

# NC CUSHION DESCRIPTION

For

General Motors Corporation

LE-6500T Transfer Press

(#7, #8, #9, #10)

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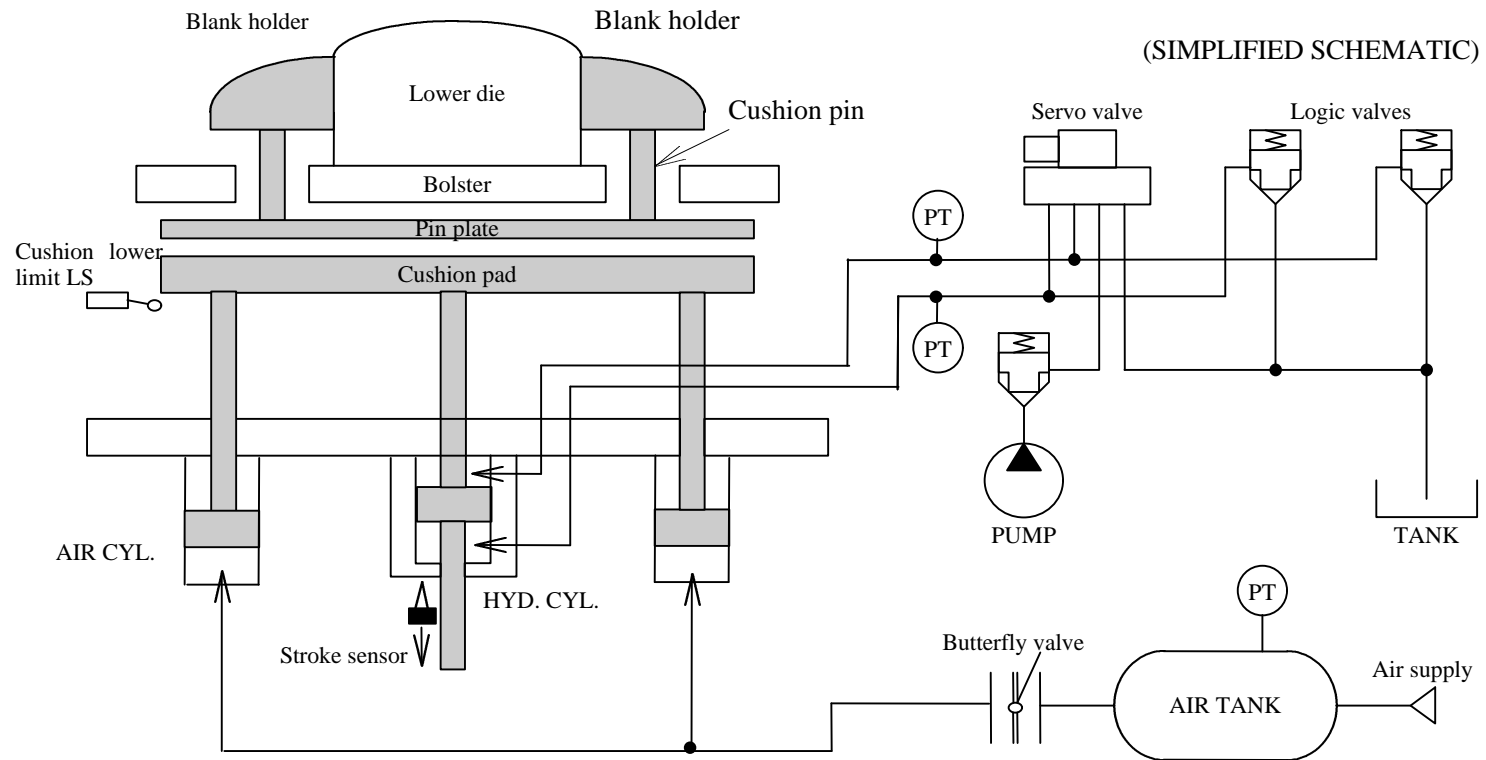
Apr. 25,2000

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## 1. GENERAL DESCRIPTION

NC Cushion system is installed at #1 work station and the system is used to control the cushion force, cushion raise and lower by hydraulic and pneumatic system. NC Cushion system is equipped by two (2) pneumatic cylinders and one (1) hydraulic cylinder. Pneumatic cylinders are controlled by the butterfly valve / air supply / air exhaust and hydraulic cylinder is controlled by the servo valves and the logic valves. At NC Cushion force control, the oil flow out amount from lower chamber of hydraulic cylinder is controlled by the servo valves during the down stroke of the press sensing the hydraulic pressure by pressure transducers. At Cushion raise and lower control, cushion position is controlled by the servo valves sensing the cushion position by the cushion stroke sensor.



The control function of N.C. Cushion.

The N.C. control portion of the cushion is single point N.C. control.

Control function of Pre-acceleration , N.C. Pressure control , Locking , Aux. Lifter and Cushion Damper control is provided.

The N.C. Cushion control system incorporates the ability to display position and pressure (load) information graphically on the Line Supervisor display monitor.

The cushion pressure (load) is controlled by a preset parameter as a part of the die recipe. The following items are able to be set as a die recipe and can be changed on the Panelview screen.

Eight (8) points of cushion pressure (load) setting according to the press slide angle.

Mode selection of N.C. Cushion “ Use - No use”.

Mode selection of Preacceleration “ Use - No use”.

Mode selection of Locking “ Use - No use”.

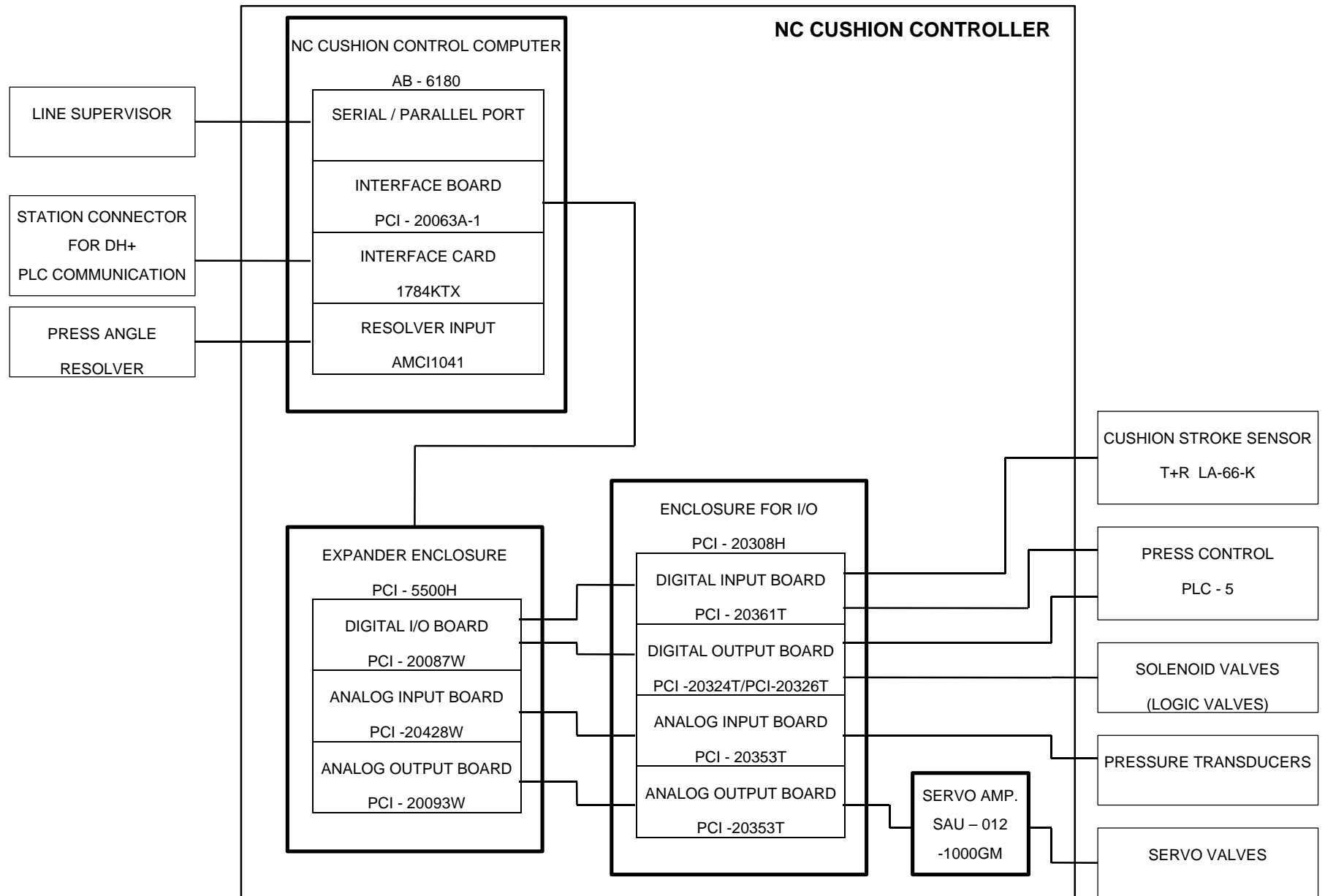
Mode selection of Aux. Lifter “ Use - No use”.

Hydraulic pressure of N.C. Cushion is controlled by two (2) sets of IHI Direct Driven Servo Valve. The rated capacity of the servo valve is 264 GPM (1000 LPM).

All solenoid valves on the manifold unit are controlled by N.C. Cushion Controller.

The pneumatic and the hydraulic pressures (both upper and lower chamber) are detected by the pressure transducer and the cushion stroke is detected by T+R linear absolute encoder (LA-66-K).

## 2. SYSTEM CONFIGURATION (GENERAL)



## 2.1 HARDWARE COMPORNENTS

Manufacturer	Description	Model Number	Q'ty
Allen-Bradley	T81 Computer	6180ABABCBACABZ/A	1
Allen-Bradley	Communication Interface card	1784KTX	1
AMCI	Resolver Input Board	AMCI1041	1
Intelligent Instr.	Digital I/O Board	PCI-20087W-1	3
Intelligent Instr.	Digital I/O Cable	PCI-20311A-1	9
Intelligent Instr.	PC Bus Host Interface Board	PCI-20063A-1	1
Intelligent Instr.	PC Expander Enclosure	PCI-5500H-1	1
Intelligent Instr.	16/8 Ch. Analog Input Board	PCI-20428W-1	1
Intelligent Instr.	Termination Panel Adapter	PCI-20430A-1	1
Intelligent Instr.	8 Channel Analog Output Board	PCI-20093W-1	1
Intelligent Instr.	Analog Cable	PCI-20310A-1	2
Intelligent Instr.	Analog I/O Panel	PCI-20353T-1	2
Intelligent Instr.	Voltage Input Block	PCI-5B42-02	4
Intelligent Instr.	Voltage Output Block	PCI-5B49-05	8

Manufacturer	Description	Model Number	Q'ty
Intelligent Instr.	16 Channel Digital Input Board	PCI-20361T-1	3
Intelligent Instr.	Optically Isolated Panel	PCI-20324T-1	6
Intelligent Instr.	Termination Panel Expander	PCI-20326T-1	4
Intelligent Instr.	DC Digital Output Block	PCI-1109	64
Intelligent Instr.	Enclosure(for I/O boards)	PCI-20308H-1	1
Intelligent Instr.	AC Digital Output Block	PCI-1112	16

### 3. SOFTWARE DESCRIPTION

#### 3.1 MODE COMBINATION

No.	Preacceleration	Cushion force control	Locking
1	Not used	Not used	Not used
2	Not used	Not used	Used
3	Not used	Used	Not used
4	Not used	Used	Used
5	Used	Not used	Not used
6	Used	Not used	Used
7	Used	Used	Not used
8	Used	Used	Used


The function of NC Cushion (Preacceleration, Cushion Force Control and Locking) can be selected at any combination as listed above.

“Used” or “Not used” of each function is selected on the basis of the Die Recipe Data and can be changed by use of Panelview manually.



## 3.2 RELATIONSHIP BETWEEN EACH MODE AND VALVE OPERATION

NC Cushion operation modes include the following. Relationship between each mode and valve operation is described for each operation mode.

3.2.1)	Standby for the cushion to rise	
3.2.2)	Cushion rise (first time)	
3.2.3)	Standby	 Ordinary stroke
3.2.4)	Preacceleration	
3.2.5)	NC control	
3.2.6)	Locking	
(1)	Locking with lifter	
(2)	Locking without lifter	
3.2.7)	Cushion rise	
3.2.8)	Lifter holding	
3.2.9)	ADC mode	
3.2.10)	Error processing	

### 3.2.1 STANDBY FOR CUSHION RISE

In this mode, air to be supplied to raise the cushion for use.

"CUSHION RISE COMPLETION OFF" & "CUSHION RISING OFF" mode

SOL	for ACCUMULATOR PRESSURE (3701)	OFF
SOL	for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3)	ON
SERV	NC CUSHION SERVO VALVES (3701, 2)	0%
SOL	for NC CUSHION SERVO CONTROL UNLOAD STOP (3782)	ON

In this case, communication can be received.

**NOTE 1. ACTUAL DEVICE NUMBER OF EACH SOLENOID VALVE AND SERVO VALVE ARE SHOWN BELOW.  
HOWEVER, FOR EASY UNDERSTANDING, ON THIS DESCRIPTION, THESE WILL BE DESCRIBED BY USING \*A AS  
SHOWN ABOVE.**

\*ASDESCRIBED ON THIS DESCRIPTION

ACTUAL DEVICE NUMBER

SOL	for ACCUMULATOR PRESSURE (3701)	: 40627 SOL HA, 40628 SOL HA
SOL	for LOWER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702)	: 40629 SOL HA, 40630 SOL HA
SOL	for UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3703)	: 40631 SOL HA, 40632 SOL HA, 40633 SOL HA, 40634 SOL HA
SOL	for NC CUSHION SERVO CONTROL UNLOAD STOP (3782)	: 40639 SOL HA
SERV	NC CUSHION SERVO VALVES (3701)	: 40803 SERV
SERV	NC CUSHION SERVO VALVES (3702)	: 40827 SERV

### 3.2.2 CUSHION RISE

Operation for returning the cushion to the upper end is performed. At this time, the soft damper is operated to reduce the shock occurring when the upper stroke end is reached.

