at both ends for the print head to prevent ink oozing overnight when the direct inking "ribbonless" technique is utilized.

## 3.11 COVER SYSTEM

### 3.11.1 Basic Dimensions

The basic printer external dimensions are 7.20 inches (183 mm) in height (not including feet), 22.9 inches (582 mm) in width and 18.35 inches (466 mm) in depth. Dimensions do not include paper guides.

### 3.11.2 Base Cover

The base cover is molded plastic with sheet metal insert to give structual integrity to the system. Base will be charcoal brown. Maximum power supply weight is 5 lbs.

### 3.11.3 Body Cover

Body cover is injection molded plastic, N190 or equivalent with minimum thickness of 0.125 inches (3.2 mm) except ribs, etc. Cover mounts to the base cover. Color is to be eggshell white, surface is textured.

### 3.11.4 Rear Cover

Cover is same material, color and texture of body cover. Cover hinges to the rear and must be removed to facilitate paper loading.

### 3.11.5 Top Cover

The top cover consists of a hinge smoked poly carbonate cover and the main top cover. The main cover is the same material, color and texture of the body cover. The cover shall snap in and out to facilitate replacement of ribbon cassette of ink reservoir. Hinged smoked portion snaps in the closed (down) position.

### 3.11.6 Feet

Feet will be provided on the unit. They will have provisions to enable mounting the machine on a specially designed stand.

### 3.11.7 Cover Tolerances

Maximum gap variations between bottom and body covers to be 1 mm on the front and 1.5 mm on all other sides. These dimensions to be measured after thermal soak testing per Centronics standard.

3.11.8 Cover Strength

Covers will be designed to support the weight of the machine for shipping.

3.11.9 Cable Strain Relief

Provisions to be made for cable strain reliefs.

3.11.10 Cover/Mechanism Clearance

A minimum of .357" (9.5 mm) will be clearance between any cover and any part of the mechanism where possible. This is to allow for possible acoustic foam addition.

3.11.11 Plastics Used

All plastics used are to be flame retardant and UL and CSA approved.

3.11.12 Paper Wire Guide

The cover will have a provision to mount a wire guide to direct the paper in without interference with any wires or cables.

3.12 WEIGHT

The weight of the mechanism and cover system must be less than 40 lbs.

3.13 INTERLOCK SWITCH

An interlock switch is located under the smoked section of the top cover. The switch is actuated whenever the cover is raised or removed.

3.14 ACOUSTICAL NOISE

The design of the machine is to achieve a noise level of 60 dbA while printing rolling ASCII single part, 15 pound paper head gap 0.010-0.015 inches with paper and ribbon, 132 columns, 100% duty cycle. Measurements of the noise level will be taken in compliance of ISO 3746.

4.0 ENVIRONMENTAL CONDITIONS

4.1 TEMPERATURE/HUMIDITY

The printer will meet the requirements as specified for a "Class B" product in Paragraph 3.0 of Centronics Engineering Standard 001.

3.1.4 Guide Bars

The front carriage guide bar will use .590" (15.0mm) dia. and the rear bar will use .472" (12.0mm) dia. steel. Both bars will have the proper surface finish (16 micro inch rms) and plating to insure a good wear surface and a better bearing life.

The parallel alignment accuracy between the guide bars and the platen must provide for carriage motion accuracy within .0025" (.064 mm) in the horizontal plane and within .003" (.075mm) in the vertical plane in relationship with the platen over the printing range.

3.1.5 Bumpers

Bumpers will be provided at the ends of the front guide bar to guard against crashing of carriage against side frames at full velocity of 20 IPS with no damage.

3.1.6 Fasteners

The frame as well as the rest of the machine components shall be fastened together using good standard practices and shall be capable of shock and vibration test survival as described below, without loosening of fasteners or parts. All fasteners used shall be metric.

