DRIVE, DRIVE CONTROLLERS AND CONTROL CUBICLES FOR AN SLB 1250 BUNCHING MACHINE FOR PHILLIPS CABLES (JOB AUTHORISATION 1456)

1.0 General.

This section of the specification describes the D.C. Drive motors and their associated controllers, lists of A.C. motors are included which are provided with the machine as continuous or intermittent fixed speed drives.

The bunching machine operating system direction is right to left and includes pay-off stands, wire break detectors, a capstan tensioner unit, and a single motorised bobbin load/unload unit. All controls are fitted in the control panel.

Supply voltages generally 460V, 3 phase, 60 Hz. Control voltages - 110V, single phase, 60 Hz, and 24 V DC.

Operator control panel to be painted N.M.C. standard gloss, finish RAL 6011 Reseda Green.

So that interested parties can more fully understand the function of the machine, a short description follows :-

2.0 Machine Functions

The function of this machine is to twist together a number of wires at high speeds up to 1500 twists per minute. The main rotating members together with the rotor ends and bows are driven at speeds up to 750 rpm and the machine produces two twists per bow revolution.

The main machine elements which are driven by Variable Speed D.C. motors during operation are the rotors and bows (the wire twisting elements), the capstan, (the wire or cable core pulling unit), the take-up drum, (the unit onto which the final product is wound), and the traverse mechanism, (which winds the product back and forth across the drum barrel between flanges).
The V.S.D.C. motors with the exception of the traverse motor are fan cooled by constant speed motorised blowers fed from a 110 volt single phase supply within the cradle and 460 volt three phase supply for the rotor motor fan.

2.1 Machine Auxiliary functions.

Auxiliary functions are driven by fixed speed motors :-

Machine cooling fans, pintle engage and retract mechanisms (drum support stub shafts) bobbin lift platform. Auxiliary motors are provided and fitted by N.M.C. as part of the fixed speed motorisation, and operate at 460 volt, 3 phase 60 Hz with the exception of the 110 volt single phase pintle motors.

D.C. Motors, SSD drive controllers, and Allen-Bradley PLC will be free issued by NMC to the selected supplier.

The bow motor is fitted with a tacho generator and the capstan motor with a tacho/encoder combination the take-up and traverse are fitted with tacho's only, so that they can be speed controlled during acceleration, running and retardation.

The ratio between the capstan unit and the bow determine the product lay, (or pitch), bow direction determines the hand of the lay (similar to a right hand or left hand thread).

The speed ratio between the capstan and the take up drum is used to determine the winding diameter, and the current in the take up motor armature, when corrected for winding diameter, is related to cable tension.

Traverse pitch is related to cable diameter and the rotational speed of the take-up drum during acceleration, running and retardation, and is controlled from a potentiometer mounted on the control panel.

2.2 Machine Take Up Bobbin Load/Unload System

The machine is equipped with a drum lift platform driven by a motorised hydraulic pump, which controls the lifting/lowering motions.

3.0 D.C. Drive Motors.

D.C. Motor details are as follows :-

3.1. Main rotor bow motor, frame size LAK200A, is a foot mounted, shunt wound, 440V armature, 414V field, 48.6Kw at 2500 RPM, with Tacho at non drive end and provided with armature and field thermostats and a fixed speed 460 V, 3 phase, 60Hz motor driven cooling fan, ambient temperature 45°C maximum.

3.2. Capstan motor is a foot mounted, GB 132-15 frame size, shunt wound, 440V armature, 90V field giving an output of 22.5Kw at a speeds of 2000 to 4000 rpm fitted with armature and field thermostats and 110 V single phase 60Hz blower, encoder 60 pulses/rev. together with a tacho fitted to non drive end. Ambient temperature 50°C maximum.

3.3. Take up motor is a foot mounted, LAK132A frame size, shunt wound, 440V armature, 90V field giving an output of 6.8Kw at speeds of 2000 RPM and 110V single phase 60Hz blower, and a tacho (60V/1000RPM) fitted to the non drive end.

3.4. Traverse motor is a foot mounted, permanent magnet field, 950 watts at 2000 RPM fitted with a tacho 60 volts/1000RPM and provided with armature choke.

4.00. D.C. Drive Controllers.

The above variable speed D.C. motors are driven by SSD D.C. Thyristor Converters as follows :-

4.1. Rotor Motor D.C. Converter is a 3 phase fully controlled double bridge re-gen converter field supply included and suitably rated for use with the rotor motor.

4.2. The capstan and take up converters are also complete with field supply units. The capstan motor field is supplied through as field weakening unit.