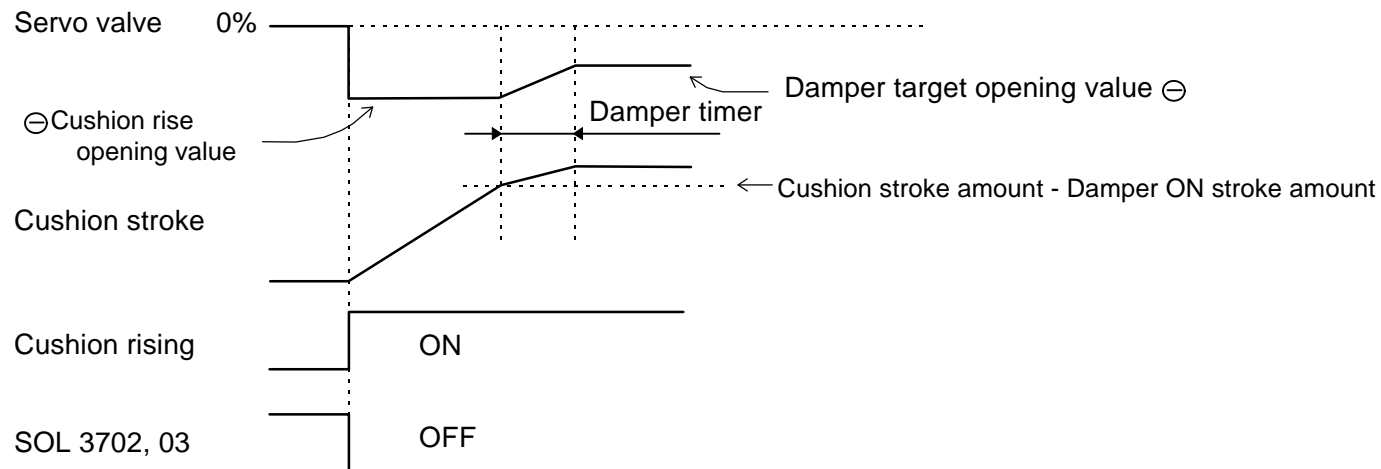
"CUSHION RISE COMPLETION OFF & CUSHION RISING ON" mode

SOL for ACCUMULATOR PRESSURE (3701) OFF

SOL for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3) OFF

SERV NC CUSHION SERVO VALVES (3701, 2)

- 1) Cushion rise opening value for up to cushion stroke amount + damper ON stroke amount (one direction).
- 2) Further than the above, interpolation is made up to the target damper opening value by means of a damper timer (Large, medium or small interpolation is available through air pressure.) (One direction)



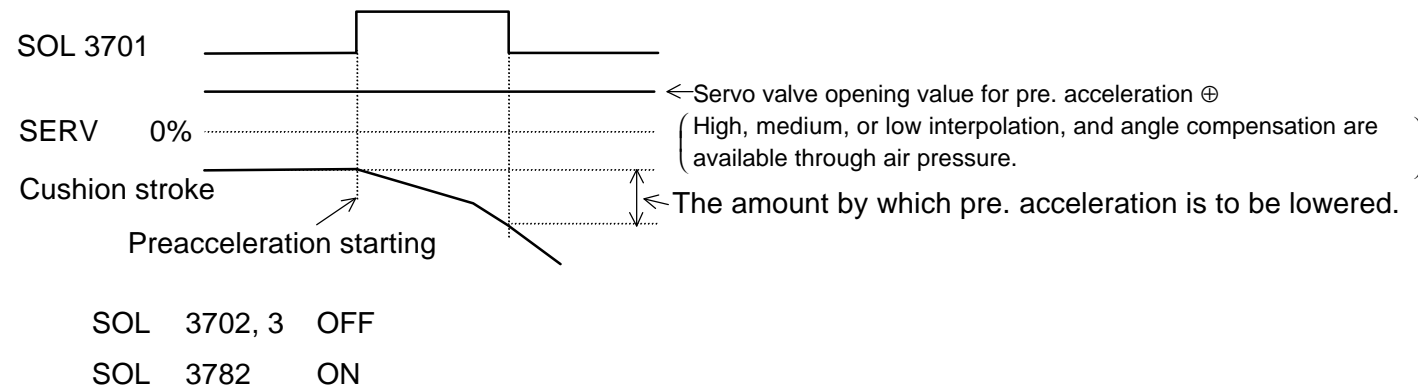
### 3.2.3 STANDBY

This is the mode in which NC Cushion has been ready for operation, allowing each mode or control to be accepted. In Standby mode, the slide returns to the home position and the next control mode is ready for starting, allowing mode switching and control. The servo valve opening amount and the solenoid operation differs depending on the mode shown on below.

	<b>ACCUMULATOR PRESSURE  (SOL 3701)</b>	<b>LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE  (SOL 3702, 3)</b>	<b>NC CUSHION SERVO VALVES  (SERV 3701, 2)</b>	<b>NC CUSHION SERVO CONTROL UNLOAD STOP  (SOL 3782)</b>
With Pre acceleration	OFF	OFF	⊕ Opening value for preacceleration	ON
Without Pre acceleration With NC	OFF	OFF	⊕ Standby opening value	ON
Without Pre acceleration Without NC With locking	OFF	OFF	⊕100%	ON
Without Pre acceleration Without NC Without locking	OFF	ON	⊕100%	ON
Preacceleration setting mode	OFF	ON	⊕100%	ON
ADC mode	OFF	ON	⊕100%	ON

### 3.2.4 PREACCELERATION

This mode is used for lowering the lower die when the upper die comes in contact with the bottom die, thereby reducing the shock at the contact of both upper and lower dies..



Angle compensation for starting the preacceleration function is available.

### 3.2.5 CUSHION FORCE CONTROL

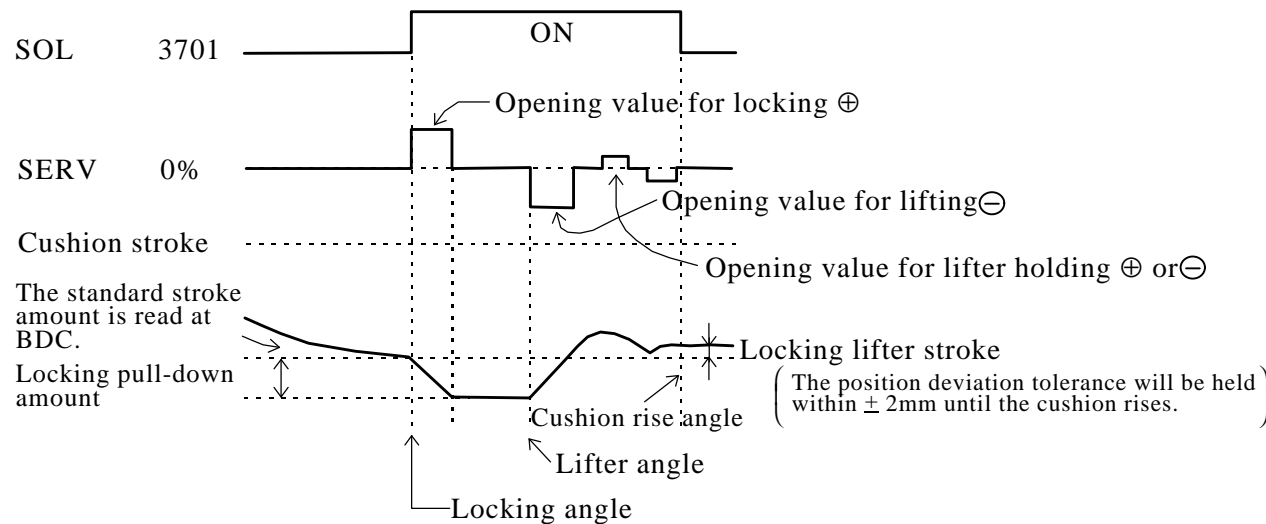
This control mode will start when the actual pressure become larger than reference pressure (REF<ACT) or at NC control angle. The servo valves will control so that actual pressure (ACT) will be equal to reference pressure (REF). In this mode, the servo valve opening amount is controlled in PI calculation of the difference between the reference pressure and the actual pressure. The control at this time is available for the direction of the pressure releasing, that is controlling the flow out amount of oil from the lower chamber of hydraulic cylinder is controlled.

SOL	for ACCUMULATOR PRESSURE (3701)	OFF
SOL	for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3)	OFF
SERV	NC CUSHION SERVO VALVES (3701, 2)	⊕ Servo valve opening value for control
SOL	for NC CUSHION SERVO CONTROL UNLOAD STOP (3782)	ON

### 3.2.6 LOCKING

#### 1) When lifter is not used

The lower die is lowered by the locking pull-down amount at the locking angle, and then is raised by the locking lifter stroke amount at the lifter angle. This lifter position is to be held through PI control until the slide stroke angle reaches the cushion rise angle, so that the die position control deviation tolerance will be within  $\pm 2\text{mm}$ .

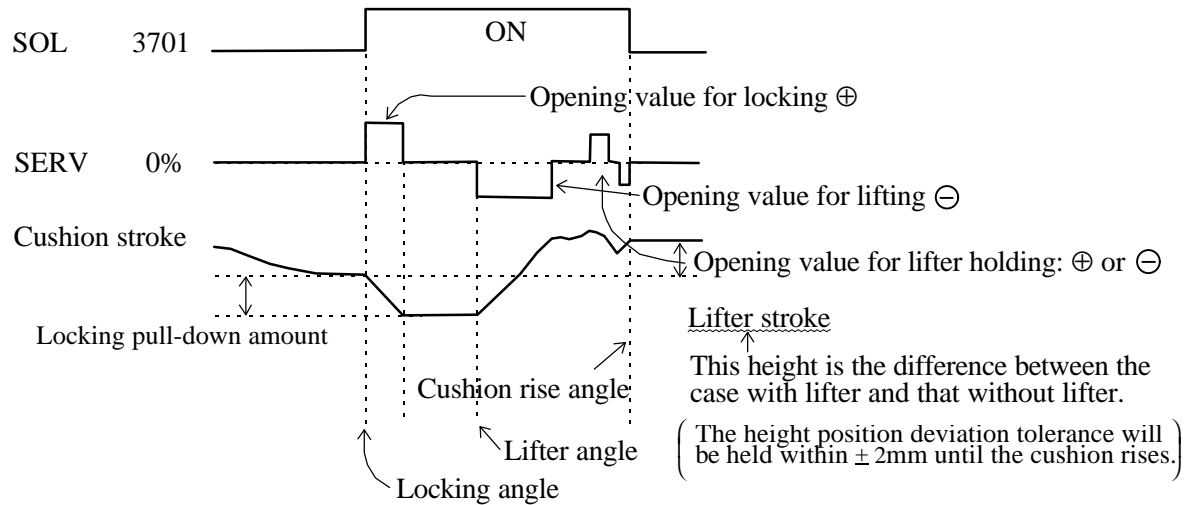


SOL for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3) OFF

SOL for NC CUSHION SERVO CONTROL UNLOAD STOP (3782) ON

The angle compensation function is available (for both locking and lifter).

2) When a lifter is to be used.



SOL for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3) OFF

SOL for NC CUSHION SERVO CONTROL UNLOAD STOP (3782) ON

The angle compensation function is available (for both locking and lifter)

The locking pull-down amount and the lifter position can be set at the Panelview screen.

### 3.2.7 CUSHION RISE

The cushion rises at cushion rise timing.

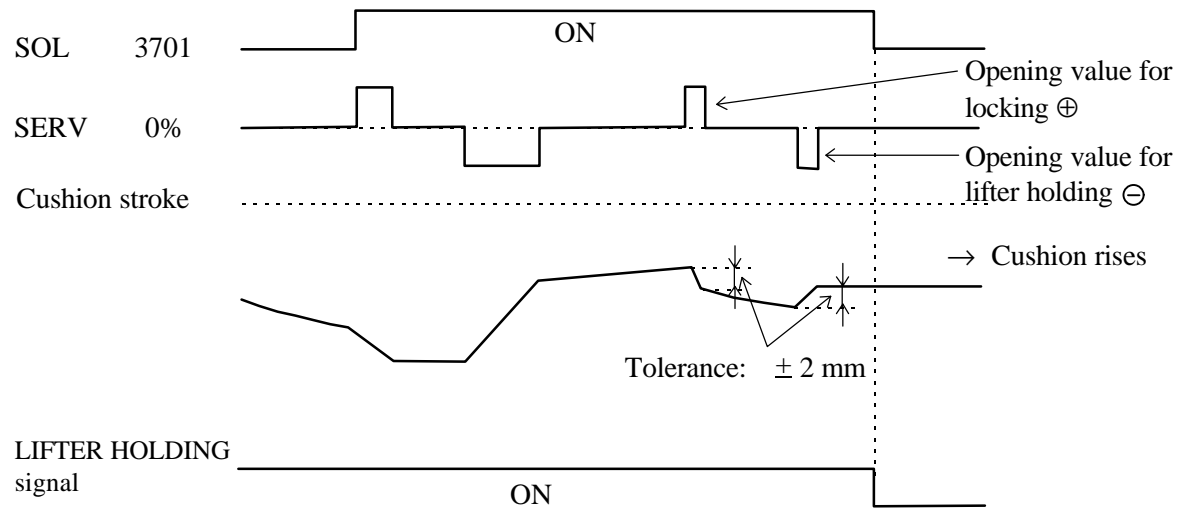
Other operation will be the same as for "3.2.1 Cushion Rise".

The angle differs depending on the use or non-use of the angle compensation function or locking.  
(Large, medium or small opening value interpolation is available through air pressure)



### 3.2.8 LIFTER HOLDING

The lifter position is held upon completion of the lifter rise by PI control while the LIFTER HOLDING signal remains ON, so that the tolerance will be within  $\pm 2$  mm.



### 3.2.9 ADC MODE

Mode at ADC

SOL	for ACCUMULATOR PRESSURE (3701)	OFF
SOL	for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3)	ON
SERV	NC CUSHION SERVO VALVES (3701, 2)	⊕ 100 %
SOL	for NC CUSHION SERVO CONTROL UNLOAD STOP (3782)	ON

### 3.2.10 ERROR MODE

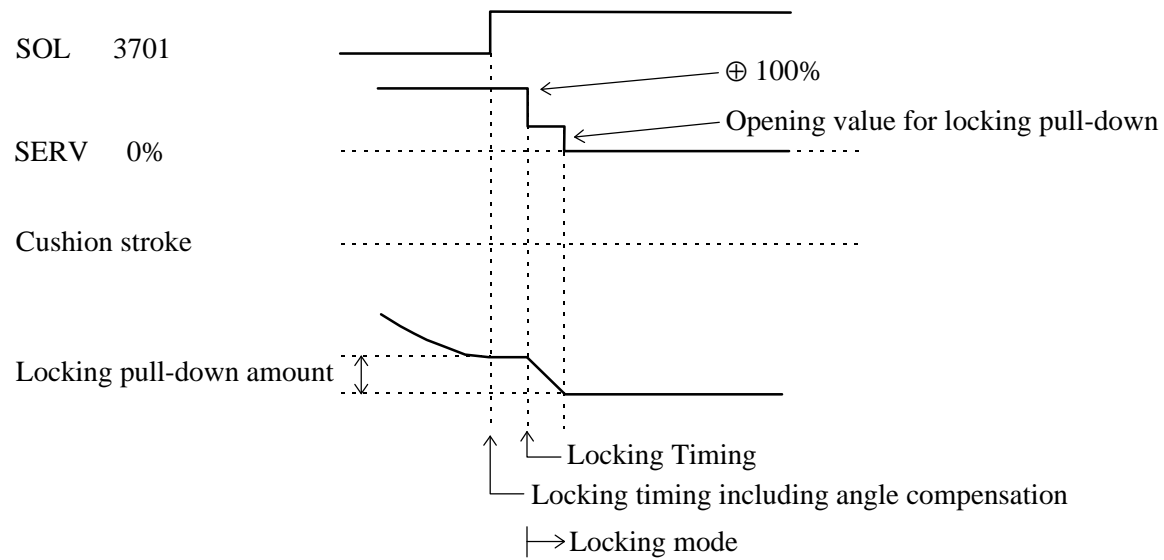
Mode when an error occurs

SOL	for ACCUMULATOR PRESSURE (3701)	OFF
SOL	for LOWER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702)	ON
SOL	for UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3703)	OFF
SERV	NC CUSHION SERVO VALVES (3701, 2)	⊕ 100 %
SOL	for NC CUSHION SERVO CONTROL UNLOAD STOP (3782)	ON

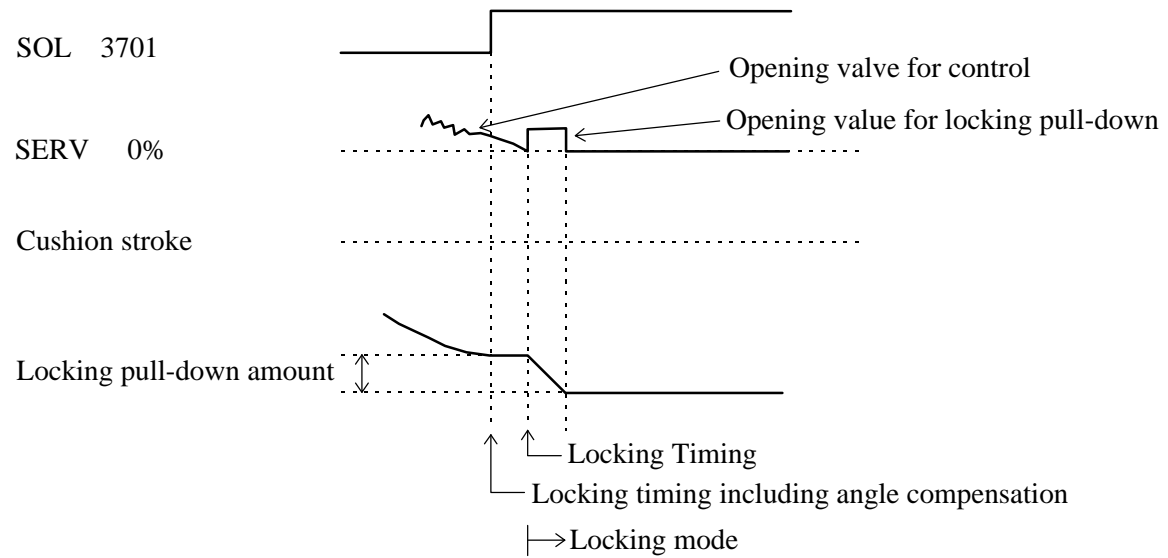
## Notes

At locking angle compensation, the valve change timing will be as follows:

- 1) Standby → Locking, Preacceleration → Locking



2) Cushion control → Locking



### 3.3 REFERENCE VALUE TO BE SET

The NC Cushion operation may be changed through the parameters set through the PLC.

