उत्पाद मानक PRODUCT STANDARD TR 15035C

परिणामित्र TRANSFORMER

शाप/डि.आ. निर्दे SHOP/DO INSTRUCTIONS

शीर्षक TITLE DIMENSIONS AND TOLERANCES FOR CORE

3.0 TOLERANCES ON LAMINATIONS

3.1 LENGTH- $^{+0}_{-2.0}$ mm

3.2 WIDTH- $^{+0}_{-0.5}$ mm

3.3 HOLES (A) ON HOLE DIA ± 0.1 mm

(B) DISTANCE BETWEEN FIRST AND LAST HOLE ± 0.25 mm

(C) DISTANCE BETWEEN SUCCESSIVE HOLES ± 0.1 mm.

(D) OFF-SET PERPENDICULAR TO CENTRE LINE ± 0.1 mm

3.4 ANGLE OF MITRE - ANGLE 45° ± 1 MINUTE.

THIS CAN BE MEASURED AS FOLLOWS: USING A FIXED 45° SET-SQUARE, THE DEVIATION OF ANGLE OF THE MITRE OVER A MAX. WIDTH OF 1000 mm SHALL NOT EXCEED 0.5 mm GAP (AS SHWON IN THE FIG. 1&2 WHEN MEASURED BY A FILLER GAUGE) OR PROPORTIONATE THERE OF FOR OTHER WIDTH.

FIGURES:-

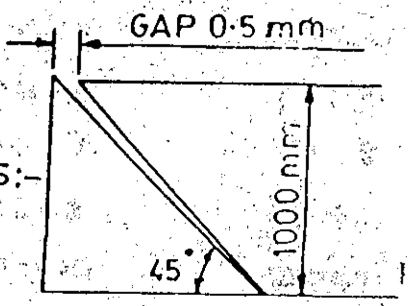


FIG. 1

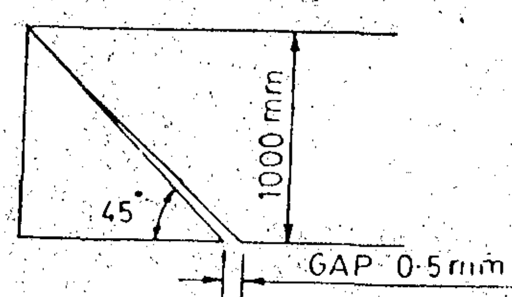


FIG. 2

3.5 EDGE BOW — THIS SHOULD NOT EXCEED 0.50 mm/METRE OR PROPORTIONATE THERE OF, WITH A MAXIMUM OF 1.5 mm

3.6 BURR LEVEL — THE MAXIMUM PERMISSIBLE BURR LEVEL IS 30 MICRONS.

Rev	DISTRIBUTION LIST UP DATED AE9 KG 28/12/94 NOTE NO 2.5 ADDED AKG 28/12/94	DISTRIBU. TRE TRP CGX TRM BAY 8 BAY-9	स्वीकृत किया APPROVED:	तैयार किया PREPD	जारी किया ISSUED	दिनांक DATE

CUTTING - PROGRAMME

WIDTH	SHAPE	L_1 (c/c) CENTRE LENGTH
110	FIG. 1	500
	FIG-2	000
	FIG-4	500
	FIG-5	500
300	FIG-2	1500
	FIG-3	1500
	FIG-5	630
	FIG-6	1000
	FIG-11	1800
600	FIG-1	1500
	FIG-2	1500
	FIG-3	1500
	FIG-5	1500
	FIG-6	1000
	FIG-7	1700
	FIG-8	1788
090	FIG-1	1000
	FIG-3	2000
	FIG-5	1500
	FIG-7	1788
	FIG-8	1708
	FIG-10	2000
390	FIG-9	1040
	FIG-6	2000
	FIG-12	1000