3.1.7 Finish

All metal parts shall have appropriate finishes to prevent corrosion. No cadmium or other hazardous finishes or plating will be used. Finish must be conductive to 1 Mho between any two points metal-to-metal on the mechanism. Finish must be compatible to prevent galvanic corrosion of dissimilar metal junctions.

3.1.8 Shock Mounts

The frame will be isolated from the cover system by grommets inserted in frame to reduce vibration and noise.

3.1.9 Grounding

Electrical continuity will be maintained, wherever possible, between metal parts of the mechanism to facilitate grounding. Threaded holes to bleed static charge to ground location will be located on each side of the mechanism.

3.1.10 Plating

Those parts where possible wear is a consideration shall be suitably designed and lubricated or plated to enable the mechanism to meet its reliability requirements. Cosmetic finish must be uniform and stable with time.

3.2 CARRIAGE & DRIVE ASSEMBLIES

3.2.1 Structure

This will include the carriage and the components required to move it. Namely, the DC drive motor, the belt, pulleys, encoder disk and optical sensor. The carriage will be made of cast aluminum and designed to handle either the cassette ribbon system (see Paragraph 3.8) or the optional ribbonless system (see Paragraph 3.9). It will be mounted on the front guide bar through sintered metal self-lubricated bearings. The surface finish of the bearings as well as the guide bars and the accuracy of fit between them must be such that when the carriage is driven, it will undergo smooth horizontal motion without undesirable movement such as chattering.

Force required to move the carriage will be less than 1,000 g. as assembled at a velocity of 2 IPS.

Clearance between the guide bars and bearings will be less than .0013 inches (.034 mm) in all directions.

3.2.2 Print Head Mounting/Penetration Control

The carriage will provide for mounting the print head. This is done through a three point mounting system that enables the print head to be snap-on mounted. One point is located towards the front of the carriage and fitted with a bushing or other means that can be adjusted upon the initial assembly of the mechanism to maintain a specified minimum gap between the print wire tips and the platen regardless of any variations from one mechanism to another due to manufacturing tolerances. The heads are set during manufacturing to allow replacement without further adjustment.

The remaining two points are located approximately at the middle of the carriage. One point is in line with the front point described above and provided with a tapered top edge to ease the mounting of the print head.

A short pin also on the print head assembly, engages with the third mounting point.

3.2.2.1 Operation

The print head is located above the carriage, then it is gradually pushed down on the tapered edge of the back mounting point. In the meantime, the print head is simultaneously pulled back compressing the spring and enabling the tip of the long rod as well as the short pin to be aligned with the front bushing and the third mounting point respectively. The pull is then gently decreased until the print head is seated in its place.

To perform the initial adjustment, the lock screw on the front bushing is loosened, the cam is moved to minimum gap position, then the print head is moved to the platen and the lock screw is tightened.

3.2.2.2 Gap Setting

Gap setting will be .016 to .0215 (.4/.55 mm) without ribbon and paper.

3.2.2.3 Spring Force

The urging spring will exert a holding force on the print head. This holding force will be 4.0 lbs. (1.8 kg.) to 6.0 lbs. (2.7 kg.) with the print head at the minimum gap position.

3.2.2.4 Head Removal

To remove the print head, it has to be pulled back and up. The urging spring will be compressed during this process.

3.3 CARRIAGE DRIVE

Drive system for the print head carriage shall consist of a closed loop servo system capable of bi-directional printing. Drive method will be a timing belt using a speed reduction system. One revolution of the motor will represent 2/3 inch (16.9 mm) of linear carriage motion.