The parameters for each mode will be described below.

- 1) CUSHION RISE (FIRST TIME)
- 2) STANDBY
- 3) PREACCELERATION
- 4) CUSHION FORCE CONTROL
- 5) LOCKING, LIFTER RISE
- 6) LIFTER HOLDING
- 7) CUSHION RISE
- 8) OTHERS

### 3.3.1 CUSHION RISE

During the cushion rising, the data set by "CUSHION RISE OPENING VALUE" is used as the servo valve opening value for the cushion rise, at which the cushion rises up to the damper position, and then, linear interpolation for the damper opening value is performed from the damper position to the upper limit set by "DAMPER OPENING VALUE" for the time set by "CUSHION DAMPER SHIFT TIMER".

Item	Air pressure Setting	High	Middle	Low
CUSHION RISE OPENING VALUE		-***%	-***%	-***%
CUSHION DAMPER OPENING VALUE		-***%	-***%	-***%

Item	Setting
CUSHION DAMPER SHIFT TIMER	*.*sec

Damper will start when the cushion position exceeds the cushion upper position in addition to the data set by "CUSHION DAMPER START POSITION".

Item	Setting
CUSHION DAMPER START POSITION	-**.** inch

### 3.3.2 STANDBY

During standby, the data set for each mode shown below is used as the servo valve opening value.

- 1) Preacceleration ..... "PREACCELERATION OPENING VALUE" + Angle compensation \*1
- 2) Without preacceleration      With NC cushion ..... "STANDBY OPENING VALUE"
- 3) Without preacceleration      Without NC cushion ..... +100% fixed (no setting)

Item	Air pressure Setting	High	Middle	Low
PREACCELERATION OPENING VALUE		+***%	+***%	+***%

Item	Setting
STANDBY OPENING VALUE	+***%

### 3.3.3 PREACCELERATION \*1

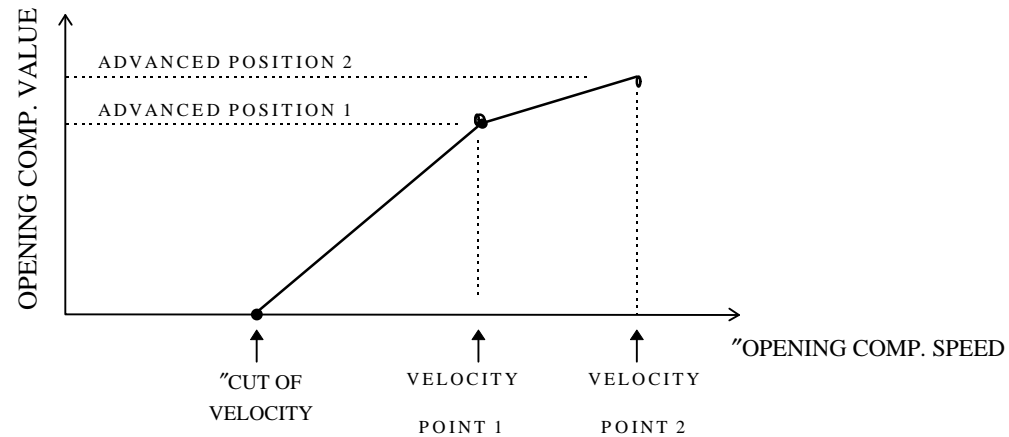
The servo valve opening value during preacceleration is the same as for standby.

Preacceleration starts at the angle set by "PREACCELERATION START ANGLE", and it continues until the cushion stroke reaches the position set by "PREACCELERATION DOWN STROKE".

Item	Setting
PREACCELERATION START ANGLE	***.* deg.
PREACCELERATION DOWN STROKE	**.* inch



- \*1 Preacceleration opening value will be the value obtained by adding the value compensated by the stroke speed to the opening value set by "PREACCELERATION OPENING VALUE". The compensation value is obtained through interpolation of the data set as shown below.



Item	Setting
CUT OF VELOCITY	**. *spm
VELOCITY POINT 1	**. *spm
ADVANCED POSITION 1	***%
VELOCITY POINT 2	**. *spm
ADVANCED POSITION 2	***%

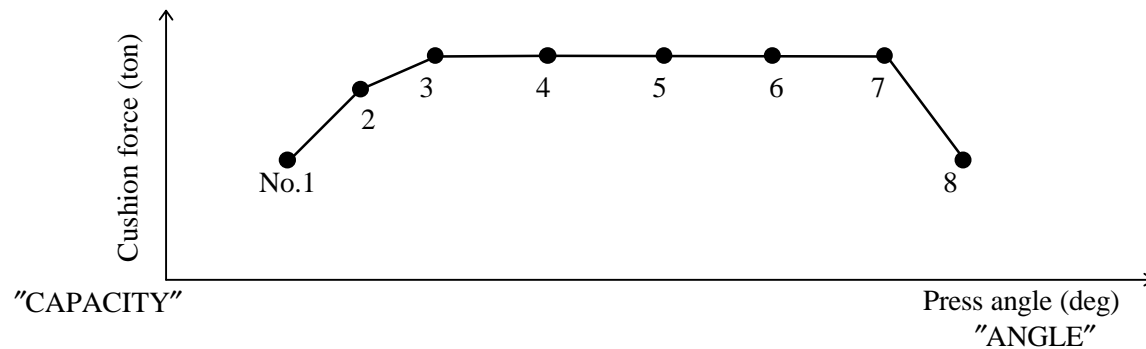
### 3.3.4 CUSHION FORCE CONTROL

The cushion force control starts at the timing when any one of the following requirements is met.

- When actual cushion force exceeds the reference cushion force No. 1 data.
- The press angle is equal to or larger than the angle set by "NC starting angle".

Item	Setting
NC STARTING ANGLE	***deg.

During cushion control, the reference cushion force at the current angle is obtained by linear interpolation of the data set at the 8 points as shown in the figure below. With this value as reference, control is performed so as to make the actual cushion force closer to that reference value. PI calculation of deviation allows the opening value to be obtained, to which value preacceleration value or standby opening value is added, which will be output as the servovalve opening value.



Data at each point (P1, P2, P3, - - - , P8) to be  $P1 \leq P2 \leq P3 \leq \dots \leq P8$

Item	No.							
	1	2	3	4	5	6	7	8
ANGLE	***deg.	***deg.	***deg.	***deg.	***deg.	***deg.	***deg.	***deg.
CAPACITY	***USTON	***USTON	***USTON	***USTON	***USTON	***USTON	***USTON	***USTON

For PI calculation, the data set by "PROPORTIONAL GAIN" for proportional gain and that set by "INTEGRAL GAIN" for integral gain are used.

Item	Setting
PROPORTIONAL GAIN	**
INTEGRAL GAIN	**

P gain = set to \*0.01  
I gain = set to \*0.4

### 3.3.5 LOCKING AND LIFTER RISE

Locking includes 2 kinds of operation, that is, locking pull-down and locking.

During locking pull-down, the data set by "LOCKING OPENING VALUE" is used as the opening value, while the opening value is fixed at 0% during locking.

Locking pull-down operation starts at the angle set by "LOCKING START ANGLE".

When the cushion goes below the position set by "LOCKING DOWN STROKE", locking will start.

Item	Setting
LOCKING OPENING VALUE	+*** %
LOCKING START ANGLE	*** deg.
LOCKING DOWN STROKE	**.** inch

After locking, when the press stroke angle reaches the angle set by "LIFTER RISE STARTING ANGLE", the cushion will be raised at the opening value set by "LIFTER RISE OPENING VALUE" by the amount set by "LOCKING LIFTER RISING STROKE" (without lifter) or by "LIFTER RISING STROKE" (with lifter).

After lifter rises, their lifter position is held through PI control at the gain set by "PROPORTIONAL GAIN FOR KEEP POSITION" until the cushion rise angle.

Item	Setting
LIFTER RISE STARTING ANGLE	*** deg.
LIFTER RISE OPENING VALUE	—*** %
LOCKING LIFTER RISING STROKE	**** inch
LIFTER RISING STROKE	**.** inch

### 3.3.6 LIFTER HOLDING

After lifter rises, when the "LIFTER HOLD SIGNAL" remains ON, that lifter position will be held through PI control with the data set by "PROPORTIONAL GAIN FOR KEEP POSITION" as P gain (until the "LIFTER HOLD" signal goes off.)

Item	Setting
PROPORTIONAL GAIN FOR KEEP POSITION	**

P gain = Set to \*0.01  
I gain is fixed as 0.0.

### 3.3.7 CUSHION RISE

During cushion rising, damper starts to rise in the same manner as for 3.3.1 Cushion Rise (first time), while the cushion starts to rise when the cushion rise angle exceeds the angle set by "CUSHION RISING START ANGLE" (without locking) or by "CUSHION RISING START ANGLE (with LOCKING)"

Item	Setting
CUSHION RISING START ANGLE	***deg.
CUSHION RISING START ANGLE (LOCKING)	***deg.

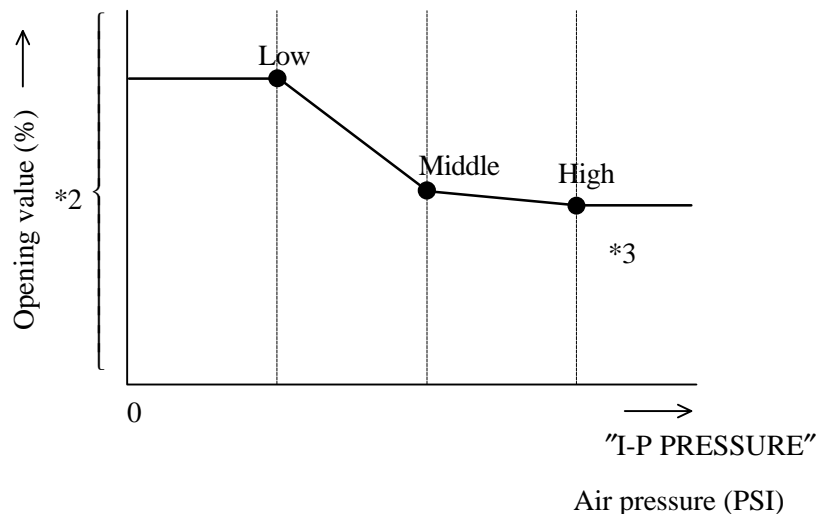
### 3.3.8 OTHERS

#### 1) Air pressure change setting

Air pressure limit values are used for changing the servo-valve opening value to LARGE, MIDDLE, or SMALL through air pressure, for the purpose of which the data set by I-P PRESSURE is used.

Item	High	Middle	Low
I-P PRESSURE	*** PSI	*** PSI	*** PSI

\*1 The servovalve opening values include "CUSHION RISE OPENING VALUE", PREACCELERATION OPENING VALUE" and "DAMPER OPENING VALUE", which should be selected through air pressure.



\*2 The opening value is obtained by interpolation of air pressure.

\*3 The opening value for the air pressure "LOW" and lower, or "HIGH" and higher is as shown in the figure. (The opening value set at the "LOW" or "HIGH" air pressure.)

## 2) Cushion force limit

The cushion force limit value is used for detecting the overload.

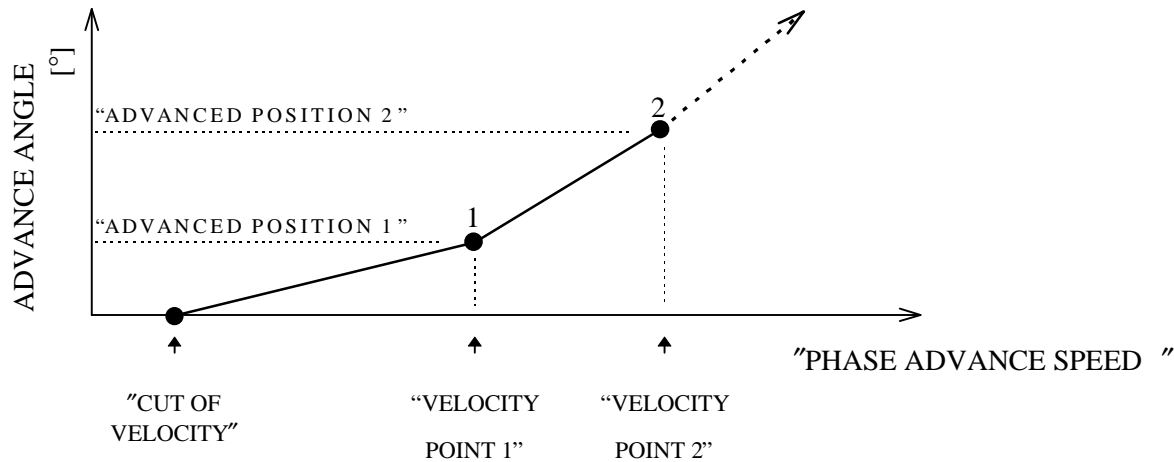
The data set by "CUSHION FORCE LIMIT" is used.

Item	Setting
CUSHION FORCE LIMIT	***USTON

### 3) Advance angle setting

For preacceleration, locking, lifter rise, and cushion rise, the advance angle reference data is used to obtain the advance angle compensation amount at the actual stroke speed by means of linear interpolation as shown below, which is added to the actual angle.

The value thus obtained is used as each starting angle.



Operation		PREACCEL	LOCKING	LIFTER RISING	CUSHION RISING
Item	Setting				
CUT OF VELOCITY		***SPM	***SPM	***SPM	***SPM
VELOCITY POINT 1		***SPM	***SPM	***SPM	***SPM
ADVANCED ANGLE 1		***deg.	***deg.	***deg.	***deg.
VELOCITY POINT 2		***SPM	***SPM	***SPM	***SPM
ADVANCED ANGLE 2		***deg.	***deg.	***deg.	***deg.