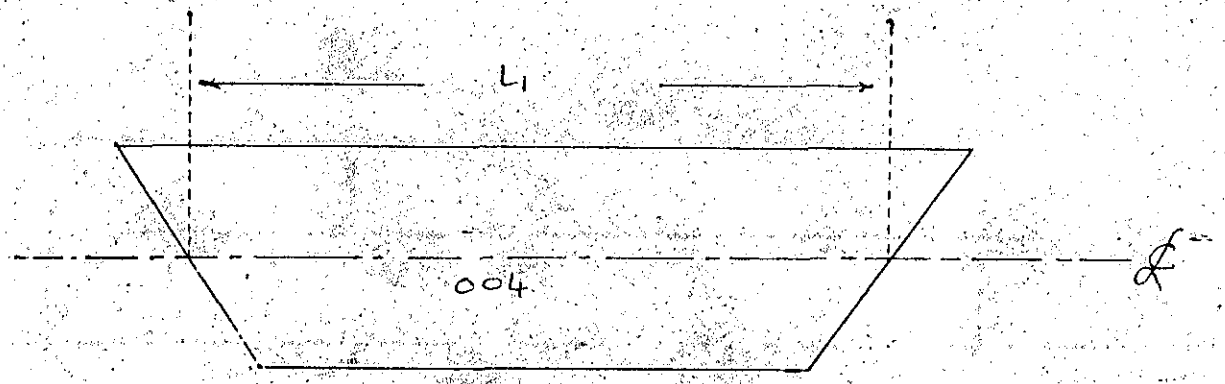


FIG - 1

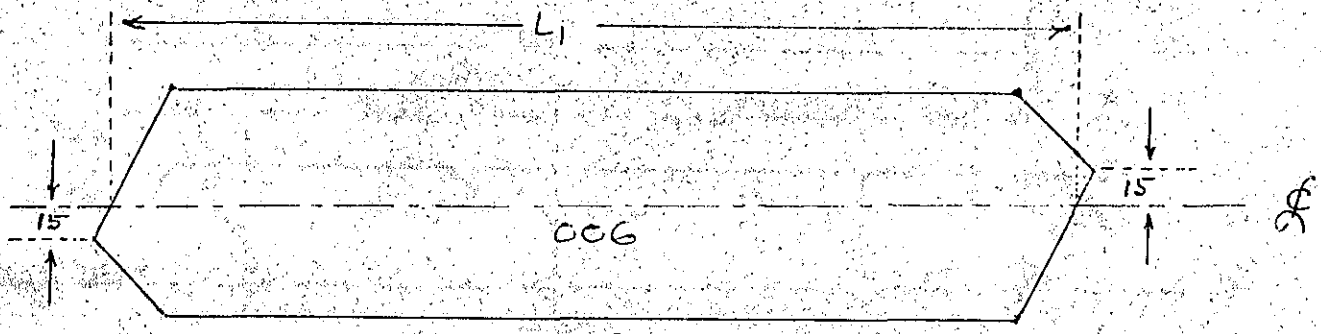


FIG - 2

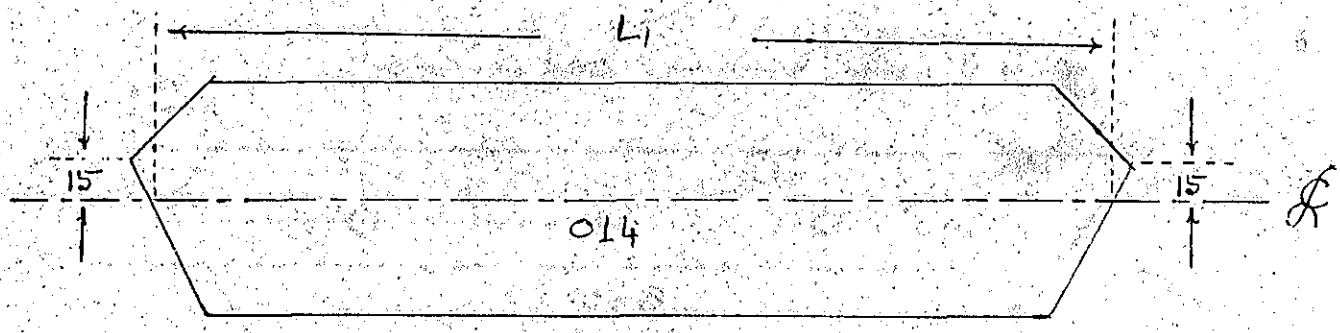


FIG - 3

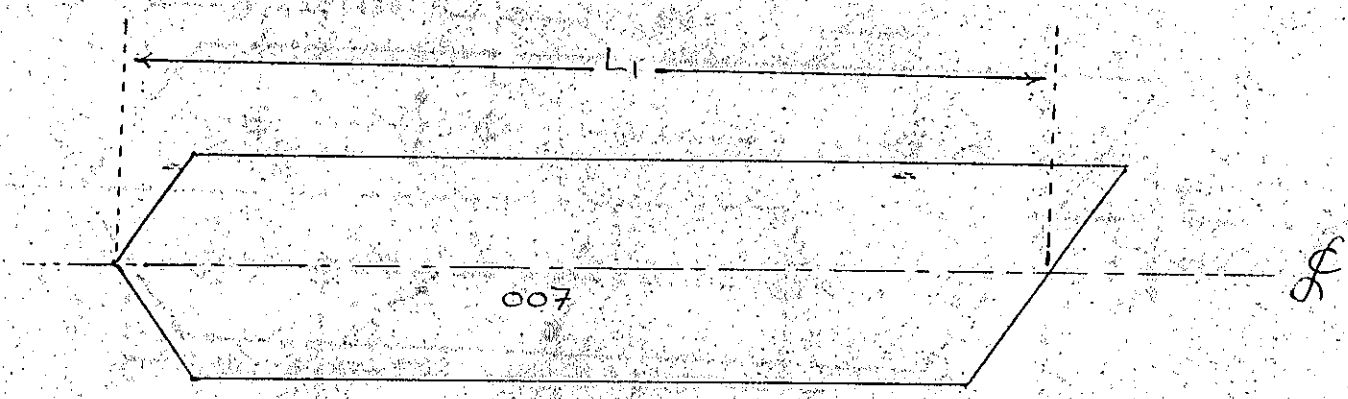


FIG-4

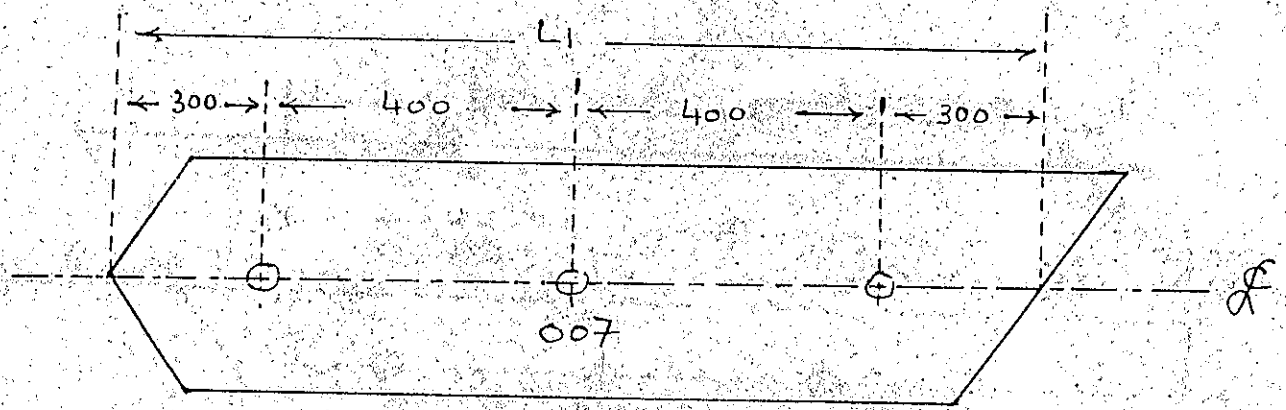


FIG-5 ϕ30/ϕ52

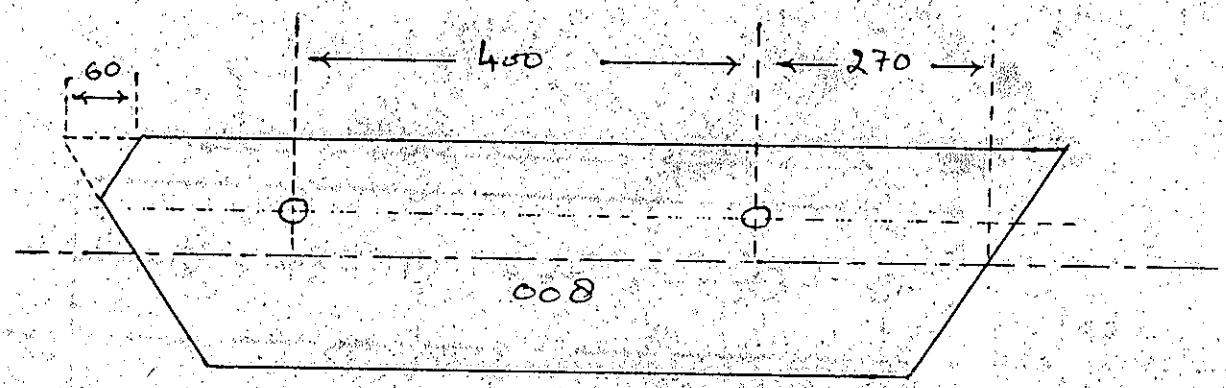


FIG-6 ϕ38/ϕ52

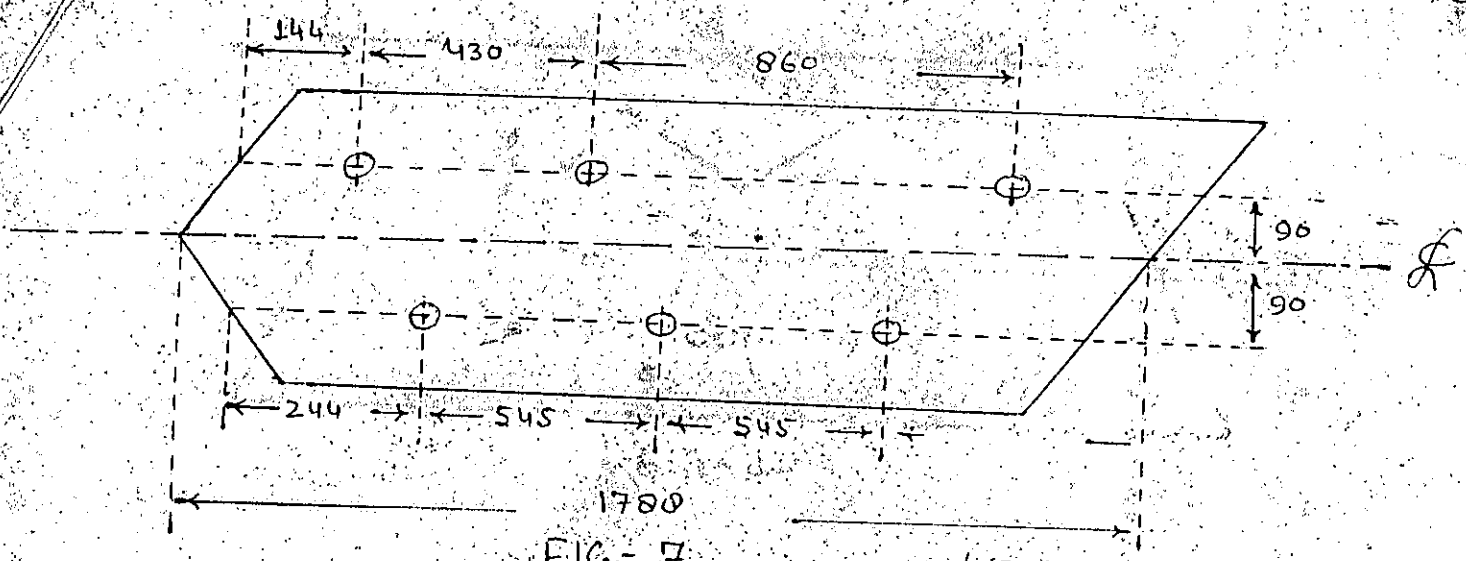


FIG- 7

ϕ 30

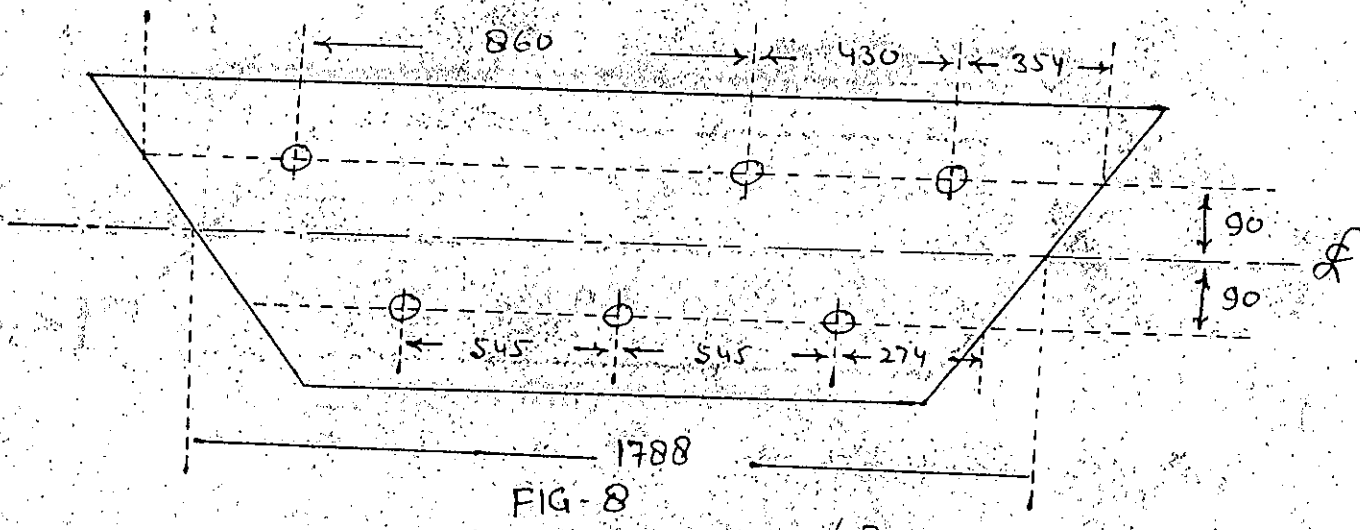
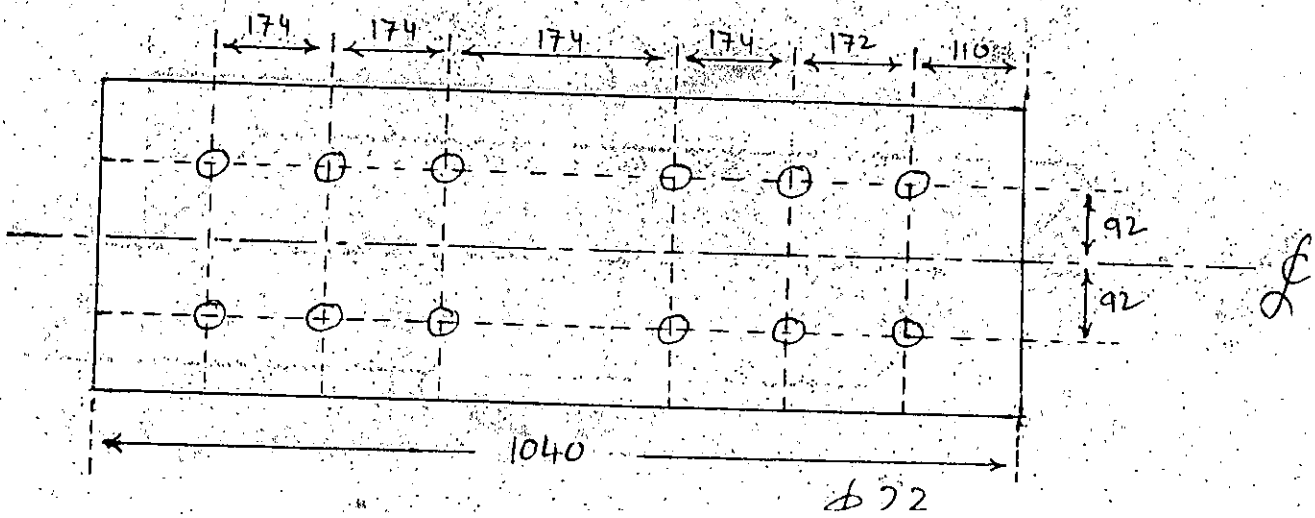