3.3.1 Carriage Drive Motor

Carriage drive motor will be of the following specs:

| | | |
|---|---|---|
| - Maximum Case Temp. | °C | 100 |
| - Rated Voltage | VDC | 35 + 10% |
| - No load Speed | r.p.m. | 4300 |
| - No load Current | mA | 170 |

| | | |
|---|---|---|
| - Stall Torque | g.cm. | 3600 |
| - Stall Current | A | 5.2 |
| - Torque Constant | g.cm./A. | 690 |
| - Armature Resistance | Ohm | 6.7 |
| - Armature Inductance | mH. | 10 |
| - Armature Inertia | $g.cm^2$ | 170 |
| - Mechanical Time Constant | m sec. | 24 |
| - Electrical Time Constant | msec. | 1.5 |
| - Rotation | - | Bidirectional |
| - End Play | inch | $\pm$0.005 |

A thermal conductive path from the motor to the front chassis will be provided.

3.3.2 Pulleys

Timing pulleys will be used for driving the timing belt. Both driving and idler pulleys will be friction-free running on ball bearings. The idler pulley will be adjustable so that it can serve as a tightener for the timing belt.

3.3.3 Drive Belt Tension

Belt tension will be set at point of manufacture such that 2/3 lbs. (300 grams) pressure will depress the belt .3" to .35" (8-9mm) to prevent vibration problems affecting printing during carriage acceleration and change of direction. Belt deflection will stabilize to less than .06" (1.5mm) over a one month period following installation under static condition.

3.3.4 Main Motor Belt

Belt tension will be set at point of manufacture such that 2/3 lbs. (300 grams) pressure will depress the belt .098 to .18 inches (2.5-4.5 mm).

3.3.5 Belt Specifications

Carriage drive timing belt will have the following specs.

| | |
|---|---|
| - Width | .375" (9.52 mm) |
| - Strength (Tensile) | 200 lbs min. (per the above stated width) |
| - % Elongation | 1% Average (under 5 to 100 lbs applied force). |

Wherever any belts are used, they shall be designed such that variations in performance due to stretching will be eliminated.

## 3.4 PENETRATION CONTROL

The adjustment of the print head in relation to the platen to facilitate varying forms thickness is accomplished by an eccentric on the front guide bar. the eccentric is moved by means of a lever located on the right side chassis which protrudes through the body cover. A detent allows for elevel (11) distinct adjustment positions. Head to platen gap variation for each position is 0.0025" (.06 mm) for a total gap adjustment of 0.025" (0.6 mm).

## 3.5 OPTICAL ENCODER

The encoder will consist of a dual channel sensor and a chemically etched metal disc mounted on the DC motor shaft. The encoder disc design will enable quadrature sensing. Maximum of ± .015 in. wobble including end play on motor.

### 3.5.1 Encoder Resolution

The encoder shall be capable of supplying 660 signals per linear inch of print head travel (440 per motor revolution).

### 3.5.2 Encoder Mounting

Mechanical means for adjusting quadrature will be provided. Snap-on dust cover will protect the disc.

## 3.6 CARRIAGE DRIVE OPERATION

The system will comply with the following requirements.

### 3.6.1 Print Speed

Printing speed of 200 cps at 20 ips bi-directional with logic seeking.

### 3.6.2 Carriage Movement

The carriage must be capable of accelerating from zero velocity to constant velocity and of decelerating from constant velocity to zero velocity as defined by the following parameters.

| | |
|---|---|
| - Carriage Velocity | 20 in/sec (508 mm/sec) ± 5% |
| - Acceleration Distance | .5 in. (12.7 mm) |
| - Deceleration Distance | .5 in. (12.7 mm) |
| - Motor Current Limited | 2 Amps ± 10% |

## 3.7 PAPER HANDLING SYSTEM

This system consists of a stepper motor drive, pin/tractor paper feeder, paper guide and top drive rolls. A paper insert guide directs the paper around the data input cables. An outlet guide guides the paper after it leaves the drive rolls. The system has push tractors below and pull rolls above the print line. The tractor feed is driven in unison with the drive rollers to enhance proper operation and accuracy requirements of this specification. Driver rollers will also keep the paper taut and snug on the platen to reduce the noise emitted by the paper. The following specifications apply to the system.