### 3.3.9 The setting values as set up on the installation

ITEM	SPAN	PLC	NC	SETTING VALUE
1.PROPORTIONAL GAIN	[0-99]	N20:21	N120:521	30
2.INTEGRAL GAIN	[0-99]	N20:22	N120:522	50
3.MODE PRE-ACCELERATION				
DOWN STROKE	[0-99.99]inch	N20:23	N120:523	1.20
SERVO OPENING VALUE				
HIGH AIR PRESSURE	[0-100]%	N20:24	N120:524	22
MIDDLE AIR PRESSURE	[0-100]%	N20:25	N120:525	10
LOW AIR PRESSURE	[0-100]%	N20:26	N120:526	6
4.MODE CUSHION FORCE CONTROL				
START ANGLE	[0-359]deg	N20:27	N120:527	175
5.MODE LOCKING				
START ANGLE	[0-359]deg	N20:28	N120:528	200
DOWN STROKE	[0-99.99]inch	N20:29	N120:529	0.20
SERVO OPENING VALUE				
NC USE				
HIGH AIR PRESSURE	[0-100]%	N20:30	N120:530	35
MIDDLE AIR PRESSURE	[0-100]%	N20:31	N120:531	25
LOW AIR PRESSURE	[0-100]%	N20:32	N120:532	15
NOT NC USE				
HIGH AIR PRESSURE	[0-100]%	N20:33	N120:533	20
MIDDLE AIR PRESSURE	[0-100]%	N20:34	N120:534	15
LOW AIR PRESSURE	[0-100]%	N20:35	N120:535	10
LIFTER RAISING STROK	[0-99.99]inch	N20:36	N120:536	1.00

#### 6.MODE LIFTER

START ANGLE	[0-359]deg	N20:37	N120:537	220
RASING STROKE	[0-99.99]inch	N20:38	N120:538	1.00
SERVO OPENING VALU	[0-100]%	N20:39	N120:539	10
PROPORTIONAL GAIN FOR KEEP POSITION	[0-99]	N20:40	N120:540	30

#### 7.MODE CUSHION RAISE

SERVO OPENING VALUE				
HIGH AIR PRESSURE	[0-100]%	N20:41	N120:541	30
MIDDLE AIR PRESSURE	[0-100]%	N20:42	N120:542	50
LOW AIR PRESSURE	[0-100]%	N20:43	N120:543	100
OPENNING VALUE SHIFT TIMER	[0-999]msec	N20:44	N120:544	100
START ANGLE				
LOCKING NONE	[0-359]deg	N20:45	N120:545	200
LOCKING USE	[0-359]deg	N20:46	N120:546	359

#### 8.MODE DAMPER

START POSITION	[0-99.99]inch	N20:47	N120:547	1.00
DAMPER SHIFT TIMER	[0-999]msec	N20:48	N120:548	0
SERVO OPENING VALUE				
HIGH AIR PRESSURE	[0-100]%	N20:49	N120:549	10
MIDDLE AIR PRESSURE	[0-100]%	N20:50	N120:550	20
LOW AIR PRESSURE	[0-100]%	N20:51	N120:551	50

#### 9.SERVO OPENING VALUE FOR STAND-BY

[0-100]%	N20:52	N120:552	0
----------	--------	----------	---

# 10.POINT OF AIR PRESSURE

## FOR SWITCHING OPENING VALUE

POINT1(HIGH)	[0-999]psi	N20:53	N120:553	59
POINT2(MIDDLE)	[0-999]psi	N20:54	N120:554	43
POINT3(LOW)	[0-999]psi	N20:55	N120:555	28
11.PRESSURE FORCE LIMIT	[0-999]ton	N20:56	N120:556	450

# 12.PHASE ADVANCED TABLE

## PRE-ACC

CUT OF VELOCITY	[0-99.9]spm	N20:57	N120:557	3.0
VELOCITY POINT1	[0-99.9]spm	N20:58	N120:558	7.0
ADVANCED ANGLE1	[0-99.9]deg	N20:59	N120:559	6.0
VELOCITY POINT2	[0-99.9]spm	N20:60	N120:560	14.0
ADVANCED ANGLE2	[0-99.9]deg	N20:61	N120:561	8.0

## LOCKING

CUT OF VELOCITY	[0-99.9]spm	N20:62	N120:562	3.0
VELOCITY POINT1	[0-99.9]spm	N20:63	N120:563	7.0
ADVANCED ANGLE1	[0-99.9]deg	N20:64	N120:564	2.0
VELOCITY POINT2	[0-99.9]spm	N20:65	N120:565	14.0
ADVANCED ANGLE2	[0-99.9]deg	N20:66	N120:566	7.0

## LIFTER

CUT OF VELOCITY	[0-99.9]spm	N20:67	N120:567	3.0
VELOCITY POINT1	[0-99.9]spm	N20:68	N120:568	7.0
ADVANCED ANGLE1	[0-99.9]deg	N20:69	N120:569	5.0
VELOCITY POINT2	[0-99.9]spm	N20:70	N120:570	14.0
ADVANCED ANGLE2	[0-99.9]deg	N20:71	N120:571	5.0

RAISE				
CUT OF VELOCITY	[0-99.9]spm	N20:72	N120:572	3.0
VELOCITY POINT1	[0-99.9]spm	N20:73	N120:573	7.0
ADVANCED ANGLE1	[0-99.9]deg	N20:74	N120:574	0.0
VELOCITY POINT2	[0-99.9]spm	N20:75	N120:575	14.0
ADVANCED ANGLE2	[0-99.9]deg	N20:76	N120:576	0.0
13.COMPENSATION TABLE				
PRE-ACC				
CUT OF VELOCITY	[0-99.9]spm	N20:77	N120:577	3.0
VELOCITY POINT1	[0-99.9]spm	N20:78	N120:578	7.0
COMP.OPENING VALUE1	[0-100]%	N20:79	N120:579	2.0
VELOCITY POINT2	[0-99.9]spm	N20:80	N120:580	14.0
COMP.OPENING VALUE2	[0-100]%	N20:81	N120:581	11.0
14.PRESS ANGLE	[0-359.9]deg	N20:82	N120:582	
15.HOME POSITION SETTING				
START ANGLE	[0-359.9]deg	N20:83	N120:583	40.0
END ANGLE	[0-359.9]deg	N20:84	N120:584	50.0
16.CONSTANT OF UPPER CHAMBER PRESSURE				
FOR PI CALCULATION	[0-99]	N20:85	N120:585	3
17.UPPER LIM POSITION OF CUSHION STROKE				
	[0-99.99]inch	N20:86	N120:586	17.92
18.PRESSURE SENSOR ANALOG INPUT CONSTANT TABLE				
UPPER CHAMBER PT	[0-9999]psi	N20:87	N120:587	5828
LOWER CHAMBER PT	[0-9999]psi	N20:88	N120:588	5828
AIR PRESSURE PT	[0-9999]psi	N20:89	N120:589	150
19.WATCH AREA OF LIFTER FAULT				
START ANGLE	[0-359]deg	N20:90	N120:590	275
END ANGLE	[0-359]deg	N20:91	N120:591	340

### 3.4 SAFETY ITEMS

Item	Sensing	Safety output display	Software/hardware
CUSHION FORCE LIMIT	When the actual cushion force exceeds the set cushion force limit	L005 Display Output to PLC	To be detected by software
UNIT HEALTHY	When servo valves 1 and 2 are normal, communication is normal, cushion force control is normal, CPU calculation is normal, and stroke sensor normal	L001 Display, output to PLC.	Servo valves 1 and 2 are detected by hardware, and the others are detected by software.
SERVOVALVE ERROR	When the servo valve 1 or 2 is abnormal and also the hydraulic pump is in operation	L006 Display Output to PLC.	To be detected by software (A servovalve error to be detected by hardware).
CUSHION STROKE ERROR	When the difference in stroke between the previous sampling value and the present sampling value (cushion stroke) is 5 mm or larger.	L007 Display Output to PLC.	To be detected by software
COMMUNICATION ERROR	When a communication error such as parity, framing, overrun, etc. occurs, or when the hand-shake signal does not operate normally	L008 Display No output	To be detected by software
PRESS ANGLE ERROR	When the difference in angle between the previous sampling value and the present sampling value (press angle) is 5 degree or larger	No output nor display	To be detected by software

When a safety item error occurs, no prescribed operation will be performed in any operation mode, allowing only safety operation.

SOL for ACCUMULATOR PRESSURE (3701), for NC CUSHION SERVO CONTROL UNLOAD STOP (3782) OFF

SOL for LOWER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702) ON (Air cushion)

SOL for UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3703) OFF

SERV NC CUSHION SERVO VALVES (3701, 2) Opening value + 100%

Home Position & ERROR RESET signal ON

SOL for LOWER and UPPER ROOM OF HYDRAULIC CYLINDER PRESSURE (3702, 3) OFF

SERV NC CUSHION SERVO VALVES (3701, 2) Cushion rise opening value

Error resetting (However, software sequence error cannot be reset)

## 3.5 INPUT / OUTPUT SIGNALS

### 3.5.1 DIGITAL INPUT

Signal name	Transmitted from	Signal level	Purpose of use
P. A. USE	PLC	Positive logic 24V*1	Controller operation mode instruction
NC USE	PLC	Positive logic 24V*1	Controller operation mode instruction
LOCKING USE	PLC	Positive logic 24V*1	Controller operation mode instruction
LIFTER USE	PLC	Positive logic 24V*1	Controller operation mode instruction
PROC. HEALTHY	PLC	Positive logic, 24V*1	Controller operation mode instruction
CUSHION RISED	PLC	Positive logic 24V*1	To be used as a requirement for allowing communication
CUSHION RISING	PLC	Positive logic 24V*1	Operation change
PUMP RUNNING	PLC	Positive logic 24V*1	Interlock for servovalve alarm
P. A. SETTING MODE	PLC	Positive logic 24V*1	Controller operation mode instruction
ADC MODE	PLC	Positive logic 24V*1	Controller operation mode instruction
LIFTER HOLD MODE	PLC	Positive logic 24V*1	Operation change
LIFTER HOLD MODE (HYD.)	PLC	Positive logic 24V*1	Operation change
RROR RESET	PLC	Positive logic 24V*1	Error stop release
DATA SET (PROC.)	PLC	Positive logic 24V*1	Communication request 1
DATA SET (OSS)	PLC	Positive logic 24V*1	Communication request 2
CUSHION STROKE RESET	PLC	Positive logic 24V*1	Initialize for Operation
CUSHION STROKE	Stroke sensor	Positive logic, 24V 19BIT+L.P 1BIT	Operation change, cushion force control and measurement output
SERVO VALVE FAIL 1	Servo-amp 1	Positive logic, 24U	Safety
SERVO VALVE FAIL 2	Servo-amp 2	Positive logic, 24V	Safety

\*1 Low voltage with positive logic active.  
Subsequently, the same will apply.

### 3.5.2 DIGITAL OUTPUT

Signal name	Transmitted from	Signal level	Purpose of use
USE P. A.	Not used	Positive logic, 24V	
USE NC	Not used	Positive logic, 24V	
USE LOCKING	Not used	Positive logic, 24V	
USE LIFTER	Not used	Positive logic, 24V	
PROCESSOR OK	Not used	Positive logic, 24V	
RAISE CUSHION	Not used	Positive logic, 24V	
CUSHION RAISING	Not used	Positive logic, 24V	
RUN PUMP	Not used	Positive logic, 24V	
SET P. A. MODE	Not used	Positive logic, 24V	
ADC MODE	Not used	Positive logic, 24V	
LIFTER HOLD MODE	Not used	Positive logic, 24V	
LIFTER HOLD MODE (HYD.)	Not used	Positive logic, 24V	
RESET ERROR	Not used	Positive logic, 24V	
SET DATA (PLC)	Not used	Positive logic, 24V	
SET DATA (OSS)	Not used	Positive logic, 24V	
READY TO COMPILE (OSS)	PLC	Positive logic, 24V	
CUSHION STROKE	PLC	Positive logic, 24V, 16Bit	
CUSHION CONTROLLER STROBE	PLC	Positive logic, 24V	
CUSHION CONTROLLER HEALTHY	PLC	Positive logic, 24V	



Signal name	Transmitted from	Signal level	Purpose of use
CUSHION CONTROLLER FAIL	PLC	Positive logic, 24V	
CUSHION FORCE LIMIT	PLC	Positive logic, 24V	
READY TO COMPILE (PLC)	PLC	Positive logic, 24V	
SERVO VALVE FAIL	PLC	Positive logic, 24V	
CONTROLLER COM. FAIL	PLC	Positive logic, 24V	
LOCKING ERROR	PLC	Positive logic, 24V	
SOL 3701	Panel LED	Positive logic, 24V	For Panel LED Display
SOL 3702	Panel LED	Positive logic, 24V	For Panel LED Display
SOL 3703-1	Panel LED	Positive logic, 24V	For Panel LED Display
SOL 3703-2	PanelLED	Positive logic, 24V	For Panel LED Display
SOL 3782	Panel LED	Positive logic, 24V	For Panel LED Display
Angle pulse drive	Measurement terminals on the panel surface	Positive logic, 24V	For measurement
LATCH	STROKE SENSOR	Positive logic, 24V	For Stroke Sensor write
F/R	STROKE SENSOR	Positive logic, 24V	For Stroke Sensor write
PRESET	STROKE SENSOR	Positive logic, 24V	For Stroke Sensor ZERO Adjust
HEALTHY	Panel LED	Positive logic, 24V	For panel LED display
CPU RUN	Panel LED	Pulse, 24V	For panel LED display

Signal name	Transmitted from	Signal level	Purpose of use
READY TO COMPILE (PLC)	Panel LED	Positive logic, 24V	For panel LED display
READY TO COMPILE (OSS)	Panel LED	Positive logic, 24V	For panel LED display
CHSHION FORCE LIMIT	Panel LED	Positive logic, 24V	For panel LED display
SERVO VALVE FAIL	Panel LED	Positive logic, 24V	For panel LED display
STROKE SENSOR FAIL	Panel LED	Positive logic, 24V	For panel LED display
COMMUNICATION FAIL	Panel LED	Positive logic, 24V	For panel LED display
P.A. USE	Panel LED	Positive logic, 24V	For panel LED display
NC USE	Panel LED	Positive logic, 24V	For panel LED display
LOCKING USE	Panel LED	Positive logic, 24V	For panel LED display
LIFTER USE	Panel LED	Positive logic, 24V	For panel LED display
P. A. SETTING MODE	Panel LED	Positive logic, 24V	For panel LED display
ADC MODE	Panel LED	Positive logic, 24V	For panel LED display
LIFTER HOLD MODE	Panel LED	Positive logic, 24V	For panel LED display
LIFTER HOLD MODE (HYD.)	Panel LED	Positive logic, 24V	For panel LED display
SOL 3701	Solenoid (SSR)	Positive logic, 120V	Solenoid drive
SOL 3702	Solenoid (SSR)	Positive logic, 120V	Solenoid drive
SOL 3703-1	Solenoid (SSR)	Positive logic, 120V	Solenoid drive
SOL 3703-2	Solenoid (SSR)	Positive logic, 120V	Solenoid drive
SOL 3782	Solenoid (SSR)	Positive logic, 120V	Solenoid drive

### 3.5.3 ANALOG INPUT

Signal name	Transmitted from	Signal level	Purpose of use
UPPER CHAMBER PRESSURE	Pressure sensor	4~20mA/2~10V /0~5828PSI	Cushion control, measurement output and safety
LOWER CHAMBER PRESSURE	Pressure sensor	4~20mA/2~10V /0~5828PSI	Cushion control, measurement output and safety
AIR PRESSURE	Pressure sensor	4~20mA/2~10V /0~150PSI	Cushion control, measurement output and safety

For the above signals, 4 to 20 mA is converted into 2 to 10 V by means of shunting resistor.

### 3.5.4 ANALOG OUTPUT

Signal name	Transmitted from	Signal level	Purpose of use
SERVO VALVE #1 OPEN COMMAND	Servo amp 1 (Servovalve 1)	-100~+100%/+5~-5V	Instruction for servovalve opening valve
SERVO VALVE #2 OPEN COMMAND	Servo amp 2 (Servovalve 2)	-100~+100%/+5~-5V	Instruction for servovalve opening valve
REFERENCE CUSHION FORCE	Measurement terminals	0~500USTON/0~5V	For measurement
ACTUAL CUSHION FORCE	Measurement terminals	0~500USTON/0~5V	For measurement
PRESS ANGLE	Measurement terminals	0~360°/0~5V	For measurement
CUSHION STROKE	Measurement terminals	0~19.68inch/0~5V	For measurement
UPPER CHAMBER OIL PRESSURE	Measurement terminals	0~5828psi/1~5V	For measurement
LOWER CHAMBER OIL PRESSURE	Measurement terminals	0~5828psi/1~5V	For measurement

### 3.5.5 OUTPUT FOR MEASUREMENT

The following signals are output for measurement to external equipment or measurement terminals.