FIG-8

ϕ 30



ϕ 32

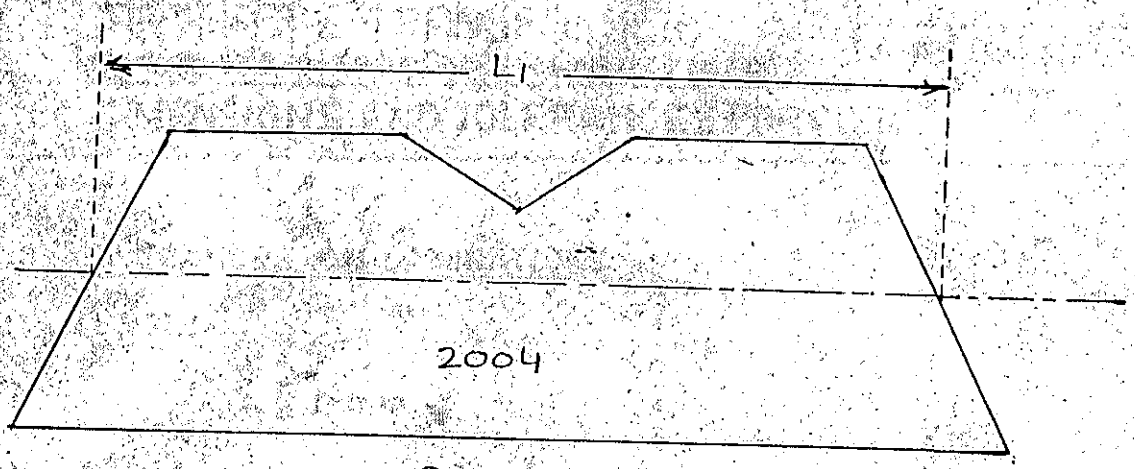


FIG - 10

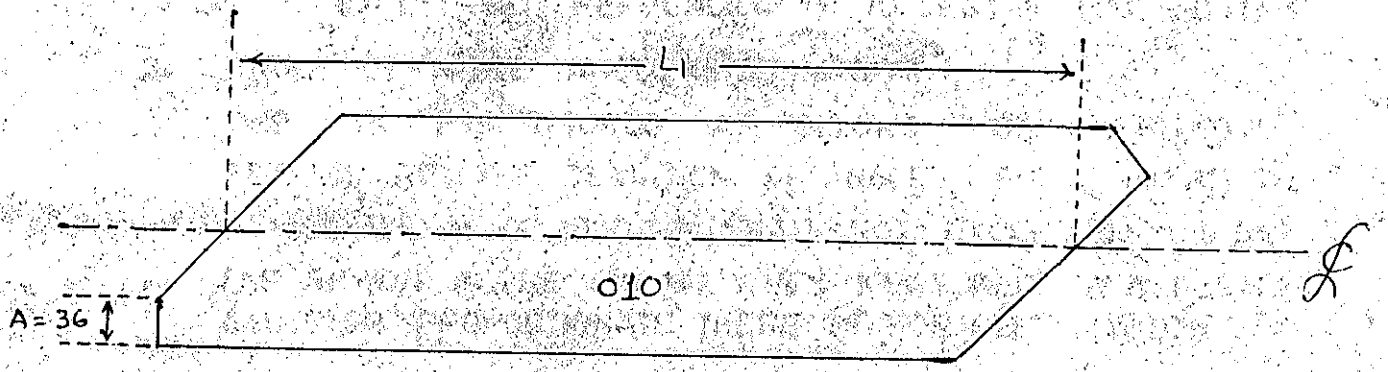


FIG - 11

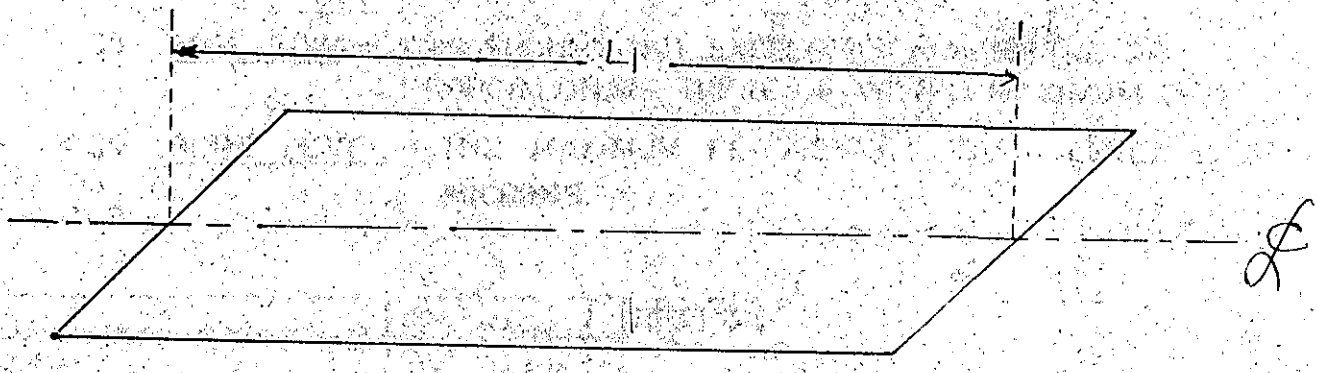


FIG - 12

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI
(WORKS ENGG. & SERVICES DEPARTMENT)

DETAILS OF EXISTING EQUIPMENT:

ITEM NO.	:	MT- 1376
OUR PURCHASE ORDER NO.	:	7108T12 DATED 13-06-2000
SUPPLIER	:	M/S SOENEN BELGIUM
MACHINE MODEL	:	TRL1000

1.0 DESCRIPTION OF THE MACHINE :

The machine, known as CNC cropping line, is meant for cutting lamination pieces out of C.R.G.O. (Cold Rolled Grain Oriented) steel rolls. The basic machine consists of three installations, namely, the de-coiler, the cutting table, the diverting unit and the sheet stackers. The machine derives its name (Cropping Line) from the basic fact that its cutting table comprises a series of tools, like punching units, V-notching units, and shearing units in a sequential line so as to produce the lamination out of the steel sheet running through the sheet guides of the cutting table. The input material, i.e., CRGO steel roll is loaded on the de-coiler of the machine. In between the de-coiler and the cutting table, there is a loop pit. The input sheet steel is made to form a loop in the loop pit before it enters the cutting table. The loop pit is equipped with electronic sensors to ensure availability of material before the cutting table. The cutting table is equipped with a set of top & bottom feed rollers at its entry so as to grab the input sheet and ensure further movement of the sheet along the sheet guides of the cutting table. Tools for various operations, as described already are located on either side of the sheet guides to execute respective operations. In automatic mode , the line will go on producing laminations as per the shape and dimensions defined in the particular cutting program, out of the CRGO steel sheet and will ensure proper stacking of the cropped lamination in a pair of top & bottom stackers located at the end of the machine. A sketch of the machine is given in "page 12 of 14" to understand the overall configuration of the machine.

(1.1) Some Special Features of the machine:

As has been shown in "(page 12 of 14 of this Annexure –I)", all the tools of the machine are movable across the width of the line(from centre line of the machine towards the direction of their location), to position them as per the requirement of the cutting program in "automatic" mode. Usually this happens at the start of an automatic cycle before cutting any material. Throughout the period of cutting, the tools stay in the position initially achieved. The tools and their corresponding motor & drive units are described below with reference to (page 12 of 14 of this Annexure –I):

- The first tool, punch unit 1 or PU-1 is driven by M1 under control of a KEB drive.
- The second tool, punch unit 2 or PU-2 is driven by M2 under control of a KEB drive.
- The third tool, tip cutting unit 1 or TU-1, is driven by SM3 under control of an INDRAMAT drive. This unit is having an absolute encoder for position feedback.
- The fourth tool, tip cutting unit 2 or TU-2, is driven by SM4 under control of an INDRAMAT drive. This unit is having an absolute encoder for position feedback.
- The fifth tool, V-notching unit, is driven by SM5 under control of an INDRAMAT drive. This unit is having an absolute encoder for position feedback.