### 3.7.1 Stepper Motor

The stepper motor must be heat sunk to the side plate. It has the following specification:

| | |
|---|---|
| Voltage, Rated | 8.7 VDC |
| Current | 1.0 Amps per Winding |
| No. of Phases | 4 (Bipolar Winding) |
| Resistance | 4.3 Ohm/Phase |
| Holding Torque | 2 Kg. Cm. |
| Rotor Inertia | 150 g. $Cm^2$ |
| Steps/Revolution | 48 ($7.5^{o}$/Step) |
| Step Error | $\pm$5% |
| Rotation | Bidirectional |
| Inductance | 6.5 MH $\pm$ 20% |

### 3.7.2 Paper System Performance

The system performance will comply with the following criteria:

| | |
|---|---|
| Line Feed Time | 50 msec maximum |
| Paper Slew | 8 in/sec (203.2 mm/sec) minimum |
| Paper Movement - Fanfold | 120 half steps per inch .00833 in. |
| Paper Movement - Cut Form | 108 half steps per inch .00926 in |

Ramp Characteristics for line feed (1/6 inch, 120 steps per inch). All times in microseconds.

| Ramp Up | Ramp Down |
|---|---|
| 5907.5 | 4461.9 |
| 3266.5 | 2050.25 |
| 2467.25 | 3892.0 |
| 2363.0 | 3857.25 |

| Ramp Up |
|---|
| 2050.25 |
| 1939.05 |
| 1876.5 |
| 1786.15 |
| 1730.55 |
| 1668.0 |
| 1633.25 |
| 1591.55 |
| 1549.85 |
| 1522.05 |
| 1487.3 |
| 1459.5 |

3.7.3 Computer Fanfold Forms

3.7.3.1 Paper Loading

The mechanism is rear loading for continuous forms. Paper is brought to the rear of the machine over the inlet guide and loaded into the tractors. The forms lever is moved to the 'LOAD' position which positions the movable paper guide up to the mouth of the drive rolls. Forward motion of the drive motor now loads the paper. The forms lever is now placed in the 'FORMS' position.

3.7.3.2 Forms Type

Total paper width is from 4.0 to 15.0 inches (10 to 381 mm). The system is designed to handle from single part 15 to 20 lb (56 $g/m^2$) paper to 6 part crimp pack. Maximum pack thickness .0204 in. (.52 mm). Paper qualifies and defined below in Section 3.7.3.4.

3.7.3.3 Line Registration

Line to line spacing error will be held within one sigma equal .004 inches (.1 mm) for single ply paper and within one sigma equal .005 inches (.13 mm) for 6 ply paper. Accuracy measurements will not be taken within 1.0 inch (25.4 mm) of the fanfold perforation line. Line spacing error is non-accumulative. Measurement is made using Pin 1 and Pin 6 firing and analyzing dot placement. Horizontal motion between lines is 10 steps at 6.032 msec each.

3.7.3.4 Qualified Paper - Fanfold

The following list of computer forms has been tested and can be handled reliably on the mechanism at 65-70°F, 40-60% RH.

| No. | Manufacturer | P/N | Ply | Forms/Box | Carbon (Non-Carbon) |
|---|---|---|---|---|---|
| 1 | Moore Business Forms | 1L171412TC56 | 1 | 2,600 | - |
| 2 | Moore Business Forms | 1L111412TC45 | 1 | 2,600 | - |
| 3 | Moore Business Forms | 1L181412T | 1 | 3,200 | - |
| 4 | Moore Business Forms | 4 8510 | 4 | 750 | Carbon |
| 5 | Moore Business Forms | 4A131412TQ51 | 4 | 850 | Non-Carbon |
| 6 | Moore Business Forms | 4K171482T76 | 4 | 800 | Non-Carbon |
| 7 | Moore Business Forms | 4L28851046 | 4 | 750 | Carbon |
| 8 | Moore Business Forms | 6 1482TQ | 6 | 600 | Non-Carbon |
| 9 | Moore Business Forms | 6L041412TQ51 | 6 | 600 | Non-Carbon |
| 10 | Moore Business Forms | 6L091412T68 | 6 | 500 | Carbon |
| 11 | Moore Business Forms | 6L201412TM57 | 6 | 600 | Non-Carbon |
| 12 | Royal Business Forms | 1411P122G | 6 | 500 | |
| 13 | Royal Business Forms | 1411F122G | 6 | 500 | |
| 14 | Royal Business Forms | 1411P2000 | 1 | 2,500 | |