No.	Signal name	Signal level	Destination	Transmitted from
1	REFERENCE CUSHION FORCE	0~500uston/0~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
2	ACTUAL CUSHION FORCE	0~500uston/0~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
3	PRESS ANGLE	0~360°/0~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
4	CUSHION STROKE	0~19.68inch/0~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
5	UPPER CHAMBER OIL PRESSURE	0~5828psi/1~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
6	LOWER CHAMBER OIL PRESSURE	0~5828psi/1~5V	●Measurement terminals on the panel surface	COM. AO board ~ buffer
7	SLIDE ANGLE PULSE	0°, 90°, 180°, 270° (40mS Pulse) 100~170°, 190~260° at every 10° (20mS Pulse) 5V Pulse	Measurement terminals on the panel surface	COM. PO board

### 3.6 COMMUNICATION TO PLC and LINE SUPERVISOR

#### A. RECEIVE (PLC -> NC CUSHION)

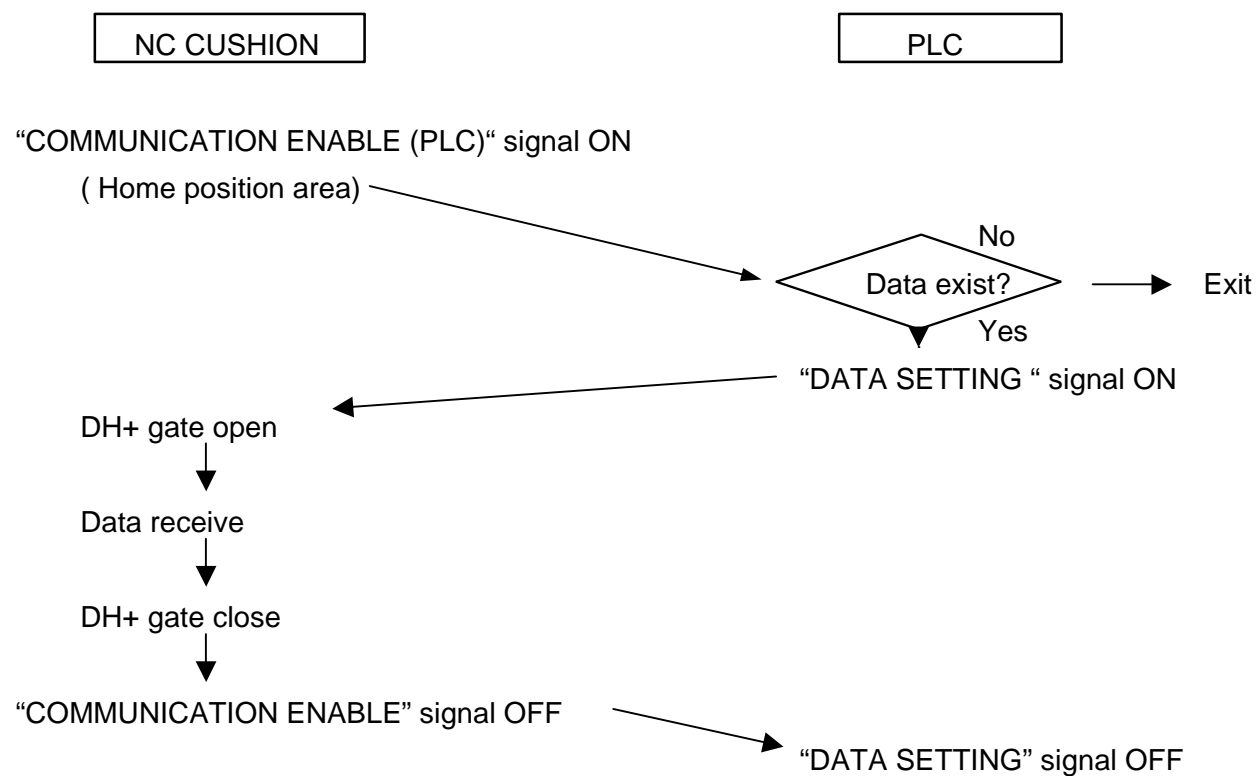
##### (1).DATA

- |                                     |           |               |
|-------------------------------------|-----------|---------------|
| (a). Ref.. angle of control pattern | *** deg.  | 2BYTE HEX x 8 |
| (b). Ref. force of control pattern  | *** uston | 2BYTE HEX x 8 |
| (c). Start angle of preacceleration | ***deg.   | 2BYTE HEX x 1 |

##### (2).PROTOCOL

DH+ STANDARD DRIVER FOR C LANGUAGE.

##### (3).HANDSHAKE



## B. RECEIVE 2 (PLC -> NC CUSHION)

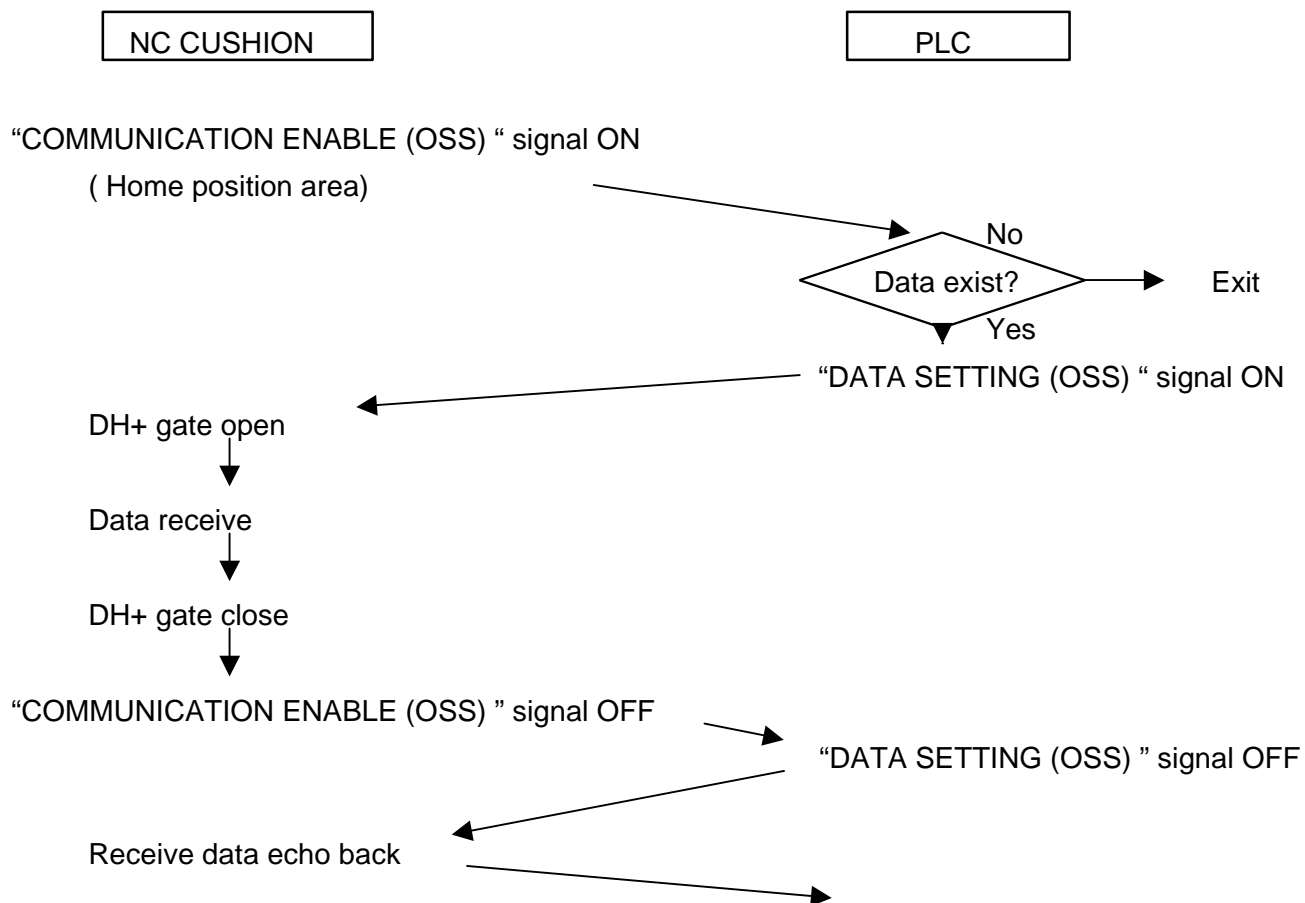
### (1).DATA

(a). System parameter                      2BYTE HEX x 71

### (2).PROTOCOL

DH+ STANDARD DRIVER FOR C LANGUAGE.

### (3).HANDSHAKE



# C. TRANSMIT (NC CUSHION -> LINE SUPERVISOR)

## (1).DATA

Two's complement binary

134.5deg.~ 359.9deg., 0deg.~ 40.0deg. each 4.5deg.

(a) .Cushion stroke position	**.**	inch	2Byte	x 60
(b) .Set up value of cushion force	***	uston	2Byte	
(c) .Actual cushion force	***	uston	2Byte	
(d) .Hyd.pressure of upper chamber	***	PSi	2Byte	
(e) .Hyd.pressure of lower chamber	***	PSi	2Byte	
(f) .Air pressure	***	PSi	2Byte	

EX. DATA OF 120deg. DATA OF 124.5deg.

( a )	( b )	( c )	( d )	( e )	( f )	
L H	L H	L H	L H	L H	L H	

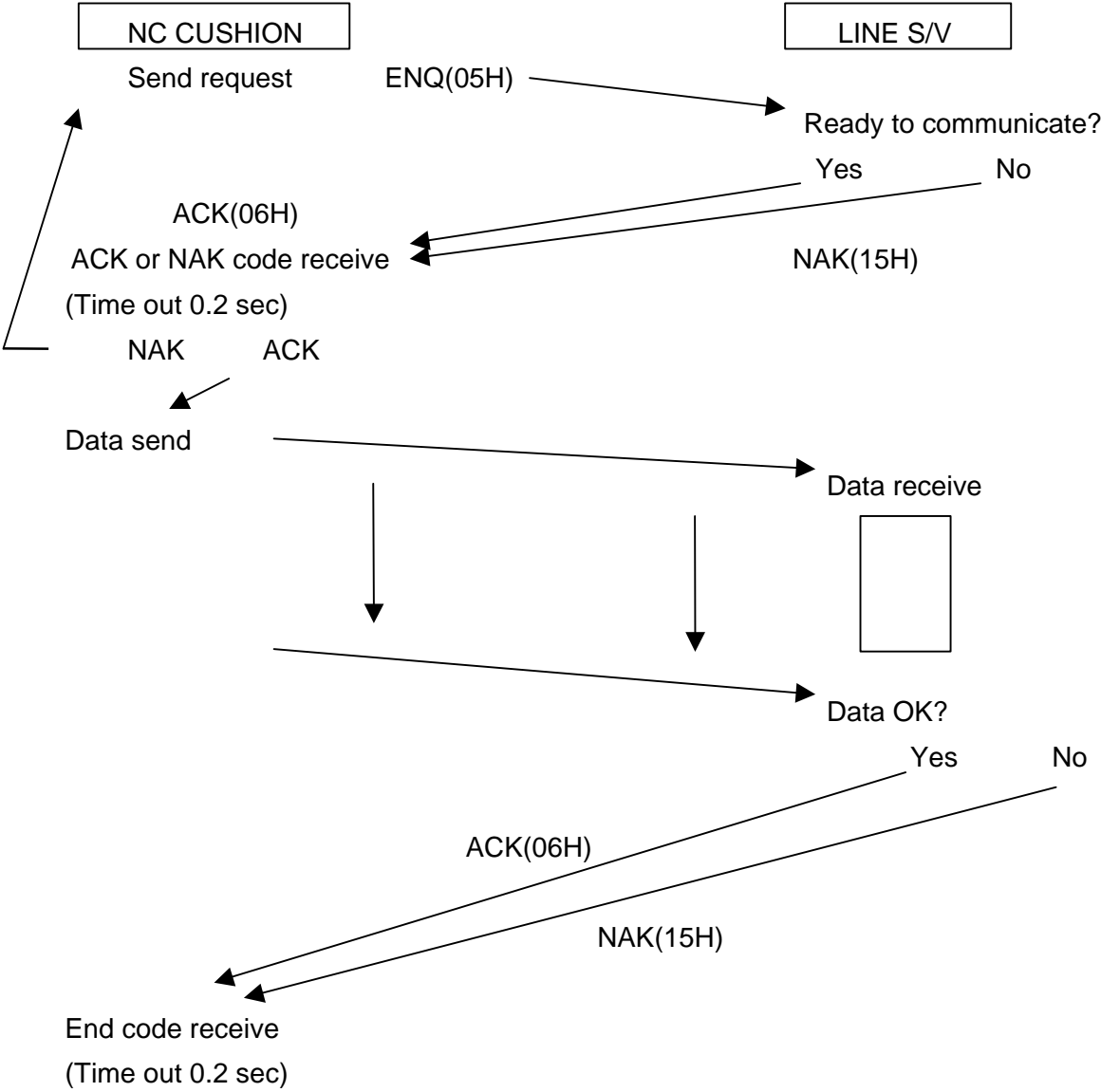
L: Lower byte

H: Higher byte

## (2).PROTOCAOL

Method :RS232C  
Speed :19200bps  
Start bit :1BIT  
Data :8BIT  
Stop bit :1BIT  
Parity :EVEN

(3).HANDSHAKE





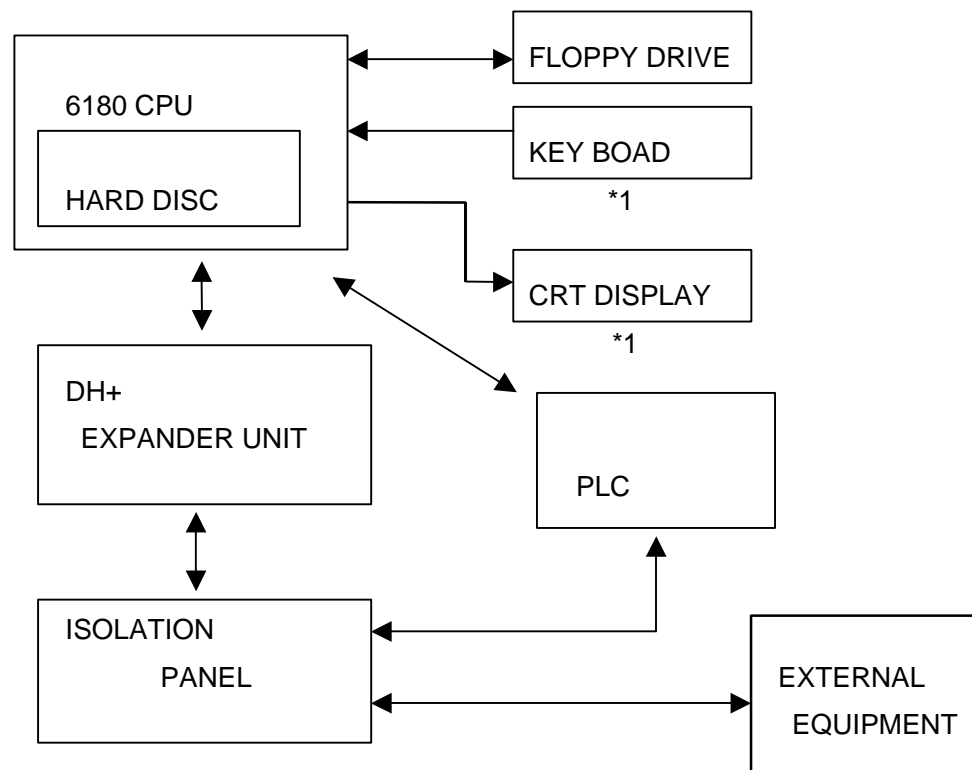
## 3.7 SOFTWARE DOCUMENT

### 3.7.1 INSTALLATION AND MAINTENANCE

Installation and maintenance for NC Cushion Controller will be described on this section.

For computer itself, refer to Rockwell Automation manuals.

#### a. configuration



\*1 : NORMALLY NOT INSTALLED.

CAN BE USED FOR MONITORING AND PARAMETER SETTING.

## b. OPERATION

### b – 1 Start-up

NC Cushion controller will be started by following procedure.

- a. Set cushion at lower end position.
- b. Connect CRT and Key board if you wish to monitor the controller or set the parameter into controller.
- c. Power on to NC Cushion controller.
- d. “HEALTHY” lamp on MOC (40603 LT) will come on when controller started normally.
- e. This condition is started successfully.

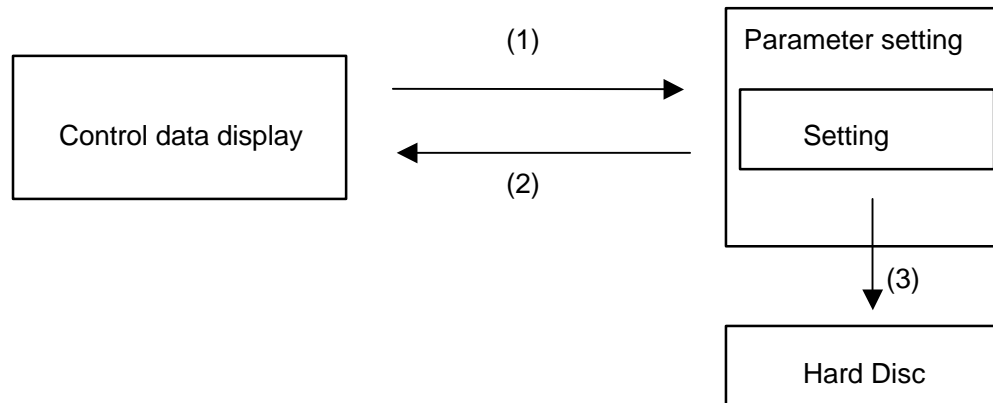
### b – 2 Shut down

NC Cushion controller will be shut off by following procedure.