4.3. The traverse converter is a three phase double bridge re-gen converter complete with line and armature reactors.

5.00 Fixed speed A.C. Main Machine Motors.

The machine is equipped with a number of fixed speed A.C. motors in addition to the blower motors described above.

5.1. Machine cooling motors.

2 off 3 phase squirrel cage motors are provided to drive machine ventilation fans. 5.75Kw, 3 phase, 60 Hz, 460V.

2 off pintle engaged/retraction driving motors, single phase, 110V, 60Hz 120 watts.

1 off drum load driving motor of 3 phase,460 V, 60Hz, motor 4.0 Kw.

1 off Door closing/opening motor of 0.55 Kw, 460 V, 3 phase, 60 Hz.

6.0. Operator Control Cubicle

The cubical houses the Allen-Bradley PLC, operator controls and displays, contactors, control relays, A.C. motor starters and contactors with the exception of the pintle motor controls which are provided N.M.C.

N.M.C. will fit a 110 volt A.C. solenoid bolt to the machine door.

6.2. Machine operating direction is right to left.

6.3. The control cubicle drawings are to be provided in outline form, and dimensioned foundation bolt details are to be included in this data, for approval by N.M.C. Drawing "control cubicle requirements " forms part of this specification, and is issued as a guide to control panel layout.

7.0 Complete System.

7.1 The system will be commissioned at N.M.C. prior to despatch and the hardware and software returned to N.M.C. within the control system, shall, when combined with an N.M.C. SLB1250, make a working unit suitable for the manufacture of cable.

8.0 Supply Conditions.

The provision of the drives and control systems or proprietary or specially designed sub-assemblies associated with the attached Purchase Order includes commissioning at our works. You have examined in great detail and made your own judgement of the commissioning times which are likely to be involved.

A requirement of this contract is that commissioning shall be complete in every respect, and no extra funds will be made available to you if you encounter problems you have not envisaged.

Issued by : _____ Date : 20-2-90

Approved by: _____ Date : 20-2-90

Issue 2 - Reason for reissue:

Section 3.1 [440V armature was 480V
[414V field was 310V
[frame size was 180 XS
[48.6Kw was 50Kw
[Phrase "Ambient temperature 45°C maximum" added

Section 3.2 & 3.3 - 440V armature was 480V
Section 3.2 [Frame size was 132T
[22.5Kw was 19Kw
["Ambient temperature 50°C maximum" added

Section 3.3 [6.8Kw was 5.6 Kw
[Frame size was 132Q

MACHINE CONTROL ARITHMETIC FOR AN SLB 1250 BUNCHING MACHINE FOR PHILLIPS CABLES (JOB AUTHORISATION 1456)

1.00. General

The performance of the SLB 1250 Bunching/Stranding Machine is determined by setting input data into an Industrial Computer. Such data would normally be transcribed into analogue or digital signals which are compared with analogue or digital feed back signals, any resulting error being used to correct machine performance.

2.00. Input Data.

Data Name	Description	All operating Data Input From Control Cubicle-
Machine speed in RPM	Rotor speed in RPM	Potentiometer.
Lay in MM	Pitch of product MM	Thumb Wheel (four digit)
Lay direction Left Hand	L.H. Lay	)Combined)
Lay direction Right Hand	R.H. Lay	)Switch
Traverse pitch	Dia. of cable.	Potentiometer on front of cubicle.
Take up running tension	0 - 40 Kg	Potentiometer.
Stand on torque	This number is derived from running torque.	Automatic.
Cable lengths metres	Length of cable.	
Preset Length	Set by counter. (six figure)	Set length counter by thumb wheel, six figure. Machine runs to length complete and stops.
Totalizer	Total length (six figure)	Reset to zero by control button

2.00 Input Data cont

Data Name	Description	All operating Data Input From Control Cubicle-
Capstan Tension	Centre	Set by potentiometer
Capstan Tension	Outers	Set by potentiometer

Main rotor motor acceleration rate will be set on the drive module speed ramp. Take up bobbin dimensions, are as follows :-

	Nominal Drum size	Actual Drum Size
Flange dia. mm.	1250	
Barrel dia. mm.	630	
Traverse width mm.	800	

Door open and close push button plus a pitch potentiometer will be mounted on the face of the control cubicle, with machine capstan jog, traverse jog, and Jog All, push buttons and bow disable push button together with platform raise, lower pushbuttons, and load run and brake release switches on the side of the cubicle.

3.00. Output Data.

The output data is arranged to control the machine in accordance with the machine control arithmetic described later and will display on analogue instruments the machine performance as listed in Section 4 of this Specification.