3.7.3.5 Paper-Out Switch

An out of paper switch will be incorporated into the paper path on the left tractor. Paper out is sensed approximately 2.83 inches (72 mm) from the last printed line.

3.7.3.6 Form Tear-Off Capability

The form tear-off capability will be within 1.08 inches (27.5mm) max. of the last printed line. A column indicator will be marked on the tear bar. Tear-off to be at perforations only. Perforations to be preserved to tear bar within +1.5 to -.5 mm. Clear window to be defined in Secton 3.10.5.

3.7.4 Cut Sheet Forms

3.7.4.1 Loading

Cut sheets are loaded from the top of the printer. The forms lever is moved to the 'LOAD' position. This removes the tension between the drive rolls and the paper pan is moved to the mouth of the rolls to accept the paper. At this time, a mechanical stop intercepts the paper path. The paper is now inserted through the paper rolls tothe stops for alignment. The forms lever is moved to the 'SHEET' position. The paper is now loaded by the reverse drive of the stepper motor.

3.7.4.2 Forms Type

Total forms width is from 4.0 to 12.0 inches (101 to 304.8 mm). Single part forms from 15 lb. (70 $g/m^2$) to 20 lb. Multipart forms up to 6 part with carbon, .0204 inches pack thickness (.52mm) maximum.

3.7.4.3 Line Registration

Line registration will be determined by the diameter of the rubber roller of 12.17 ± .05mm, which is measured with a low force micrometer.

3.7.4.4 Cut Sheet Handling & Restrictions

The center of the first line on the cut sheet which can be printed is below 1.08 inches (27.5 mm) from the top of the paper because of the distance between the drive rolls and the first printed line. The stops to which the form is loaded is 2.75 inches (70 mm) from the edge of the cutter bar. This distance subtracted from form length is the maximum the paper can be inserted with the reverse stepper drive. The drive rolls are driven 10% more than the tractor drive. When in cut sheet mode, paper moves at 216 half steps per inch (1/6 inch LF = 36 half steps).

3.7.4.5 Head Positioning

The print head will be positioned out of the paper path for paper loading.

3.8 RIBBON SYSTEM

A standard disposable ribbon cassette system will be available. The ribbon will be .472" (12 mm) in width and 70 yards (64 m) long provided with a mobius loop giving two pass capability.

3.8.1 Ribbon Life

Refer to Centronics 70 Yard Ribbon Specification #80002151-9001.

3.8.2 Shield

The ribbon will be supplied with a plastic nose shield which will snap in place over the print head jewel for a clean hands installation.

3.8.3 Ribbon Drive Motor

Drive motor will be 12 VDC geared for a ribbon speed of 3 to 5.5 in/sec minimum.

3.8.4 Chemical Resistance

All plastic and elastomeric materials used in manufacturing the ribbon cassette or any other components used to handle ink or inked ribbon, must be resistant to chemical attack from substances used in Centronics ribbons. Most important of these substances are oleic acid, acetic acid and fatty amines.

3.8.5 Instructions

Instruction plate will be used to assist the operator in changing the ribbon.

3.9 RIBBONLESS PRINTING

3.9.1 Printing Method

This feature will be optional on the printer. It is accomplished by using a special print head equipped with a wicking system that transfers ink from a reservoir held under the print head at close proximity so that the print head wick comes in contact with another wick in the ink reservoir and the route is established for the ink to flow from the reservoir to the print wire tips and upon printing to the paper.