- a. Set cushion at lower end.
- b. Displayed on CRT other than parameter setting screen.

c. SCREEN CHANGE ON CRT.

Real time indication of control data and parameters can be displayed on CRT.



- (1) Can be changed the screen from Control data display screen to Parameter setting screen by depressing F1.
- (2) Can be changed the screen from Parameter setting screen to Control data display screen by depressing F10.
- (3) When depress Enter key, new parameter data will be stored into hard disc. Parameter change to be done when Press stopped at home position.

#### d. MAINTENANCE

##### d -1 Location of Interface board

###### a.T81CPU AB 6180

0	SYSTEM BOARD 1	FOR RS 232C etc.
1	SYSTEM BOARD 2	RGB, KEY BOARD
2	ENCODER INPUT BOARD	AMCI 1041
3	DH+ NET WORK BOARD	1784KTX
4	EXPANSION UNIT, I/F	PCI20063A1

b. EXPANSION UNIT PCI-5500H-1

S1	I/F BOARD FOR CPU	
S2	DIGITAL OUTPUT BOARD	PCI20087W1A
S4	DIGITAL OUTPUT BOARD 2	PCI20087W1A
S6	DIGITAL INPUT BOARD	PCI20087W1A
S8	ANALOG INPUT BOARD	PCI20428W1
SA	ANALOG OUTPUT BOARD	PCI20093W1

c. ISOLATION PANEL RACK 1

7	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
11	DIGITAL OUTPUT PANEL	PCI20326T1+PCI1109
23	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
27	DIGITAL OUTPUT PANEL	PCI20326T1+PCI1109
35	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
43	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
55	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
59	DIGITAL OUTPUT PANEL	PCI20326T1+PCI1109
72	DIGITAL OUTPUT PANEL	PCI20324T1+PCI1109
76	DIGITAL OUTPUT PANEL	PCI20326T1+PCI1109

d. ISOLATION PANEL RACK 2

3	DIGITAL INPUT PANEL	PCI20353T1
12	DIGITAL INPUT PANEL	PCI20353T1
20	DIGITAL INPUT PANEL	PCI20353T1
28	ANALOG INPUT PANEL	PCI20353T1+PCI5B3201
43	ANALOG OUTPUT PANEL	PCI20353T1+PCI5B4905

#### d – 2 Board Setting

Board setting to be done as follows. No description on this section is same as default setting from the maker.

(1) Digital output board 1 PCI – 20087W – 1A

Address : CD400 H

(2) Digital output board 2 PCI – 20087W – 1A

Address : CD800 H

(3) Digital input board PCI – 20087W – 1A

Address : CD000 H

(4) Analog input board PCI – 20428W – 1

Input voltage : 0 – 5 v

Jumper : W5, 7, 17, 21

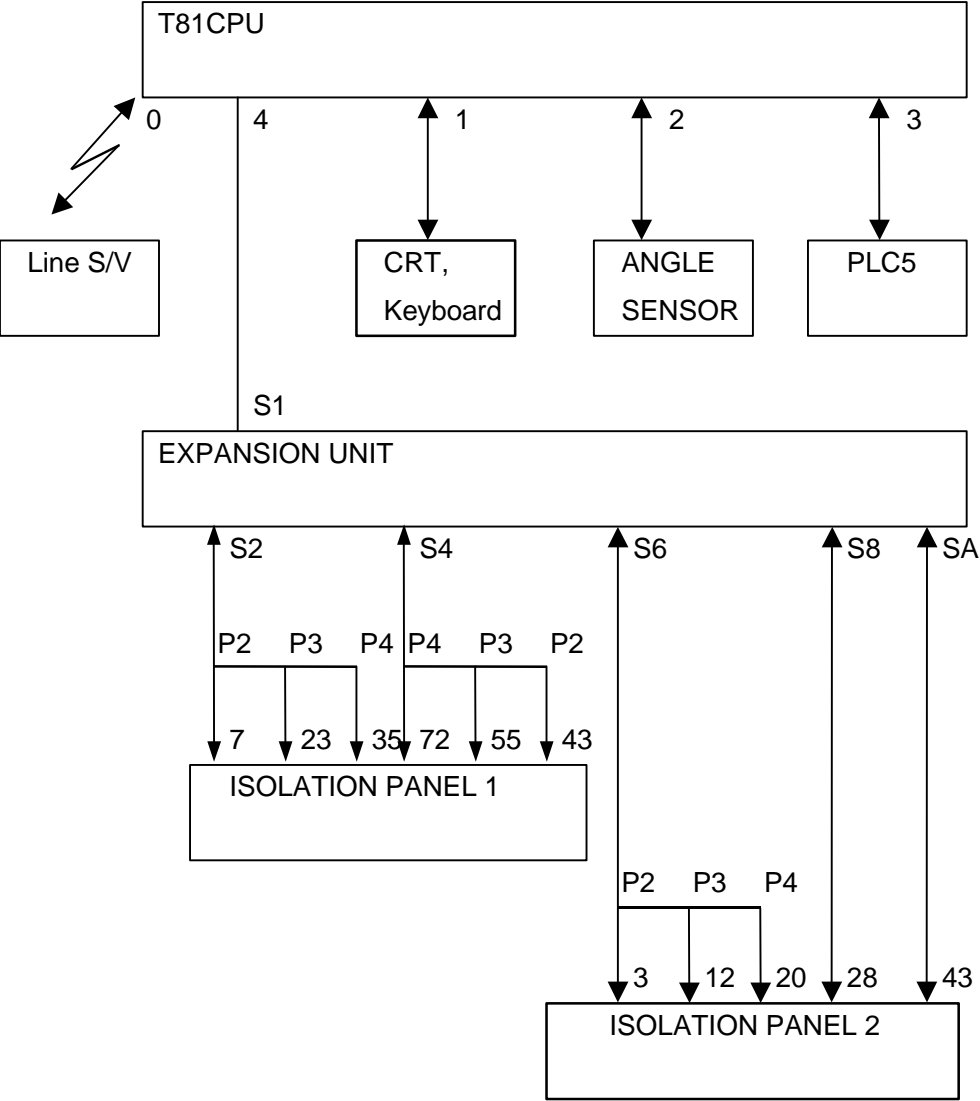
Open : W4, 6, 15, 16, 19, 20

(5) Analog output board

Address : CDC00 H



d – 3 Cable connection



## 3.7.2 SOFTWARE INSTALLATION

### 3.7.2.1 Software installation procedure.

Software loading to the NC Cushion controller (T81 - AB 6180) to be done by following procedure.

#### (1) Installation of Windows 95

Windows 95 is pre-installed into NC Cushion controller (T81 - AB 6180). If re-installation of Windows 95 is required, refer to the instruction manual of the computer (T81 - AB 6180).

The directory for Windows 95 is “\WINDOWS”

#### (2) Installation of the application software

##### a. Initial installation

Application software including the driver software of DH+ to be loaded into NC Cushion controller (T81 - AB 6180) by following procedure.

- (1) Insert the boot disk into floppy disk drive.
- (2) Reset the NC Cushion controller (T81 - AB 6180). Re-boot the NC Cushion controller (T81 - AB 6180) or Ctrl + Alt + Del by key board.
- (3) Set-up program will be executed automatically and necessary installation will be executed.
- (4) Remove the boot disk from floppy disk drive and do reset 10 seconds after the access lamp goes off on the floppy disk drive. (The boot disk must be removed before doing reset, otherwise installation will be executed again.)
- (5) Installation is completed by above operation.

b. Version up the installed application software.

Version up the installed application software can be done same procedure as initial installation by using version up disk.

Version up disk is the boot disk also.

The back-up of old software and loading the version up software will be done automatically.

Old software will be stored into “ C:\SVC” with the name of “ BACK.EXE”

(3) Required operation after the completion of installation.

After installing the new software, prior to operate the cushion, parameter set must be done from panelview #2.

If you operate the cushion without setting the parameter from panelview, multi-function of the NC Cushion controller or serious problem may happen.

### 3.7.3 CRT DISPLAY FORMAT

Actual Display Screen

Parameter set screen (1) - (6)

## Actual Display Screen

Operation Mode	AAAAAAAAAAAAAAAAAAAAA
Oil Cylinder(Upper) Pressure	9999 psi
Oil Cylinder(Lower) Pressure	9999 psi
Air Cylinder Pressure	9999 psi
Slide Position	999.9 deg.
Cushion Stroke	99.99 inch
Servo Valve Opening Value Ref.	+999 %
Cycle Speed	999.9 SPM
Source Data For Timing Compens.	999.9 SPM
Cushion Force REF.	9999 uston
Cushion Force ACT.	9999 uston

# Servo Cushion Controller System Data

[illegible]

F1 : Go to Parameter set screen (1)

## Parameter Set Screen (1)

[ Parameter Setting ] 1/6		5. Mode 'LOCKING'	
1. Proportional Gain	99	Start Angle	999 deg.
2. Integral Gain	99	Down Stroke	99.99 inch
3. Mode 'PRE-ACCELERATION'		Servo Opening Value	
Down Stroke	99.99 inch	NC Use	
		High Air Pressure	999 %
Servo Opening Value		Middle	999 %
		Low	999 %
High Air Pressure	999 %	Not NC Use	
Middle	999 %	High Air Pressure	999 %
low	999 %	Middle	999 %
4. Mode 'CUSHION FORCE CONTROL'		Low	999 %
Start Angle	999 deg.	Lifter Rising Stroke	99.99 inch

f.1f.2f.3f.4f.5f.6f.7f.8f.9f.10

F3 : Go to Parameter set screen (2)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (To be input at Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (To be input at Press Home Position)

## Parameter Set Screen (2)

[ Parameter Setting ] 2/6		Opening Value Shift Timer 999 msec	
6. Mode 'LIFTER'		Start Angle	
Start Angle	999 deg.	Locking None	999 deg.
		Locking Use	999 deg.
Rising Stroke	99.99 inch		
Servo Opening Value	999 %	8. Mode 'DAMPER'	
Proportional Gain For Keep Position	99	Start Psition	99.99 inch
		Damper Shift Timer	999 msec
7. Mode 'CUSHION RISE'		Servo Opening Value	
Servo Opening Value		High Air Pressure	999 %
		Middle	999 %
High Air Pressure	999 %	low	999 %
Middle	999 %		
low	999 %	9. Servo Oening Value	
		For Stand-by	
f.1	f.2	f.3	f.4
f.5	f.6	f.7	f.8
f.9	f.10		

F2 : Go to Parameter Set Screen (1)

F3 : Go to Parameter Set Screen (3)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (To be input at Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (To be input at Press Home Position)

## Parameter Set Screen (3)

[ Parameter Setting ] 3/6

### 10. Point of Air Pressure

For Switching Opening Value

Point 1 (High)	999 psi
Point 2 (Middle)	999 psi
Point 3 (Low)	999 psi

11. Pressure Force Limit      999 ton

f.1

f.2

f.3

f.4

f.5

f.6

f.7

f.8

f.9

f.10

F2 : Go to Parameter Set Screen (2)

F3 : Go to Parameter Set Screen (4)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (To be input at Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (To be input at Press Home Position)



## Parameter Set Screen (4)

[ Parameter Setting ] 4/6

### 12. Phase Advanced Table

	Pre-ACC.	Locking	Lifter	Rise
Cut of Velocity (SPM)	99.9	99.9	99.9	99.9
Velocity Point 1 (SPM)	99.9	99.9	99.9	99.9
Advanced Angle 1 (deg.)	99.9	99.9	99.9	99.9
Velocity Point 2 (SPM)	99.9	99.9	99.9	99.9
Advanced Angle 2 (deg.)	99.9	99.9	99.9	99.9

f.1

f.2

f.3

f.4

f.5

f.6

f.7

f.8

f.9

f.10

F2 : Go to Parameter Set Screen (3)

F3 : Go to Parameter Set Screen (5)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (To be input at Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (To be input at Press Home Position)

## Parameter Set Screen (5)

[ Parameter Setting ] 5/6

### 13. Compensation Table

Pre-ACC.

Cut of Velocity	99.9
( SPM )	
Velocity Point 1	99.9
( SPM )	
Comp. Opening Value 1	999
( % )	
Velocity Point 2	99.9
( SPM )	
Comp. Opening Value 2	999
( % )	

f.1

f.2

f.3

f.4

f.5

f.6

f.7

f.8

f.9

f.10

F2 : Go to Parameter Set Screen (4)

F3 : Go to Parameter Set Screen (6)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (To be input at Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (To be input at Press Home Position)

## Parameter Set Screen (6)

[ Parameter Setting ] 6/6		18. Pressure Sensor Analog Input Constant Table	
14. Press Angle(**.*)	999.9 deg.	Upper Chamber PT	9999 psi
15. Home Positin Setting		Lower Chamber PT	9999 psi
Start Angle	999.9 deg.	Air Pressure PT	9999 psi
End Angle	999.9 deg.	19. Watch Area of Lifter Fault	
16. Constant of Upper Chamber Pressure For PI Calculation	99 ton	Start Angle	999 deg.
		End Angle	999 deg.
17. Upper Limit Position of Cushion Stroke	99.99 inch		

f.1	f.2	f.3	f.4	f.5	f.6	f.7	f.8	f.9	f.10
-----	-----	-----	-----	-----	-----	-----	-----	-----	------

F2 : Go to Parameter Set Screen (5)

F10 : Go to Actual Display Screen

Use Numeric key to data input. (Can be input at not Press Home Position)

Data will be set, stored into hard disk and sent to PLC by Enter key. (Can be input at not Press Home Position)

## Program File Format

### (1) CSNSTR.TXT

Cushion stroke position data at the last cushion raise will be stored into CSNSTR.TXT file.  
Data format is ASCII code, 1 – 5 byte of integer data, unit of data is 0.1 mm.

### (2) DATA.TXT

Edit data on the parameter setting screen will be stored into DATA.TXT file.  
Data format is ASCII code, 1 – 5 byte of integer data, data is separated by CR/LF code.  
Data format is as follows;

Proportional gain

Integral gain

Pull down amount at Pre-acceleration

Servo valve opening amount at Pre-acceleration at high air pressure

Servo valve opening amount at Pre-acceleration at middle air pressure

Servo valve opening amount at Pre-acceleration at low air pressure

NC control start angle

Locking start angle

Pull down amount of Locking

Servo valve opening amount at Locking

Servo valve opening amount at Locking to lifter position

Lifter raise start angle

Lifter raise stroke

Servo valve opening amount at Lifter raise

Proportional gain at Lifter hold

Servo valve opening amount at Cushion raise at high air pressure  
Servo valve opening amount at Cushion raise at middle air pressure  
Servo valve opening amount at Cushion raise at low air pressure  
Cushion raise start angle  
Cushion raise start angle when Locking use  
Stroke position of Damper start  
Timer for Damper  
Servo valve opening amount at Damper at high air pressure  
Servo valve opening amount at Damper at middle air pressure  
Servo valve opening amount at Damper at low air pressure  
Servo valve opening amount at Stand-by  
Air pressure switching point for high pressure  
Air pressure switching point for middle pressure  
Air pressure switching point for low pressure  
Cushion force limit  
Angle compensation for Pre-acceleration, cut of velocity  
Angle compensation for Pre-acceleration, velocity point 1  
Angle compensation for Pre-acceleration, advanced angle 1  
Angle compensation for Pre-acceleration, velocity point 2  
Angle compensation for Pre-acceleration, advanced angle 2

Angle compensation for Locking, cut of velocity

Angle compensation for Locking, velocity point 1  
Angle compensation for Locking, advanced angle 1  
Angle compensation for Locking, velocity point 2  
Angle compensation for Locking, advanced angle 2  
Angle compensation for Lifter raise, cut of velocity  
Angle compensation for Lifter raise, velocity point 1  
Angle compensation for Lifter raise, advanced angle 1  
Angle compensation for Lifter raise, velocity point 2  
Angle compensation for Lifter raise, advanced angle 2  
Angle compensation for Cushion raise, cut of velocity  
Angle compensation for Cushion raise, velocity point 1  
Angle compensation for Cushion raise, advanced angle 1  
Angle compensation for Cushion raise, velocity point 2  
Angle compensation for Cushion raise, advanced angle 2  
Servo valve opening amount compensation for Pre-acceleration, cut of velocity  
Servo valve opening amount compensation for Pre-acceleration, velocity point 1  
Servo valve opening amount compensation for Pre-acceleration, compen. 1  
Servo valve opening amount compensation for Pre-acceleration, velocity point 2  
Servo valve opening amount compensation for Pre-acceleration, compen. 2