- The sixth tool, shearing station, comprises a set of shears mounted over a common platform. The first shear S1 is indexable and it can have either an angle of 45 degree or 90 degree with the guide. The second shear S2 makes an angle of 135 degree with the guide. The shears are the most essential tools of the machine as no shape of lamination is practicable without having any shear cut. The shearing station is driven by M9 under control of a KEB drive.

The total sheet guiding system of the machine consists of 16 segments of guides driven by individual motor and drives over ball lead screw. All the motor –drive (KEB) units are under a position control loop with an incremental encoder for moving the individual guide segment over ball lead screw. All the segments are also having their individual reference position equipped with a proximity sensor.

For safety there are also two more proximity switches for defining the maximum and minimum limits of the guide movement. All the motors are normal squirrel cage induction motors driven by vector drives of KEB make.
The details of this with reference to "(page 12 of 14 of this Annexure –I)", are given below.

- The guide segment before feeder (BF) is driven by M3.
- The guide segment after feeder (AF) is driven by M4.
- The guide segment after tip cutter (ATC) is driven by M5.
- The guide segment after V cutter (AVC) is driven by M6.
- The guide segment before shear1 (BS1) is driven by M7.
- The guide segment after shear1 (AS1) is driven by M8.
- The guide segment before shear2 (BS2) is driven by M10.
- The guide segment after shearing station (ASS) is driven by M11.
- The guide segment sheet stacker1 (ST1) is driven by M12.
- The guide segment sheet stacker (ST2) is driven by M13.

The decoiler station of the machine is equipped with two decoiler heads. The heads are selectable through a rotary turn head. The input CRGO roll is loaded on either of the two heads. There are three induction motors driven by vector drives in the de coiler station. One motor is for rotating the turn head whereas the other two motors are for moving the particular de coiler head during operation of the machine. During automatic operation of the machine, the selected de coiler head is required to regulate its speed so as to keep pace with the sheet demand in the cutting table.

In the cutting table, there are two servo motors moving in tandem for feeding and positioning sheet within the machine. The cropped laminations are carried to the diverting unit by conveyor belts driven by simple induction motors. The diverting unit directs a lamination alternatively towards top or bottom stackers. The two stacker units at top and bottom are again equipped with servo motors to position and stop the cropped lamination precisely before dropping it to the sheet pallet by a pneumatic pusher.

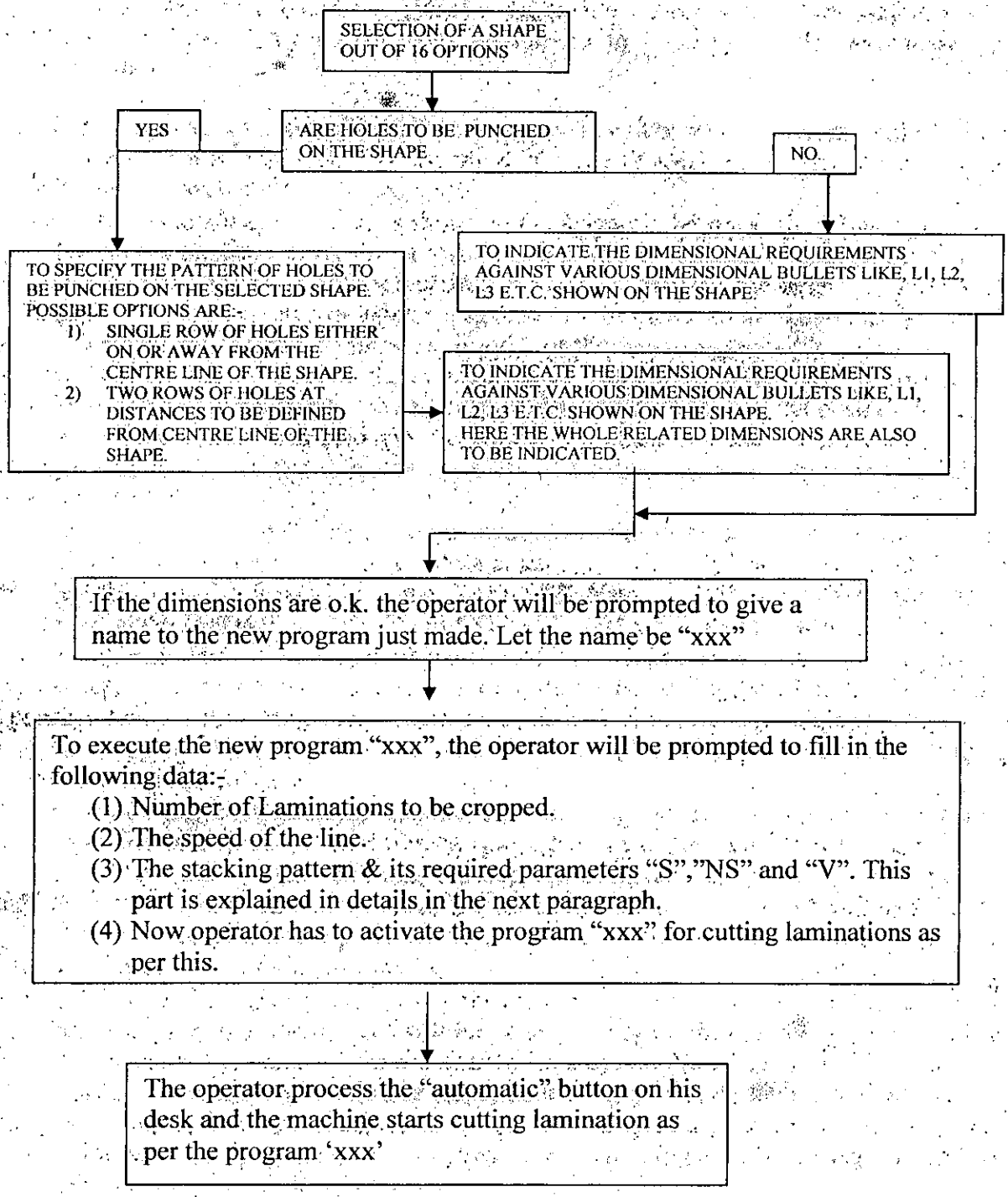
Facility to move all the above motors at a fixed jog rate in manual mode is a mandatory requirement of the machine for making the machine ready for production. Once the machine is ready with presence of sheet up to shear1, the "automatic" mode can be selected for cutting laminations as per shape and size defined in the cutting program.

(2) Machine Operation:

There are about 16 shapes of lamination. All the shapes are indicated in "ANNEXURE-2". Depending upon the production requirement, the operator loads a roll of particular width on the de-coiler of the machine and then selects the particular shape that is to be cropped over the line. After selecting the particular shape, the operator is required to feed in the required dimensions of the lamination with respect to the basic geometry of the lamination. The machine can accept a roll having a sheet width ranging from 100 mm to 1000 mm. The input steel roll is generally loaded on the de-coiler of the machine and then it is uncoiled manually to place the sheet within the sheet guide of the cutting table after leaving a sufficient loop within the loop pit. To be more precise, the sheet is kept beneath the feeding roller of the machine, so that the sheet could be moved over the cutting table as per job requirement. Here the configuration of the machine, given in "(page 12 of 14 of this Annexure)", may please be referred, to understand the operation of the machine described hitherto. The shear 1 of the machine is always taken as the reference tool for all automatic operations. Hence all automatic production schedules usually starts with a cut by the reference tool, i.e. the shear 1. After this the movement of sheet to the specific tool location as per requirement of the cutting program will be done by the main feeder servo motor of the line. The presence of sheet beyond shear is sensed by a proximity sensor placed over the cutting table. Naturally the first sheet produced by the machine is always a scrap sheet. Actual production takes place only from the second sheet. In between the de-coiler and the cutting table, there is a loop pit equipped with optical sensors so as to ensure a regular availability o input material for the line. A sonic sensor, capable of sensing the diameter of the input steel roll is also there to regulate the uncoiling rate of the de-coiler motor so that the loop pit is never without sufficient material. Finished laminations are stacked in two stacking platform, placed one above another. Sheet conveyors and a two way diverting unit are there to carry the respective lamination to its desired stacking platform. Normally to produce a stack of particular laminations, the machine operator is required to perform the following activities, step by step.

- To reference all the guides of the machine in case the machine is to be started after a power off.
- To position the guides as per requirement of the sheet width.
- To load a roll of CRGO of the required width on one of the de-coiler heads of the m/c. The machine is equipped with two de-coiler heads. Usually while using one head for the job under process, the other head is kept loaded with the material planned for the next job. In this case, the operator has to place the head loaded with the required material in front of the machine by selecting it.
- To raise the pneumatic foldable table between de-coiler and cutting table for bridging the loop pit. This is required to move sheet from the de-coiler upto the rollers of the feeder.
- To raise the measuring and feed rollers of the cutting table. As soon as the sheet comes beneath the measuring and feed rollers , both the rollers are brought down to grab the sheet.
- Once sheet is grabbed by the rollers in the cutting table , the foldable table is lowered down to expose the loop pit.
- The de-coiler is then moved forward to fill sheet inside the pit. In case the sheet reaches bottom of the pit it can be brought up either by moving the sheet inside the cutting table by moving the feed roller or by moving the de-coiler head slightly in the reverse direction.
- A button called " de-coiler in auto" is then pressed. Once this button is pressed the de-coiler adjusts itself by moving forward or reverse to obtain an optimum level of sheet inside the pit. After this adjustment the lamp of "de-coiler in auto" will lit up. Once this lamp starts burning, the de-coiler will move automatically to fill sheet inside the pit even when sheet is moved in the cutting table by pressing the manual jog switch of the feeder roller.

- To manually move the material till the end of the shear-1.
- To cut a program, the operator can either load an old program or he can make a new program. If an old program is to be used the operator needs to load that programme in the active directory before activating it for actual cutting on the machine. In case a new program is to be made, the operator has to follow the following steps.