4.00. Machine Control Arithmetic.

The capstan motor is fitted with both a tacho and encoder, the traverse, bow and take-up motors are fitted with tachos only. The signals from the capstan motor tacho/encoder combination are gated by the rotor proximity and fed after signal conditioning into a Computer where the requisite calculations are undertaken and where signals correcting machine speed, speed ratios, armature currents etc., are derived and sent to the appropriate drive control systems.

Reference to Drawing Number , will provide the majority of data required. Stand on torque is the rest torque, and when applied to a stationary take up bobbin should be 30% of full load running torque.

The control computer should operate sufficiently rapidly so that corrections occuring during acceleration and retardation at maximum controlled rate are not noticable and an absolute maximum deviation of 3.5% from the set lay will be permitted to occur during the most rapid machine acceleration and retardation, although attempts should be made to keep this deviation to a minimum.

SYSTEM CONTROL AND SEQUENCING FOR AN SLB 1250 BUNCHING MACHINE FOR PHILLIPS CABLE (JOB AUTHORISATION 1456)

1.0. General.

The control system is required to control a number of A.C. squirrel cage motors, lift platform, ventilation fan motors, as well as a group of four D.C. motors. The functions of the D.C. motors are described more fully in Specification Sections 1,2 and 4.

2.0. D.C. Motors.

Two of the four main machine D.C. Motors are driven in sychronism (at pre-selected ratios) and drive,rotor and capstan. The drum drive motor maintains a preset winding tension in the cable, and the traverse motor is related by winding pitch and reversal to drum speed and flange position respectively.

3.0. Fixed Speed Motors and Other Controls.

3.1 D.C. motor cooling fans, these operate continuously whilst the main isolator is closed. (N.B. the traverse motor has a P.M. field and no fan).

3.2 Machine cooling fans, two off, operate when isolator closed, desk emergency stop released, and machine doors closed.

3.3 Pintle motors are operated to insert and retract bobbin pintles when, and only when the loading platform is in the load position.

3.4 Drum loading platform is raised by a motor driven unit. This is operable only when the machine is at rest, the bow is in the correct loading position, the machine doors are open, and load switch has been selected,lowering is also only operable under the above conditions.

3.5 Guard door motor. This motor is only permitted to operate when the machine is at zero speed, although it is not necessary for the bow to be in the loading position when the machine is at zero speed.

3.6 Loading system. The machine lifting table may be equipped with two adjustable height limit switches, a platform down switch, and a safety trip switch, which is operated from the underside of the platform when lowering.

4.0. OTHER CONTROLS.

4.1 Machine Lights.

These can be switched on and off from the operators control cubicle.

4.2 Cradle Control Panel.

The Cradle Control Panel forms the end face of the control cubicle and will be equipped with two position switches labelled load and run. In the load position the loading system is enabled and platform switches may be fitted to detect bobbin size.

The Panel is equipped with push buttons to raise and lower the platform, and to move the traverse left or right.

A bow disable push button is also provided. These operate in the following fashion. If the bow disable push button is operated when the doors are closed, the machine shall be stopped and a non mutable audible alarm shall be actuated. The bow disable push button shall not disable the door opening facility.

Jog push buttons. These facilities are available for capstan, traverse control; and capstan, traverse, and drum together, and is only available when pintles are engaged and the platform is in the down position.

Entry and retraction of pintles are controlled from push buttons mounted on the machine cradle. Jog capstan only permitted when selector switch is in the load position.

5.0. Supply system controls.

5.1 On threading wires from the supply stands and over various tensioners, pulleys and wire break detectors, and locking out those switches which are not required, the control cubicle wire break over-ride switch should show input system healthy when not over-ridden. Separate terminals for additional wire break detection are to be incorporated.

6.0. System Control Sequence.

This section describes in words the functions of the various machine components and how they relate to the machine operating conditions, and assumes conditions on both the wire supply system, and bobbin load/unload systems are healthy, or machine not loading.

6.1 Power must be connected to the drive system,to open the doors.

6.2 With the isolator closed and power connected it should be possible to open and close the doors.

As power is available to the door motor contactor it can be opened from the machine door push buttons by operating the door open button.

Doors can only be opened when the machine is at rest.

6.3 The supply system wire break switches, have to be made or over-ridden to permit machine running, although machine jog is available for the capstan and drum together, and the fast traverse when the machine doors are open.

Machine running is only permitted when machine doors are shut and bolted.

The machine doors are closed by operating (within 0.5 secs of one another), two spaced apart push buttons on the cubicle.