### 3.7.5 I/O SIGNAL TABLE

(1) Digital Input (PCI20087W-1)

Port #	Bit #	From	Description	Address	Port #	Bit #	From	Description	Address
0 (A)	0	PLC	Pre-acceleration use	CD00+80H	1 (A)	0	PLC	Pre-acceleration set mode	CD00+81H
0 (A)	1	PLC	NC Cushion use	CD00+80H	1 (A)	1	PLC	ADC mode	CD00+81H
0 (A)	2	PLC	Locking use	CD00+80H	1 (A)	2	PLC	Lifter hold mode	CD00+81H
0 (A)	3	PLC	Lifter use	CD00+80H	1 (A)	3	PLC	Lifter hold mode (w/o air)	CD00+81H
0 (A)	4	PLC	PLC healthy	CD00+80H	1 (A)	4	PLC	Error reset	CD00+81H
0 (A)	5	PLC	Cushion raised	CD00+80H	1 (A)	5	PLC	Data set (PLC)	CD00+81H
0 (A)	6	PLC	Cushion raising	CD00+80H	1 (A)	6	PLC	Data set (OSS)	CD00+81H
0 (A)	7	PLC	Hyd. pump running	CD00+80H	1 (A)	7	PLC	Spare	CD00+81H

Port #	Bit #	From	Description	Address	Port #	Bit #	From	Description	Address
2 (B)	0	TR	Cushion stroke 2**0	CD00+C0H	3 (B)	0	TR	Cushion stroke 2**8	CD00+C1H
2 (B)	1	TR	Cushion stroke 2**1	CD00+C0H	3 (B)	1	TR	Cushion stroke 2**9	CD00+C1H
2 (B)	2	TR	Cushion stroke 2**2	CD00+C0H	3 (B)	2	TR	Cushion stroke 2**10	CD00+C1H
2 (B)	3	TR	Cushion stroke 2**3	CD00+C0H	3 (B)	3	TR	Cushion stroke 2**11	CD00+C1H
2 (B)	4	TR	Cushion stroke 2**4	CD00+C0H	3 (B)	4	TR	Cushion stroke 2**12	CD00+C1H
2 (B)	5	TR	Cushion stroke 2**5	CD00+C0H	3 (B)	5	TR	Cushion stroke 2**13	CD00+C1H
2 (B)	6	TR	Cushion stroke 2**6	CD00+C0H	3 (B)	6	TR	Cushion stroke 2**14	CD00+C1H
2 (B)	7	TR	Cushion stroke 2**7	CD00+C0H	3 (B)	7	TR	Cushion stroke 2**15	CD00+C1H

Port #	Bit #	From	Description	Address	Port #	Bit #	From	Description	Address
4 (C)	0	TR	Cushion stroke 2**16	CD00+80H					
4 (C)	1	TR	Cushion stroke 2**17	CD00+80H					
4 (C)	2	TR	Cushion stroke 2**18	CD00+80H					
4 (C)	3	SERVO	SERVO ABNORMAL 1	CD00+80H					
4 (C)	4	SERVO	SERVO ABNORMAL 2	CD00+80H					
4 (C)	5			CD00+80H					
4 (C)	6			CD00+80H					
4 (C)	7			CD00+80H					

## (2) Digital Output (PCI20087W-1)

Port #	Bit #	To	Description	Address	Port #	Bit #	To	Description	Address
0 (A)	0	PLC	Pre-acceleration use	CD40+80H	1 (A)	0	PLC	Pre-acceleration set mode	CD40+81H
0 (A)	1	PLC	NC Cushion use	CD40+80H	1 (A)	1	PLC	ADC mode	CD40+81H
0 (A)	2	PLC	Locking use	CD40+80H	1 (A)	2	PLC	Lifter hold mode	CD40+81H
0 (A)	3	PLC	Lifter use	CD40+80H	1 (A)	3	PLC	Lifter hold mode (w/o air)	CD40+81H
0 (A)	4	PLC	PLC Healthy	CD40+80H	1 (A)	4	PLC	Error reset	CD40+81H
0 (A)	5	PLC	Cushion raised	CD40+80H	1 (A)	5	PLC	Data set (PLC)	CD40+81H
0 (A)	6	PLC	Cushion raising	CD40+80H	1 (A)	6	PLC	Data set	CD40+81H
0 (A)	7	PLC	Hyd. pump running	CD40+80H	1 (A)	7	PLC	Ready to compile	CD40+81H

Port #	Bit #	To	Description	Address	Port #	Bit #	To	Description	Address
2 (B)	0	PLC	Cushion stroke 2**0	CD40+C0H	3 (B)	0	PLC	Cushion stroke 2**8	CD40+C1H
2 (B)	1	PLC	Cushion stroke 2**1	CD40+C0H	3 (B)	1	PLC	Cushion stroke 2**9	CD40+C1H
2 (B)	2	PLC	Cushion stroke 2**2	CD40+C0H	3 (B)	2	PLC	Cushion stroke 2**10	CD40+C1H
2 (B)	3	PLC	Cushion stroke 2**3	CD40+C0H	3 (B)	3	PLC	Cushion stroke 2**11	CD40+C1H
2 (B)	4	PLC	Cushion stroke 2**4	CD40+C0H	3 (B)	4	PLC	Cushion stroke 2**12	CD40+C1H
2 (B)	5	PLC	Cushion stroke 2**5	CD40+C0H	3 (B)	5	PLC	Cushion stroke 2**13	CD40+C1H
2 (B)	6	PLC	Cushion stroke 2**6	CD40+C0H	3 (B)	6	PLC	Cushion stroke 2**14	CD40+C1H
2 (B)	7	PLC	Cushion stroke 2**7	CD40+C0H	3 (B)	7	PLC	Cushion stroke 2**15	CD40+C1H

Port #	Bit #	To	Description	Address	Port #	Bit #	To	Description	Address
4 (C)	0	PLC	Cushion data strobe	CD40+C2H	4 (D)	0	LED	SOL 35727	CD80+C2H
4 (C)	1	PLC	Healthy	CD40+C2H	4 (D)	1	LED	SOL 35729	CD80+C2H
4 (C)	2	PLC	Stroke sensor abnormal	CD40+C2H	4 (D)	2	LED	SOL 35731	CD80+C2H
4 (C)	3	PLC	Cushion force limit	CD40+C2H	4 (D)	3	LED	SOL 35739	CD80+C2H
4 (C)	4	PLC	Ready to receive (PLC)	CD40+C2H	4 (D)	4	LED	Angle pulse	CD80+C2H
4 (C)	5	PLC	Servo valve abnormal	CD40+C2H	4 (D)	5	LED	TR – Preset	CD80+C2H
4 (C)	6	PLC	Communication abnormal	CD40+C2H	4 (D)	6	LED	TR – F/R	CD80+C2H
4 (C)	7	PLC	Locking abnormal	CD40+C2H	4 (D)	7	LED	TR - Latch	CD80+C2H



Digital Output

Port #	Bit #	To	Description	Address	Port #	Bit #	To	Description	Address
2 (E)	0	LED	Healthy	CD80+C2H	3 (E)	0	LED	Pre-acceleration use	CD80+C1H
2 (E)	1	LED	CPU run	CD80+C2H	3 (E)	1	LED	NC cushion use	CD80+C1H
2 (E)	2	LED	Ready to compile (OSS)	CD80+C2H	3 (E)	2	LED	Locking use	CD80+C1H
2 (E)	3	LED	Ready to compile (PLC)	CD80+C2H	3 (E)	3	LED	Lifter use	CD80+C1H
2 (E)	4	LED	Cushion force limit	CD80+C2H	3 (E)	4	LED	Pre-acceleration set mode	CD80+C1H
2 (E)	5	LED	Servo valve abnormal	CD80+C2H	3 (E)	5	LED	ADC mode	CD80+C1H
2 (E)	6	LED	Stroke sensor abnormal	CD80+C2H	3 (E)	6	LED	Lifter hold mode	CD80+C1H
2 (E)	7	LED	Communication fail	CD80+C2H	3 (E)	7	LED	Lifter hold mode (w/o air)	CD80+C1H

Port #	Bit #	To	Description	Address	Port #	Bit #	To	Description	Address
0 (F)	0	Relay	SOL 35727	CD80+80H	1 (F)	0	Relay	SOL 35739	CD80+81H
0 (F)	1	Relay	SOL 35728	CD80+80H	1 (F)	1			CD80+81H
0 (F)	2	Relay	SOL 35729	CD80+80H	1 (F)	2			CD80+81H
0 (F)	3	Relay	SOL 35730	CD80+80H	1 (F)	3			CD80+81H
0 (F)	4	Relay	SOL 35731	CD80+80H	1 (F)	4			CD80+81H
0 (F)	5	Relay	SOL 35732	CD80+80H	1 (F)	5			CD80+81H
0 (F)	6	Relay	SOL 35733	CD80+80H	1 (F)	6			CD80+81H
0 (F)	7	Relay	SOL 35724	CD80+80H	1 (F)	7			CD80+81H

(3) Analog Input

A/D Code : Straight Binary 0 – 5 V / 0 – 4095 (FFFH)

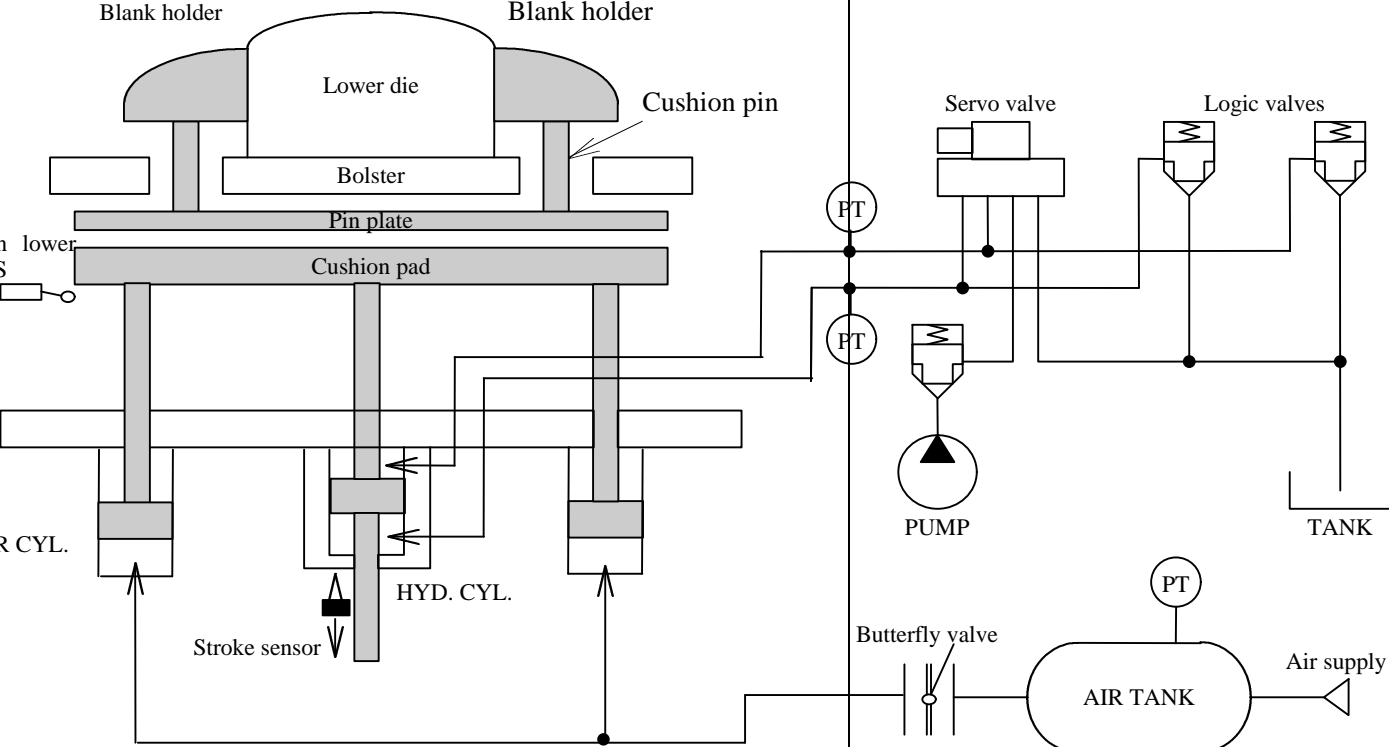
Channel	Description	Range
0	Spare	
1	Upper chamber hyd. pressure	0 – 500 Kg/cm <sup>2</sup> / 4 – 20 mA / 0– 5 V
2	Lower chamber hyd. pressure	0 – 500 Kg/cm <sup>2</sup> / 4 – 20 mA / 0 – 5 V
3	Air pressure	0 – 10 Kg/cm <sup>2</sup> / 4 – 20 mA / 0 – 5 V
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

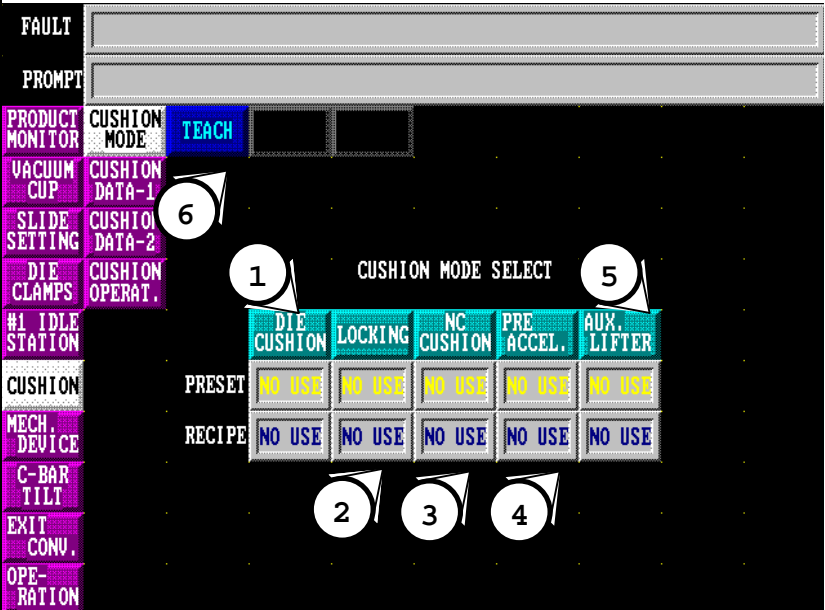
(4) Analog Output

D/A code : Straight Binary (0 – 4095 (0 – FFFH) / -5 – 0 - +5 V )

Channel	Description	Range
0	Servo amp 1	-100 - +100 % / +5 - -5 V
1	Servo amp 2	-100 - +100 % / +5 - -5 V
2	Cushion force setting	0 - 300 Ton / 0 - 5 V
3	Cushion force actual	0 - 300 Ton / 0 - 5 V
4	Press angle	60 – 360 (0) – 59.9 Degree / 0 - 5 V
5	Cushion stroke	0 - 500 mm / 0 - 5 V
6		
7		

### 3.8 PANEL VIEW SCREEN OPERATION

No.	Function & Operation	Description	Sequence & Interlock
	<p><b>CUSHION</b></p> <p>General Description</p>	<p>The die cushion is installed only on W1. It provides force for the blank holder by means of hydraulic and pneumatic control devices.</p> <p>The die cushion is provided with 2 pneumatic cylinders and 1 hydraulic cylinder: The pneumatic cylinders are controlled a by butterfly valve, while the hydraulic cylinder is controlled by servo valves and logic valves.</p> <p>During cushion load control, when the slide is lowered, a pressure signal from PT is detected to control the outgoing oil amount by means of the servo valves. During cushion raising/lowering control, a position signal from the stroke sensor is detected to control the amount of oil flowing in or out.</p>  <p>( NOTE : SIMPLIFIED DESCRIPTION )</p>	

No.	Function & Operation	Description	Sequence & Interlock
	Selecting an operation mode (PANEL VIEW #3 CUSHION MODE SCREEN)	<p>The cushion has the following operation modes, the use or non use of which is automatically selected based on ADC data. Also, the selected use or non use of a mode can be changed through PANEL VIEW of MOS (2UF). The details of each mode are described on the next page.</p>  <p>1. DIE CUSHION USE / NO USE Selecting PBL</p> <p>2. LOCKING      USE / NO USE Selecting PBL</p> <p>3. NC CUSHION USE / NO USE Selecting PBL</p> <p>4. PRE. ACCEL    USE / NO USE Selecting PBL</p> <p>5. AUX. LIFTER    USE / NO USE Selecting PBL</p> <p>6. TEACH or UPDATE RECIPE Setting PBL</p>	

No.	Function & Operation	Description	Sequence & Interlock
	DIE CUSHION PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	Use or no use of cushion can be selected.	CUSHION selection can be changed at: 1. Cushion lower end
	LOCKING PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	Use or no use of locking can be selected.	NC CUSHION , PRE. ACCEL , AUX. LIFTER and LOCKING selection can be changed at: 1. Cushion lower end 2. Cushion upper end
	NC CUSHION PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	Use or no use of NC cushion can be selected.	At upper end following interlocks to be satisfied. At PTO connected SLIDE / FEEDER HOME POSITION
	PRE. ACCEL PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	Use or no use of PRE. ACCEL can be selected.	At PTO disconnected FEEDER WAIT POSITION SLIDE HOME POSITION
	AUX. LIFTER PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	Use or no use of the auxiliary lifter can be selected. Locking needs to be selected when the auxiliary lifter is to be used. Combination operation of LOCKING + AUX. LIFTER is performed.	
	UPDATE RECP PBL (PANEL VIEW #3 CUSHION MODE SCREEN)	UPDATE operation is performed after the above setting is changed. Upon completion of this operation, the slide can be operated.	