(3) Stacking Modes:

The machine supports five different modes of stacking laminations. These five different modes are Straight, Zig zag, Llap, Cvlap and Clap. The operator has a choice of selecting any one out of the five available options by clicking the particular option of his choice. After selecting the particular option, the operator will have to define the three defining parameters, indicated as "S(steps)", "NS(Nsame)", "s" and "v (variable displacement)" to exactly define the desired mode of stacking the cropped laminations. Please refer to the diagram enclosed along with the descriptions of the various modes of stacking to understand these. (A particular shape conforming to shape no:-006 has been chosen in the illustrative example)

- STRAIGHT: In this mode of stacking all the laminations will be of the same dimension and these will be stacked in a straight pile. To activate this mode of stacking the operator is needed to define: Steps = 1, Nsame = 1, s = o and v = 0.
- ZIG-ZAG: In this mode of stacking, as shown in the diagram, the stacking will take place in two steps. The number of sheets stacked in a particular step will be defined by the number entered by the operator against "s". There will be a definite lateral shift between the steps (sub stacks) which will be as per the value entered by operator against "v". In the example shown, as "s = 5", there will be 5 laminations of same dimensions, in each of the two sub-stacks. So we can say that in this case: Steps = 2, Name = s (5 in the example) and v = the required displacement between sub-stacks. From the functional point of view, the machine will need to shift the position of the holes and V-cuts of the laminations belonging to second sub stack while keeping the overall length unchanged , in such a way as to match the holes of the two sub stacks even after shifting the second stack by "v".
- LLAP: In this mode of stacking, as shown in the diagram, the centre length of the laminations (tip to tip distance) are required to be same, while creating a shift of "v" between the edges of each step. . Here the control system will assume: Steps = "s", Name = "NS" and "v"= the shift between steps. In the given example as, "s"= 3 and "NS" = 1 and "v"=v, there will be three steps, each having a single lamination, the edges of which will have a shift by a of "v" with respect to the previous step. Functionally the machine control system will need to position the shear cuts and the punched holes in the laminations in such a way as to have all the holes aligned properly while having the edgewise shift. Because of the shift in the edge, the shape of lamination belonging to different steps will be different.
- CVLAP: In this mode of stacking, as shown in the diagram, the dimensions of laminations belonging to different steps will be different. Here again the control system will assume: Steps = "s", Name = "NS" and "v"= the shift between steps. In the given example as , "s"= 3 and "NS" = 1 and "v"=v, there will be three steps, each having a single lamination, which will be shifted by a length of "v" with respect to the previous step. In this case the shift "v" will make a lamination shorter by 2v with respect to its previous step.
- CLAP: In this mode of stacking, as shown in the diagram, the dimensions of the laminations other than holes, belonging to different steps will be same. Here again the control system will assume: Steps = "s", Name = "NS" and "v"= the shift between steps. In the given example as , "s"= 3 and "NS" = 1 and "v"=v, there will be three steps, each having a single lamination, which will be shifted by a length of "v" with respect to the previous step. Functionally the machine control system will need to manipulate the holes of laminations pertaining to different steps in such a way as to obtain a perfect alignment of holes.

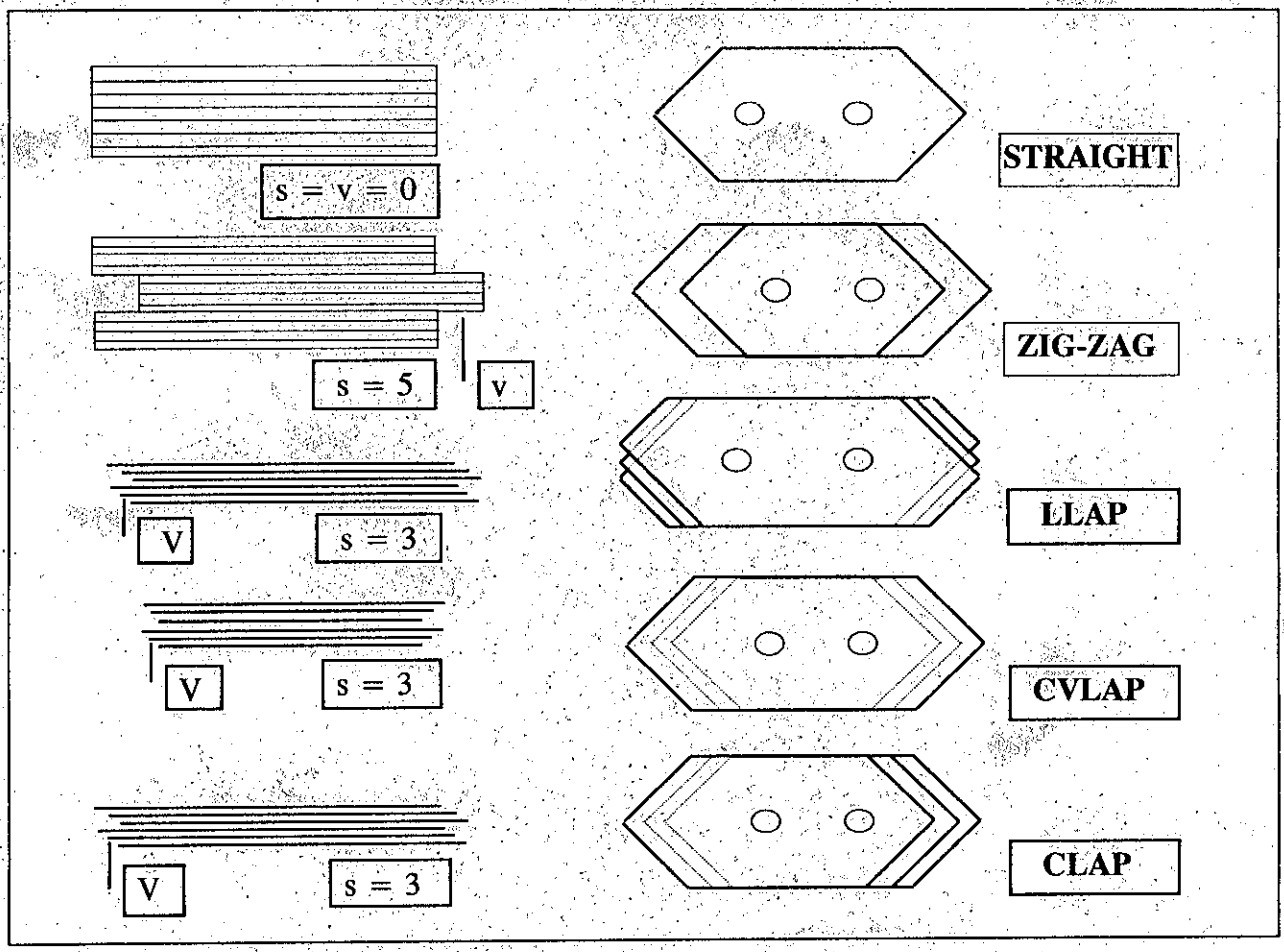
  After selecting a particular mode, the operator will be prompted to feed in only "s" and "v" in case of all the options. In case of "LLAP", "CVLAP" and "CLAP" he will be needed to fill in "NS" as well. (In the example we have taken NS =1. If, "NS"= 2, then each step will have two identical laminations.

The feature of various " step lap" cutting of laminations is an important feature of this machine as transformer cores built with step lap laminations offers less magnetic loss resulting in considerable saving of CRGO steel.

Example of various "step lap" stacking modes

Below is a drawing of a 006 product with the different stacking methods. Identical concept applies to cutting of other shapes under different variety of stacking options. In this context the other shapes given in "ANNEXURE-2" may be referred to have an idea of the various shapes of laminations, which are usually cut on this machine. While developing application software for this machine the following aspects shall be considered and incorporated as a built in feature of the application developed.

- There shall be a base application to achieve the profile defined against each shape. Each base application shall have options for incorporation of holes in the respective shapes.
- Various dimensional data fed by the operator shall be linked to specific assignable parameters conceived by application devloper.
- Selection of various stacking method will call for manipulation of the various assinable parameters as per the specific requirement of the stacking pattern desired. Developing such an application may need manipulation of the base application with assignable parameters by use of subroutine or macro programming.



The machine operator is generally required to operate the machine in the manual (Hand) and automatic modes only to carry out his required activities. The machine control system offers three modes which are defined as "Hand", "Setup" and "Automatic". The "setup" mode is mostly used by the maintenance group to set up and tune various tools and items of the machine. A flow chart indicating various modes and the functions/features available under these is given in the following page to illustrate the various functional capabilities of the existing control system. The existing control concept offers various softkeys under various menues (mostly through mouse selectable software buttons and menues) to realize various functions on the machine. For an example if the operator desires to reference a guide segment he can do so clicking : MANUAL -→ ADJUSTMENT GUIDE -→ SELECTION OF PARTICULAR GUIDE , SAY, BF → SELECTION OF JOG → SELECTION OF FORWARD OR REVERSE. **Because of this there are not much harwared button on the operator's desk to realize various required functions. This aspect is very important for conceiving the operational aspects of the machine with a new control system.**

Manual	Set Up	Automatic

Actual Position Display & movement of

- Feeder
- Measuring Wheel
- Guides.
- All servo axes (TC1,TC2,VC,ST1,ST2,HA)
- All adjustment axes (All guide driving motors, Punch unit1, Punch unit2, ASS e.t.c.)
- Selection of motor encoder or Line Pulse Generator.
- Decoilers & turn head

Manual Operation of Tools

Shear1, Shear2, V-cut, Punch-1, Punch-2, Sheet conveyors,

Display & Editing of parameters for

- All Servo axes
- All adjustment axes
- Offsets for various tools (Shear1, Shear2, TC1, TC2, PC1, PC2, V-cut e.t.c.
- Creation and password protection for parameter edit.
- Calibration parameters.
- Definining pulse weightage of various encoders.