3.9.2 Ink Density Adjustment

A mechanism will be provided to enable adjusting the amount of ink delivered to the head to maintain good printing quality versus speed, humidity, temperature, etc.

3.9.3 Ink Reservoir

Ink reservoir will be a throw-away type. It will contain approximately 5.3 cu. in. of ink which is enough to print about 15 million characters.

3.9.4 Initialization to Prevent Ink Oozing

When not in oeration, the print head can be positioned to a home position (far left and off paper). This will decrease the chances of ink oozing onto the paper.

3.9.5 No-Smearing Guide

A guide will be provided on the tip of the print head to avoid smearing ink during printing and when the print head traverses the left paper edge.

3.10 FIRST PRINT POSITION

The first printed position for continuous forms is 0.625 inches (15.97 mm) nominal from the left edge of the paper. Adjustment allows this position to change from 0.525 inches (13.3 mm) minimum to 0.725 inches (18.4 mm) maximum.

4.2 ALTITUDE

As per Paragraph 4.0, Centronics Engineering Standard 001.

4.3 MECHANICAL SHOCK

As per Paragraph 5.0, Centronics Engineering Standard 001.

4.4 VIBRATION

As per Paragraph 6.0, Centronics Engineering Standard 001.

4.5 PHYSICAL STABILITY OF EQUIPMENT DURING SHIPPING & HANDLING

As per Paragraph 7.0, Centronics Engineering Standard 001.

5.0 SAFETY

The printer will meet the requirements as specified in Centronics Engineering Standard 011.

6.0 RELIABILITY PROVISIONS

6.1 DEFINITIONS

6.1.1 Mechanism Reliability Provisions

6.1.1.1 Failure

A failure is any stoppage or malfunction of a printer which is directly caused by the mechanism. This excludes stoppages or substandard performance caused by operator error, power failure, environmental conditions exceeding specified limits, or failures induced in the mechanism (secondary failures) due to malfunctions in other portions of the printer.

6.1.1.2 Mechanism Operating Time

The period of time during which the mechanism is either moving paper, or the print head carriage is in motion.

6.1.1.3 Duty Cycle

The measurement shall be based upon 25% duty cycle.

6.1.1.4 Mechanism Failure Rate

Mechanism Failure Rate (MFR) shall be calculated as follows:

$$MFR = \frac{\text{Total Number of Failures}}{\text{Total Mechanism Operating Time}}$$

6.1.1.5 Infant Mortality Period

This shall be defined as the first hour of Mechanism Operating Time.

6.1.1.6 Mechanism Useful Life

The duration of Mechanism Operating Time during which the failures generated are field repairable. Mechanisms which pass the Useful Life may be expected to generate failure types which require overall refurbishment or reconditioning of the Mechanism or repairs which cannot be performed by a properly trained and equipped field representative.

6.1.1.7 Mean Time to Repair (MTTR)

MTTR shall be calculated as follows:

$$\text{MTTR} = \frac{\text{Total Repair Time}}{\text{Total Number of Failures}}$$

6.1.1.8 Performance

Mechanisms shall conform to the following:

A. The maximum Mechanism Failure Rate during the Infant Mortality Period shall not exceed .0008 failures per hour.

B. The Mechanism Failure Rate for the overall population shall not exceed .0004 failures per hour, during the Mechanism Useful Life.

C. Ninety percent (90%) of the individual Mechanisms shall have a Mechanism Failure Rate of less than .00067 failures per hour during the Mechanism Useful Life.

D. The Mechanism Useful Life shall exceed 4,500 hours of Mechanism Operating Time.

E. MTTR shall be less than .5 hours.

F. Ninety percent (90%) of all repair actions shall require less than one (1) hour to complete.

G. Any randomly selected sample of mechanisms shall be capable of demonstrating conformance to the above parameters with a 90% level of statistical confidence.