With the supply wires tight and all wire break detectors healthy, with the twisted product broken wire switches also showing healthy, machine doors closed the pintles inserted into the bobbin and registered home and platform properly lowered, and all the machine vent fans running, and supply stand broken wire switches healthy, the machine is in a run condition.

If during the operation of the machine the machine guard doors are not fully closed, then the machine shall operate in the emergency stop mode.(All motors regenerating in synchronism to stop capstan and drum last)

In the event of a broken input wire the machine will operate in fast sychronised stop. In the event of twisted product break occuring the machine will operate in fastest stop available, i.e. non synchronised re-generating power to line until the system is at rest, when the rotor pneumatic brake may be applied and the power to the bow, capstan, take up drum, and traverse, removed.

During normal operation the machine accelerates slowly at a pre-determined rate to the selected operating speed. Prior to the length complete signal being received the machine is instructed to slow down to crawl then run on at crawl speed until final length signal stops machine. At zero speed the rotor brake is applied.

Issued By: _____ Date : 4 - 4 - 90

Approved By: _____ Date: 4-4-90

Issue 2
Reason for reissue: Deletion of Section 3.7 "Traverse End Stops The turn round proximities (two off) are motor driven via push buttons on the control panel."

Specification No. 0088
Section 4 of 5 Sections.
13th December 1989.
Issue No.1.

OPERATOR CONTROLS FOR AN SLB 1250 BUNCHING MACHINE FOR PHILLIPS CABLES (JOB AUTHORISATION 1456)

General.

The SLB 1250 Control System is based on manual control of the main rotor motor drive. Automatic computer controls of drive ratios, current, relay logic analogue displays of motor speeds and current. Most functions are accessable to the machine operator but an industrial P.L.C. is utilized to undertake high speed arithmetic and relay logic replacement and used for control interlocking purposes where safety considerations permit. Emergency stops are hard wired.

1.0. Operator Control Cubicle

1.1. The operator control cubicle illustrated on Drawing No..... which forms part of this Specification. The local isolator, controls, instruments, indicators and fault monitoring lamps are there depicted and their functions explained. An audible alarm is incorporated which forms functions :-

A. Alarm operates if capstan overspeeds when machine is running. This alarm can be cancelled by adjusting machine controls, or if over speeding is not possible this function is deleted.

B. Alarm operates if bow disable push button is pressed and doors are closed. This situation indicates personnel trapped in machine and will only be muted on machine doors being opened.

2.0. Machine diagnostics.

These comprise the fault monitor lights on the control panel and indicate the situations described by the lamp labels when extinguished (lamps are illuminated for system healthy).

Issued By: _____ Date: 15-12-89

Approved By: _____ Date: 15-12-89

THE PROVISION OF ELECTRICAL DRAWINGS, MANUALS, DATA, AND SOFTWARE FOR AN SLB 1250 BUNCHING MACHINE FOR PHILLIPS CABLES (JOB AUTHORISATION 1456)

1.0. General.

The suppliers of electrical equipment against all or parts of this specification shall provide to N.M.C. three copies of all mechanical (where applicable) and electrical data so that N.M.C. can provide to their clients comprehensive Operating and Maintenance Manuals.

2.0. Data Constructions.

Written data will ultimately be bound into A4 size Operating Manuals, and it is of considerable assistance if data is made available in this size documentation to N.M.C.

Electrical drawings should be on A3 size documents suitable for filing (left hand margin) and folding into an A4 size manual.

The data shall be constructed so that the electrical sections of the manual can be split into the following sub-sections:-

Sub Section.	Data to be supplied by-
SLB 1250 Supply System comprising:-	[
Supply stands	[
Capstan Tensioner	[NMC/Chosen Contractor
SLB1250.	NMC/Chosen Contractor
Lift Platform.	NMC

Explanatory notes shall be concise easily read and understood by Technicians, and describe in broad terms the various sub-systems, and refer in some detail to system function, cover commissioning and installation, start-up, operation (running), - preventative maintenance etc.

Three copies of the manuals in English are to be provided for use with this equipment.

A quotation covering spare parts sufficient for one years operation (5000 Hours) shall be provided with the quotation for the system.

3.0. Software

NMC require some introductory words confirming that the programme complies fully with this specification, particularly regardidng machine arithmetic, and interlock functions for all parts of the sdystem, together with a detailed annotated programme, and two copies of the programme on 5.50 ins. floppy discs, as well as the requisite relay logic replacement diagrams for the PLC's.

Issued By: _____ Dated: 15-12-89

Approved By: _____ Dated: 14-12-89