Program creation & Loading.

-Creation of New Program.
-Editing of old Programs.
- Loading a old Program.
- Saving a Program
- Activating a Program.
-Delete a Program

Auto adjustment of Tools & Guides

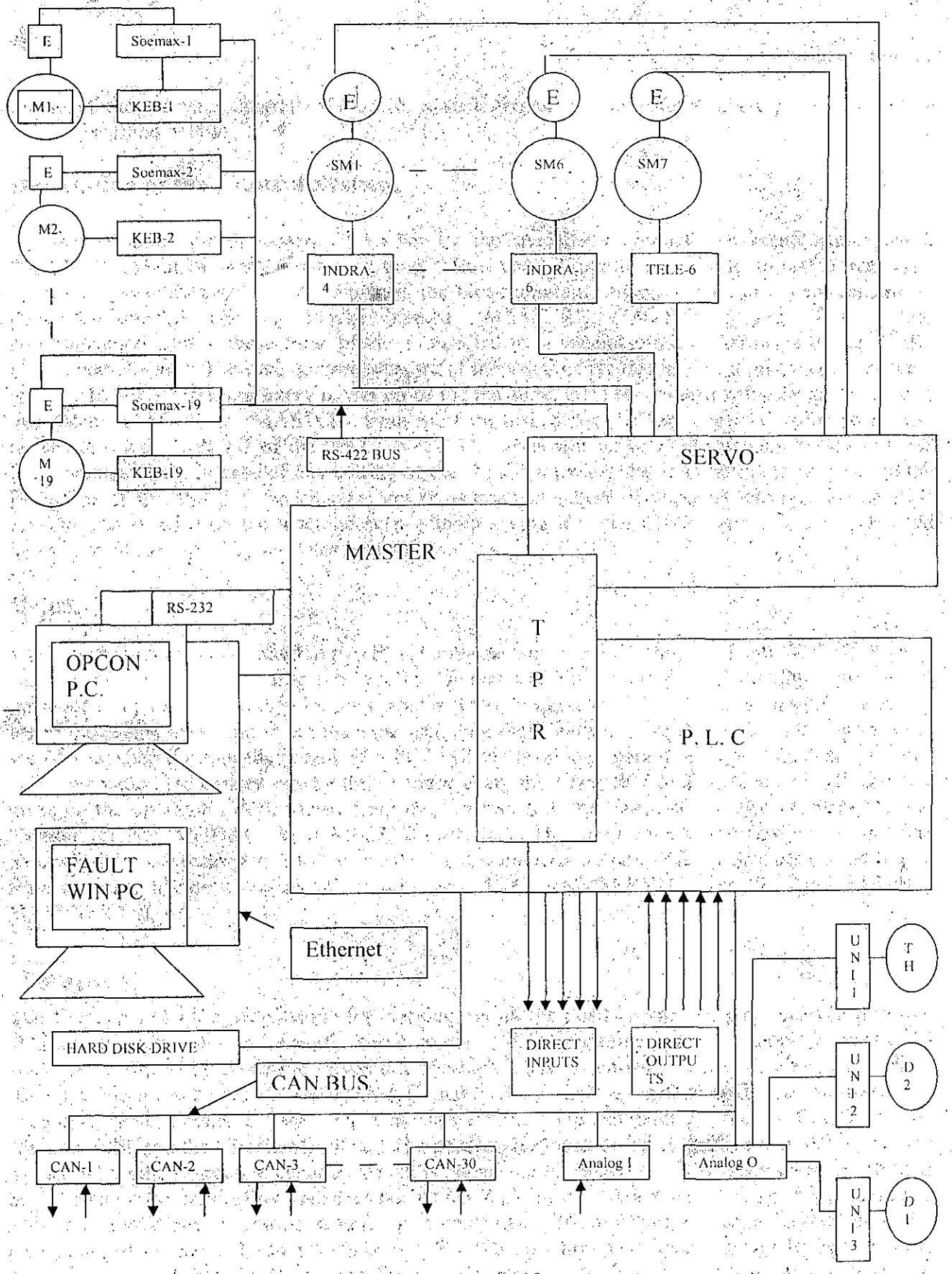
- Automatic positioning of tools & guides as per requirement of program loaded.
- Auto adjustment of stacker height and stacker guides.

Auto calibration.

Automatic calibration of pulse length

Auto Parameter setting.

To set line speed and delays in tool operation to obtain proper output.


E
Soemax-1
M1
KEB-1
E
Soemax-2
M2
KEB-2
E
Soemax-19
M 19
KEB-19
E
SM1
E
SM6
E
SM7
INDRA-4
INDRA-6
TELE-6
RS-422 BUS
SERVO
MASTER
RS-232
OPCON P.C.
FAULT WIN PC
T
P
R
P. L. C
Ethernet
HARD DISK DRIVE
CAN BUS
DIRECT INPUTS
DIRECT OUTPUTS
CAN-1
CAN-2
CAN-3
CAN-30
Analog I
Analog O
UNI 1
TH
UNI 2
D 2
UNI 3
D I

Please refer to the block diagram of the CNC system given above to understand the description of the system furnished below.

Description of the Control System.

The existing control system is known by the machine manufacture's brand name, called "MODAC" (Modular Axis Control system). This control platform is built around a real time operating system named OS9. As shown in the block diagram, the basic control system consists of three fundamental building blocks, named "MASTER", "MOTION", and "PLC". Inter communication among these three blocks is handled by a special piece of hardware called "TPR" (Triple ported Ram). The core control software of the machine resides in a hard disk drive connected to the "MASTER". During every power on of the machine, this core control software gets loaded to the system RAM of the "MASTER" from the hard disk drive (HDD). The PLC software usually resides in some EEPROM of the "PLC" block. During power on booting this gets loaded to some RAM area in PLC. In case of any editing of the "PLC" software, the same needs to be saved in the EEPROM of the PLC, if the changes are of permanent nature. Temporary changes in the PLC program can be tried on the machine even without saving it in the EEPROM of the PLC. Detailed description of the three key modules is as follows:

Master:

The master module is connected to two PCs, known as "the user PC" and "the Fault Win" PC over an Ethernet network, thus forming the "HMI" (Human Machine Interface) of the CNC system. All operational inputs are keyed in by the operator through the "user PC" to run the machine. Message log of the events occurring in the machine including fault messages are conveyed to the operator by the CNC system through the "Fault Win PC". All the machine operations in the "manual" "set up" and "automatic" are carried out by the operator using the "user PC" and some functional switches given on the operator's desk. Apart from the Ethernet link the "user PC' is also connected to the "Master" of the "MODAC" by a RS-232C serial link. The main control software of the machine under the RT-OS9 resides in side the "master" and from here the task specific data are carried to and from the other two function specific blocks, i.e., "PLC" and "SERVO" over the "TPR" (TRIPLE PORTED RAM).

Servo:

This functional block is responsible for carrying out all the position specific data received from the "Master" by activating the specific servo motor – drive combination. This block is having 10 analogue command ports for the servos out of which 7 have been used in the machine to command the 7 specific servo drives of "INDRAMAT" make. The 7 servo axes of the existing control are the "Feeder-1" and "Feeder-2", the "Tip Cut Unit-1", the "Tip cut Unit-2", the "V-Cut Unit", the "Stacker Top" and the "Stacker Bottom". The position feedback of the respective motors is conveyed to 'Servo" by the respective encoder, which is connected to this block. Obviously there are 10 feed back channels for connecting encoders out which 7 are in use. Apart from commanding the servo axes, this block has a unique feature of commanding 16 motor-drive combinations, used for positioning of guides and some tools over a RS 422 bus through a special bit of hardware called "Soemax" cards. There are 16 "soemax"cards, connected to the RS 422 bus, each having a unique address. The "Servo" places the address of the specific "Soemax" along with the task it is required to perform on the bus. Out of the 16 modules, the one with the matching address picks up the command and execute it by commanding the "KEB" drive to which it is connected. All the "KEB" drives are

simple vector drives, driving ordinary induction motors. The encoders connected to these motors are linked to the "Soemax" modules. After executing the command through the KEB, the "Soemax" monitors the encoder feedback, till completion of the required positioning of the motor. On completion it will indicate the same to the "Servo" over the RS 422 bus.

PLC:

The "Process Machine Interface (PMI)" which includes handling of all process related inputs and outputs of the machine are taken care of by this block. Apart from digital inputs and outputs there are three analogue outputs and one analogue input which needs to be handled by the PLC. The PLC is capable of handling 164 direct digital inputs and 164 direct digital outputs. Apart from this it also supports a "CAN" bus to which a number of PLC sub modules, each having 32 inputs and 32 outputs can be connected. In the existing configuration of the machine, 30 digital sub modules, 1 analogue input module and one 3 channel analogue output modules have been used. The PLC has got its own CPU. Through a serial port (RS-232c) on PLC board it is possible to access the PLC, using the "Fault Win "PC for troubleshooting as well as up/down loading of PLC programme. To and fro Communication between "PLC" and "Master" is again taken care of by the "TPR". The single analogue input module of the "PLC" is meant for sending the analogue signal of the "sonar" device placed beneath the position of the de coiler head in use. With feeding of material in the machine, the diameter of the CRGO coil loaded on the decoiler goes on decreasing resulting in more distance between the "Sonar" sensor and the coil in use. According to this change in the level of the analogue sensor, the decoiler motor driven by one of the analogue output channels of the PLC increases its speed so as to maintain the uniformity in feeding of sheet to the machine. It needs no saying that with reduction in diameter of the loaded coil the de coiler needs to rotate more to maintain the feeding rate of sheet. Apart from the single analog input & the two analog outputs (Two for two de coiler heads), the third analog out put is used for rotating the turn head for selection of de coiler head. Since the machine is quite long the "PLC" sub modules are placed practically all over the machine. Each sub-module usually handles the inputs and outputs of the location around it. However there are some high priority inputs & outputs which are directly connected to the PLC.

Triple Ported Ram:

This block takes care of the to and fro communication among the other three blocks, i.e., the "Master", "Servo" and the "PLC".

Electrics & Control harwares:

Apart from the "MODAC" the system includes the following control hardwares which have been indicated in the diagram of the machine as well as in the diagram of the control system shown above.

- There are 7 "INDRAMAT" make a.c. servo drives & motors in the machine. Of all the servos, the main and the auxiliary servos of the sheet feeder are most vital to the operation of the machine. The two servos for feeder are required to move together during positioning of sheet. However for cutting shorter lamination often it is sufficient to select the main feeder only. Positioning feed back of the sheet moved by the feeder servos is generated by a high resolution incremental encoder which is coupled to a roller preceding the feeder roller. This roller is called the measuring roller and it is moved by the sheet driven by the drive roller coupled to the servo motor of the main feeder. The resolution of the measuring roller encoder is 25000 pulses/revolution. This encoder actually ensures the accuracy in length of the laminations being cropped on the machine. Though the feeder servo motor does have its own encoder coupled to its motor shaft, it is never used for carrying out actual production of jobs.

- If jobs are tried with this encoder, excessive error in dimension is observed. The servo motors for the V cut and the tip cut units are required to move only once during an entire production cycle. However the positioning of these three tools is very important and hence they have absolute encoders for providing feedbacks to the control system. The two servo motors driving the top and the bottom stacker belt are required to position a lamination accurately before it is dropped to the stack pile by a pneumatic pusher. Hence these two motors are required to move frequently in any automatic operation of the line.
- There are 13 "KEB" make vector drives & induction motors in the machine. Apart from the guide segments, the two punching units and the shearing table are also driven by this category.
- There are 6 vector drives of "Control Technique" make to control the motors of the turn head, the two decoiler head and the two stacking cars. Analog commands for the turn head and the two de coiler drives are generated by the 3 channel analog output card of the PLC. Encoders coupled to these motors are connected to the drives for feedback. The speed of the motors connected to the de coiler head needs regulation with reference to the reduction in coil diameter sensed by the "Sonar" and the depth of the loop within the pit. The stacking cars move at a fixed speed. Accordingly no external speed command is given to these drives. These are simply being enabled by the PLC to make a move at a pre determined speed.

SUMMARY OF VARIOUS MOTORS AND DRIVES

INDRAMAT SERVO AXIS DETAILS

	AXIS NAME	DRIVE DETAILS	MOTOR DETAILS	EMCODER DETAILS
1	FEEDER I	INDRAMAT MOD01/1X0422-166 992102 CONTR : TDM1 -100-300-W1 MOTOR : MAC112D -.- HD I (CONT)=65 A I(PEAK)=65 A n(OPERATE) = 2200 RPM MA=50mV/A I/P E1/2 E3/OVM E4/OVM O/P 1500/10 1500/10 1500/10	INDRAMAT PERMANENT MAG. MOT. MAC112D-7-HD-4-C/130-A-1/DI522LV CONVECTION SURF. COOLED MdN 38 Nm 57.0 Nm IdN 42 A 63.0 A TACHO CONST. 3.0 / 1000 MIN-1 BRAKE : 14 Nm 24 V DC +/-10% 0.7 A	HEIDENHAIN ROD 1424.039B / 2500 Id Nr. 297 252 - 32 SR.No. 8 101 021 A W1
2	FEEDER II	INDRAMAT MOD01/1X0118-406 992102 CONTR : TDM1 -050-300-W1 MOTOR : MAC090C C -.- HD I (CONT)=35 A I(PEAK)=50 A n(OPERATE) = 2200 RPM MA=50mV/A I/P E1/2 E3/OVM E4/OVM O/P 3000/10 3000/10 3000/10	INDRAMAT PERMANENT MAG. MOT. MAC090C-1-KD-4-C /110-A-0/DI522LV CONVECTION SURF. COOLED MdN 10.4 Nm 16.0 Nm IdN 17 A 26.1 A TACHO CONST. 3.0 / 1000 MIN-1	HEIDENHAIN ROD 1424.039B / 1250
3	TIP CUT 1	INDRAMAT MOD01/1X0082-178 992102 CONTR : TDM3.. -030-300-W1 MOTOR : MAC063C -.- HS I (CONT)=15 A I(PEAK)=30 A n(OPERATE) = 6400 RPM MA=250mV/A I/P E1/2 E3/OVM E4/OVM O/P 1500/10 3000/10 1500/10	INDRAMAT PERMANENT MAG. MOT. MAC063C-7-HS-3-C / 095-B-1 CONVECTION SURF. COOLED MdN 2.1 Nm 2.7 Nm IdN 6.8 A 8.7 A TACHO CONST. 1.5 / 1000 MIN-1 BRAKE : 3.0 Nm 24 V DC +/-10% 0.6 A	STEGMANN AG 626 WSR ART NO. 4626WSR00000 KN.A00 SN - B70020814 VDC = 10-32
4	TIP CUT 2	INDRAMAT MOD01/1X0082-178 992102 CONTR : TDM3.. -030-300-W1 MOTOR : MAC063C -.- HS I (CONT)=15 A I(PEAK)=30 A n(OPERATE) = 6400 RPM MA=250mV/A I/P E1/2 E3/OVM E4/OVM O/P 1500/10 3000/10 1500/10	INDRAMAT PERMANENT MAG. MOT. MAC063C-7-HS-3-C / 095-B-1 CONVECTION SURF. COOLED MdN 2.1 Nm 2.7 Nm IdN 6.8 A 8.7 A TACHO CONST. 1.5 / 1000 MIN-1 BRAKE : 3.0 Nm 24 V DC +/-10% 0.6 A	STEGMANN AG 626 WSR ART NO. 4626WSR00000 KN.A00 SN - B70020814 VDC = 10-32
5	V-NOTCH	INDRAMAT MOD01/1X0082-178 992102 CONTR : TDM3.. -030-300-W1 MOTOR : MAC063C -.- HS I (CONT)=15 A I(PEAK)=30 A n(OPERATE) = 6400 RPM MA=250mV/A I/P E1/2 E3/OVM E4/OVM O/P 1500/10 3000/10 1500/10	INDRAMAT PERMANENT MAG. MOT. MAC063C-7-HS-3-C / 095-B-1 CONVECTION SURF. COOLED MdN 2.1 Nm 2.7 Nm IdN 6.8 A 8.7 A TACHO CONST. 1.5 / 1000 MIN-1 BRAKE : 3.0 Nm 24 V DC +/-10% 0.6 A	STEGMANN AG 626 WSR ART NO. 4626WSR00000 KN.A00 SN - B70020814 VDC = 10-32
6	STACKER CONVEYOR 1	INDRAMAT MOD01/1X0118-406 992102 CONTR : TDM1 -050-300-W1 MOTOR : MAC090C C -.- HD I (CONT)=35 A I(PEAK)=50 A n(OPERATE) = 2200 RPM MA=50mV/A I/P E1/2 E3/OVM E4/OVM O/P 2000/10 2000/10 2000/10	INDRAMAT PERMANENT MAG. MOT. MAC090C-1-KD-4-C /110-A-0/DI522LV CONVECTION SURF. COOLED MdN 10.4 Nm 16.0 Nm IdN 17 A 26.1 A TACHO CONST. 3.0 / 1000 MIN-1	HEIDENHAIN ROD 1424.039B / 1250
7	STACKER CONVEYOR 2	INDRAMAT MOD01/1X0118-406 992102 CONTR : TDM1 -050-300-W1 MOTOR : MAC090C C -.- HD I (CONT)=35 A I(PEAK)=50 A n(OPERATE) = 2200 RPM MA=50mV/A I/P E1/2 E3/OVM E4/OVM O/P 2000/10 2000/10 2000/10	INDRAMAT PERMANENT MAG. MOT. MAC090C-1-KD-4-C /110-A-0/DI522LV CONVECTION SURF. COOLED MdN 10.4 Nm 16.0 Nm IdN 17 A 26.1 A TACHO CONST. 3.0 / 1000 MIN-1	HEIDENHAIN ROD 1424.039B / 1250

KEB DRIVES AND MOTOR DETAILS

	AXIS NAME	DRIVE DETAILS	MOTOR DETAILS	EMCODER DETAILS
1	BF (BEFORE FEEDER)	INPUT : 50 / 60 Hz AC 1 PH 200 - 264 V. / 14.0 A OUTPUT : 0 1600 Hz MAX. AC 3 PH. 0 - 240 V / 7.0 A POWER : 2.8 KVA AC-MOT: 1.5 KW 2/4 P 50/60 Hz. ART. NO. 09 F4 SID 1220/1.2	3 PAHSE INDUCTION MOTORS WITH BRAKES .55 KW 915 RPM 3 AMP	GI 331.Z02 403000 5 V DC +/- 10% 1024 IMP
2	AF (AFTER FEEDER)			
3	PU1 (PUNCH UNIT 1)			
4	PU2 (PUNCH UNIT2)			
5	ATC (AFTER TIP CUT)			
6	AVC (AFTER V.- CUT)			
7	BS1 (BEFORE SHEAR 1)			
8	AS1 (AFTER SHEAR 1)			
9	ADJ.SS (SHEARING STATION)			
10	BS2 (BEFORE SHEAR 2)			
	AS5 (AFTER SHAERING STATION)			
	ST1 (STACKER GUIDE 1)			
	ST2 (STACKER GUIDE 2)			

UNIDRIVE DRIVES AND MOTOR DETAILS

	AXIS NAME	DRIVE DETAILS	MOTOR DETAILS	EMCODER DETAILS
1	DE-COILER 1	UNIDRIVE CONTROL TECHNIQUE UNI2402 7.5 KW INPUT: 380/440 V 3 PH 50/60 Hz 16.3 A OUTPUT: 380/440 V 3 PH 50/60 Hz 16.0 A OVERLOAD: 24 A FOR 60 SEC. SOFTWARE VERSION : 03.01.05	7.5 KW, 1420 RPM, 3 PH INDUCTION MOTORS	RESOLVER
2	DE-COILER 2		7.5 KW, 1420 RPM, 3 PH INDUCTION MOTORS	RESOLVER
3	TURN HEAD		1.1 KW, 1420 RPM, 3 PH INDUCTION MOTORS	RESOLVER
4	PALLETE CAR 1		4.0 KW, 1420 RPM, 3 PH INDUCTION MOTORS	
5	PALLETE CAR 2		4.0 KW, 1420 RPM, 3 PH INDUCTION MOTORS	
6	HEIGHT ADJUSTMENT (CONTROLLED BY MODAC)		1.1 KW, 1420 RPM, 3 PH INDUCTION MOTORS	GI331.Z02 403000 5 V DC +/- 10% 1024 IMP

MEASURING WHEEL ENCODER DETAILS

HEIDENHAIN
ROD 1424.0398 / 9000
Id Nr. 297 252 - 37

BHARAT HEAVY ELECTRICALS LIMITED, JHANSI
(WORKS ENGG. & SERVICES DEPARTMENT)

SPECIFICATION FOR RECONDITIONING OF CNC CROPING LINE
MAKE SOENEN

1.0 DETAILS OF EXISTING EQUIPMENT:

ITEM NO. : MT- 3/2/1376

MAKE : M/S SOENEN BELGIUM

MACHINE MODEL: TRL1000

DESCRIPTION OF THE MACHINE:

Refer Annexure I (Page no. 1 to 14)

2.0 SCOPE OF WORK (CNC SYSTEM)

2.1 Scope of work in substituting the old CNC controller with a new CNC controller

1. We proposed to retain adjustment axis/ motors, drives (KEB & Control Technique) and other electrics, including the existing control panel as all these items are in good service conditions. As indicated in machine (Annexure I page No14)
2. Interested vendor will have to integrate the new CNC system with the existing drives, motors and electrics detailed out *in or spec.* Space to accommodate the new CNC system after dismantling and removing the existing one will probably not be a problem.
3. With retro fitment of the new CNC system it shall be possible to meet or surpass the functional requirements and features of the machine described in depth in our specification.
4. Broadly speaking the interested vendor will have **to supply a new CNC package** (CNC + PLC + motors + drives +Suitable Interface Hardware's) which **they will need to integrate properly** with the existing drives , motors and hardware's to realize the various functional aspects of the subject machine.
5. **Referencing of all adjustment axis for guide movement shall be ensure in line with control system (as per machine description (annexure-I)**

2.2 Broad specifications of a CNC system likely to substitute the existing one.

1. The new CNC system shall be Siemens 840 D CNC system. We have already retrofitted similar machine with Siemens 810D system successfully in the year 2002. Because of the proven performance of the earlier machine, Siemens 840 D recommended which can accommodate more nos. of axes required in the subject machine.
2. The HMI shall support extensive use of graphics and VB tools for capturing information's required from machine operator for realizing various machine functions as well as the cutting programmes required for automatic production of job.
3. Once the machine has been proven for handling all the desired cutting programmes and the desired machine functions, it should be possible to store the (a) the machine configuration data, (b) the axis specific data,(c) the servo related data,(d) complete PLC programmE with related data, (e) all application programmes developed for various shapes etc. in the HDD(Hard Disk drive) of the HMI.

4. The system shall provide possibility of creation of a ghost HDD of the HMI which may prove handy in case of a hard disk crash of HMI in future. It shall also be possible to have a system restoration diskette for the HMI to handle instances of system crash in future.
5. The new CNC system shall support a standard field bus structure (PROFIBUS, CAN BUS , INDUSTRIAL ETHER NET,) to accommodate the distributed I/Os (refer description of existing system) and the networked drives (Soemax-KEB combo in existing system).

3. SCOPE OF WORK (ELECTRONICS / ELECTRICAL/MECHANICAL) :

1. Replacement of existing control system with Siemens 840d and rewiring the machine with its Distributed IO modules in the existing panel.
2. Replacement of existing Servo Motors & Drives (make Indramet) with Siemens Servo Drives &Motors. All Works/activities towards this are to be under taken by vendor.
3. Synchronization between In feed Servo with Feeder 2 Servo Drive.
4. Software for sheet cutting shapes and data storage.
5. PLC Software for the complete machine.
6. Parameterization control on operator panel.
7. Installation of operator friendly, operator panel.
8. Fixing and fitting of all electrical and control system components/modules in the existing Control panel of the machine.
9. Complete wiring of the new control system to integrate it properly with machine & operator's console.
10. Interfacing & wiring of new AC Servo motors, Drives encoders with the new CNC Control. Fixing of all necessary bracketry and fitments required for the same.
11. Machine wiring shall consist of AC Servo motors, Encoders, Safety switches, proximity switches, interfacing relay boards, wherever required.
12. Mechanical adjustment on the machine where ever required.
13. Guide way to be overhauled and alignment to be done. Guide way, Pins, bearings, nut & bolt to be replaced and material will be provided by BHEL.
14. Damaged control wiring to be replaced.
15. Pneumatic pipes to be replaced.
16. Job proving as per Annexure – II
17. On line lader display & editing facility.
18. Comprehensive diagnostics available on display screen.

4. SCOPE OF SUPPLY

1 Siemens 840D CNC controller System with complete package.
2 Servo motors and drives for feed and tooling will be replaced refer point 1 to 7 of summary of various motors and drives (Annexure I page 13).
3 New operator console
4 Encoder for Measuring Wheel is to be replaced in line with new CNC system. (Annexure I, Page No. 14)
5 External Encoders for adjustment Axes 13 Nos. (Annexure I page no.14 Make KEB) are to be Replaced to suit the new CNC system
6 Six numbers solenoid valves (festo make) and proximity switch (P&F make) to be replaced.
7 Material supply towards Pneumatic pipes and control wiring.(refer Point no.14/15 of above)
8 Following accessories are to be supplied as a part of the PLC and Drives for the retrofitting package.
   a. DI/DO's Module
   b. DI/DO's on distributed I/O modules on Profibus
   c. Analog I/O on profibus
   d. Motor mounting brackets.

e. All Electrical & Mechanical hardware's for interfacing of new Drives and Motors to the new CNC system.

9. Complete Ghost backup in Hard disk.
10. Complete backup of software's used in machine control system and in operator panel.
11. Electrical schematic diagram of the main and operator's control panels.
12. Complete set (Hard Copies - 3 no's) of retrofit manuals(Operations & Maintenance) shall be provided, having following details/documents:

12.1 Ladder Diagram /Cross Reference /IO Listing/Electrical Circuit Diagram /Alarms /Message Listing. Complete PLC Manual.
12.2 Technical spec./brochure/ of all bought-out items used in the machine.
12.3 List of spare parts with part no's for sourcing of spare in future.
12.4 Operational description of various functional features corresponding to functional switches
12.5 Any other items required for trouble free operation and maintenance of the retrofitted machine shall be included in addition to the defined scope of the supply.
12.6 Any other details required for facilitating operational & maintenance aspects shall be indicated.

5. MACHINE INSPECTION:

5.1 Vender shall prove out the machine after retro fitment of new CNC system by cutting the various Shapes / profile, as given in Annexure II.

6.0 MISCELLANIOUS

6.1 Reconditioning work to be done at BHEL Jhansi., Offer must be submitted with details i.e. scope of supply and scope of work.
6.2 All material used for reconditioning of the machine shall meet/match or surpass the quality of the material replaced to restore the original or enhance the machine performance.
6.3 Details of supply items must be given with quantity in Nos. indicating make and model.
6.4 Price brake up to be given of all supplied items & works.
6.5 Time required for reconditioning work to be given along with activity chart.
6.6 The venders should submit offer for complete work. Order shall be given to only single supplier for complete work.
6.7 Guarantee of the reconditioning work shall be given; it shall not be less than 12 months from the date of successful trial & handing over of the Machine.
6.8 Operation & maintenance training to BHEL personnel (two engineers) at principal's works i.e Siemens India Ltd. for control system to be arranged at free of cost.

7 Vendor Qualification

7.1 Only those vendors, who have done at least one number reconditioning/ retrofitting of CNC Cropping line in last Ten years in any of the manufacturing plants of India and have performance certificate to prove satisfactory performance of such machine, are qualified for participating in this tender.

M.K.NAGAICH
Sr. Mgr (WE&S)

1/12/10
INDER MATHUR
Sr. Mgr. (WE&S)

ANSHUMAN MATHUR
Dy. Mgr. (TRM)

1/9/10
S.J.CHAKRABORTY
Sr. DGM (WE&S)

A.K.SHIVPURI
Sr. Mgr (WE&S)