No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 (CUSHION DATA-1 SCREEN)		1. PBL for setting cushion air pressure and the display of current address/set value CUSHION AIR PRESSURE 2. DIGI key for setting the data below. 3. PBL for NC CUSHION ANGLE set point and display of set values. 4. PBL for NC CUSHION PRESSURE(TON) set point and display of set value
	PANEL VIEW #3 (CUSHION DATA-2 SCREEN)		



No.	Function & Operation	Description	Sequence & Interlock
	2. Adjustment of cushion air pressure	When using either air cushion or NC cushion, the pressure of the cushion air tank is always maintained to the preset pressure. Automatic adjustment of the cushion air pressure is done in the following manner. The current pressure value is read from the PT in the cushion air tank,. This value is used to control the ON/OFF position of the air supply and exhaust solenoid valves.(see chart on following page) Control of cushion air pressure starts automatical when cushion use is selected.	(Note) This control is similar to that for the counterbalance air pressure adjustment.
	1) Air pressure setting value  CUSHION AIR PRESSURE” PB  “SETTING VALUE” DIGI KEY  PANEL VIEW #3 (CUSHION DATA-1 SCREEN)	Air pressure is automatically set as ADC data, which can, however, be changed via MOS(2UF) PANEL VIEW. The setting value P (kgf/cm <sup>2</sup> ) of adjusted air pressure is calculated by inputting the air pressure setting C (ton), using the conversion formula shown in the right column.  <u>Setting allowable range of air pressure C</u> When the following operation modes are used: 60.0 to 250.0 (ton) PRE. ACCEL LOCKING AUX. LIFTER NC CUSHION  When none of the above modes is used: 60. 0 to 300.0 (ton)  <u>Changing the set value</u> Select "MANUAL" for the press operation mode . After selecting "CUSHION AIR PRESSURE", change the air pressure capacity setting value using DIGI key. By pushing the "DIGI KEY ENTER" PB after changing the set value, air pressure adjustment starts adjustment to reach the preset value.	Conversion formula: $P = (C + M) \times 10^3 / S$ (kgf/cm <sup>2</sup> ) where M: Weight of a cushion movable section (ton) S: Cylinder cross-sectional area (cm <sup>2</sup> ) C: Air pressure setting xxx.x (ton)
	2) “AIR PRESSURE ACTUAL VALUE DISPLAY”  PANEL VIEW #3 (CUSHION DATA-1 SCREEN)	The pressure of the cushion air tank is detected through the PT and displayed on the PANEL VIEW. Air pressure actual value xxx.xx (PSI)	

No.	Function & Operation	Description	Sequence & Interlock
		<p>As shown in the figure below, the air supply SOL (1-O25511) and the air exhaust SOL (1-O25512) are turned on/off at the value of the set value <math>\pm P</math>, and thereby control is performed in order to keep the air pressure at the set value.</p>	<p>Judgement of "CUSHION AIR PRESSURE ADJUSTMENT NORMAL" must always be implemented when pressure adjustment control is performed while the press is stopped.</p> <p>During the press operating, this is checked upon completion of the cushion rise, and if the result is not "CUSHION AIR PRESSURE ADJUSTMENT NORMAL", fault is generated to stop the cycle.</p> <p><math>\Delta P: 1.4(\text{PSI})</math></p>

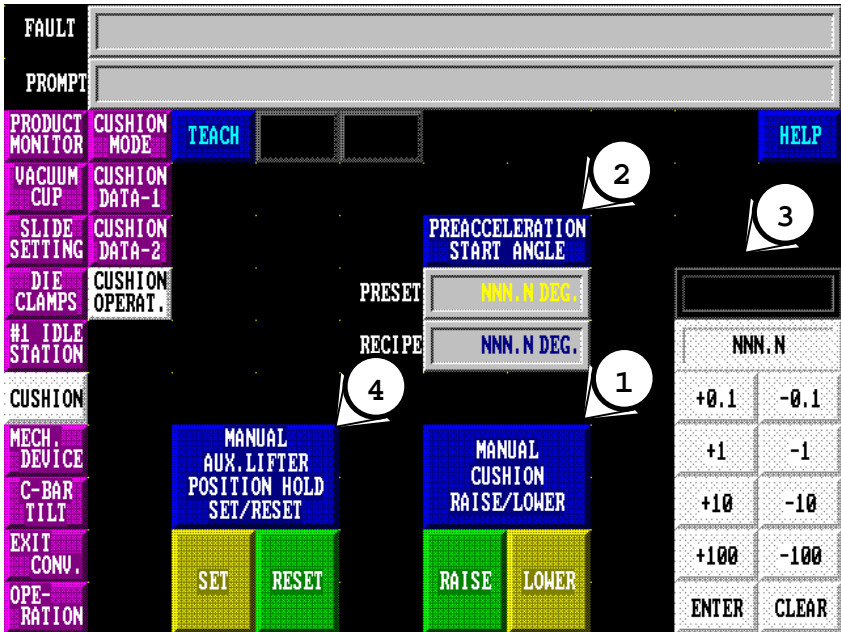
No.	Function & Operation	Description	Sequence & Interlock
	4) Requirements for Air Pressure Control	<p>(1) The air pressure is controlled at the set pressure value when the cushion rise is complete.</p> <p>(2) Except for the above-mentioned case, both air supply/exhaust solenoid valves of the air tank are not energized.</p> <p>When pressure adjustment of the air tank is performed at the lower limit of the cushion during ADC, control is performed at the 140% pressure of the set pressure. (This is because when the cushion is raised, pressure will be lower because of the increased volume in the cushion cylinders ).</p>	Completion of the cushion rise is recognized by the stroke sensor and the butterfly valve open limit LS.

No.	Function & Operation	Description	Sequence & Interlock
	3. Air Cushion 1) Basic operation	Cushion control is performed only by means of air pressure. Cushion pressure (air cylinder pressure) increases as the cushion goes down. Both the upper and lower chambers of the hydraulic cylinder are connected to the oil tank through logic valves, while servo valves open to the cushion lowering side, thus closing the servo pressure supply valve (logic valves). For the air pressure control method, refer to the previous section.	
	4. NC Cushion 1) Basic operation	Cushion control is performed by air pressure and hydraulic pressure. The oil flow from the hydraulic cylinder lower chamber is adjusted by the servo valves to control the pressure inside the hydraulic cylinder. Capacity setting for each press angle of up to 8 steps allows pressure control in synchronization with the press angle. The control method of air pressure is the same as that for air cushion.	
	2) NC control starting requirements	In the case of NC cushion use, control starts when any of the following conditions is satisfied: 1) When the actual pressing force exceeds the No. 1 data of the NC cushion capacity setting. (For the cushion setting capacity, see the next page.) 2) When the press angle exceeds the "NC START ANGLE" "NC START ANGLE" is included in NC CUSHION PARAMETER settings.	When the "NC START ANGLE" is set at an angle smaller than the press angle for the No. 1 data setting stroke, control is started according to No. 1 data capacity setting.
	3) Requirement for ending NC control	NC cushion control ends at the bottom dead center (200°) of the W1 slide. At the slide bottom dead center and subsequent angles, the cushion is operated in accordance with the settings of LOCKING and AUXILIARY LIFTER.	

No.	Function & Operation	Description	Sequence & Interlock																											
	<div>4) NC cushion capacity setting</div> <div>PANEL VIEW #3 CUSHION DATA-1,2 SCREEN</div> <div>"POINT" Selecting PB</div> <div>"SETTING VALUE" DIGI KEY</div> <div>PANEL VIEW #3 CUSHION DATA-1,2 SCREEN</div>	<div>NC cushion must be input when NC cushion is selected. NC cushion capacity is set according to the load for each slide stroke of up to 8 steps from the bottom dead center. Linear interpolation is made between the setting steps to create the setting value at each stroke.</div> <div>NC cushion capacity is automatically set based on the ADC data, but this setting can be changed via PANEL VIEW.</div> <div><div>Changing the set value</div><div>Select "MANUAL" for the press operation mode. Change the set value using the DIGI key after selecting the setting angle or setting load "POINT". Then, pushing the "DIGI KEY ENTER" PB allows the set value to be changed.</div></div> <div><div>NC cushion capacity setting (Example)</div><div><div><div>Capacity setting (ton)</div><div><div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div><div>350</div><div>300</div><div>250</div><div>200</div></div><div><div>130</div><div>140</div><div>150</div><div>160</div><div>170</div><div>180</div><div>190</div><div>200</div></div></div></div><div>Setting angle(deg.)</div></div><div><table><tr><td>Step No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Setting angle(deg.)</td><td>130</td><td>140</td><td>150</td><td>160</td><td>170</td><td>180</td><td>190</td><td>200</td></tr><tr><td>Capacity setting(ton)</td><td>350</td><td>350</td><td>300</td><td>300</td><td>275</td><td>275</td><td>250</td><td>250</td></tr></table></div></div></div>	Step No.	1	2	3	4	5	6	7	8	Setting angle(deg.)	130	140	150	160	170	180	190	200	Capacity setting(ton)	350	350	300	300	275	275	250	250	<div>Requirements for allowing NC cushion capacity change</div> <div>1) Press mode to be "OFF"</div> <div>2) Cushion to be at the upper limit or lower limit</div> <div><div>Setting allowable range</div><div>1) Slide stroke</div><div>Step1 Step2 ~ Step8 200(deg.)</div></div>
Step No.	1	2	3	4	5	6	7	8																						
Setting angle(deg.)	130	140	150	160	170	180	190	200																						
Capacity setting(ton)	350	350	300	300	275	275	250	250																						

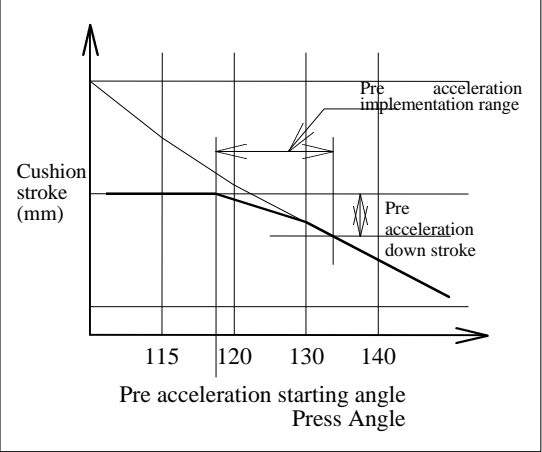
No.	Function & Operation	Description	Sequence & Interlock
	5. Locking and Auxiliary Lifter 1) Basic operation	<p>Selecting Locking and Aux. Lifter allows the cushion to perform the following 3 kinds of operation after the slide passes the bottom dead center:</p> <p><u>Non Use of Locking</u>            After the slide passes the bottom dead center, the cushion goes up to the cushion upper limit with the rise of the slide</p> <p><u>Locking</u>            1) In the case of NC cushion (position control by servo valves)</p> <p>At the slide bottom dead center, the cushion is lowered by 0.2 inch through the hydraulic cylinder, to hold the position.</p> <p>When the press angle passes the "LIFTER RISE ANGLE", the cushion is raised up to the bottom dead center, to hold the position.</p> <p>When the press angle passes the "CUSHION RISE ANGLE", the cushion is raised up to the upper rise limit.</p>	

No.	Function & Operation	Description	Sequence & Interlock
	2) Setting values	<p>Locking and auxiliary lifter operate in accordance with the following setting values. Each of these settings is a semi-fixed value in the controller and therefore it cannot be changed from the operation panel, etc.</p> <p>"LOCKING PULL-DOWN STROKE": 0.2 inch (NC cushion) 0 inch (Air cushion)*1</p> <p>"LIFTER RISE STROKE": To be set at trial operation adjustment (a fixed value in the controller)</p> <p>"LOCKING START ANGLE": 200° (No. 1 slide bottom dead center)</p> <p>"LIFTER RISE ANGLE": To be set at trial operation adjustment (a fixed value in the controller)</p> <p>"CUSHION RISE ANGLE": To be set at trial operation adjustment (a fixed value in the controller)</p> <p>Also, the rise angle for each operation is determined by adjusting the opening of the servo valve at trial operation adjustment. (Air cushion locking is performed through logic valves, and therefore, the rise speed changes depending on the air pressure setting.)</p>	<p>Advance angle compensation is provided to angle setting.</p> <p>Compensation by air pressure is provided to servo valve opening setting.</p>

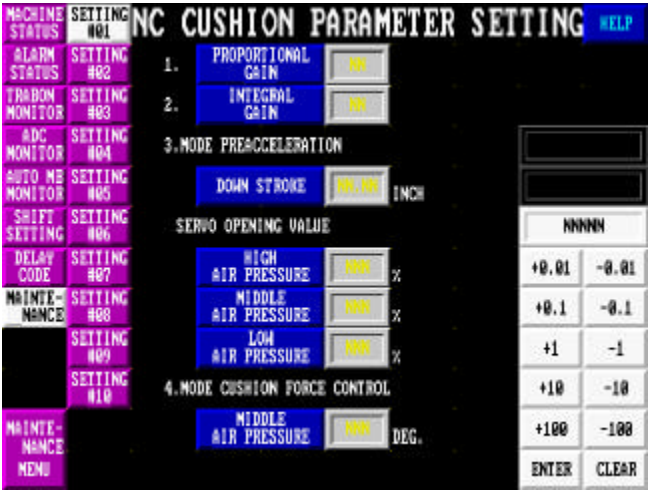
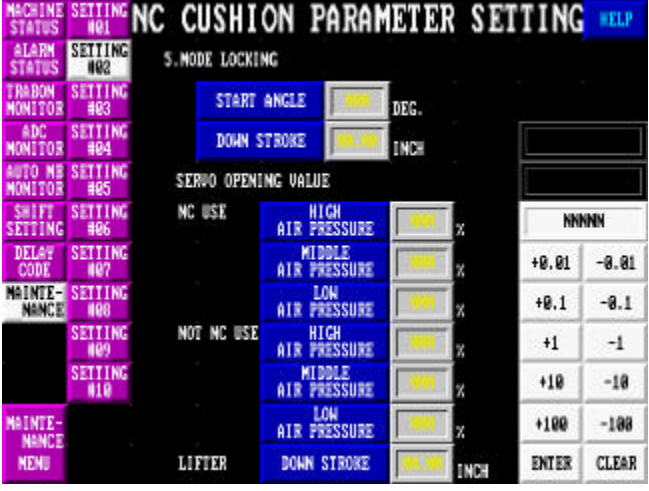
No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 CUSHION OPERATION SCREEN	 <p>① CUSHION "RAISE/LOWER" PBL Operates by pressing the "RAISE/LOWER" PBL after pressing the function PBL. Flashes PL during operation, and lights PL upon completion of operation.</p> <p>② PRE ACCELERATION START ANGLE PBL Press the function PBL when changing the pre acceleration starting angle setting, and input the starting angle using the DIGI key.</p> <p>④ MANUAL AUX. LIFTER POSITION HOLD SET/RESET SET PBL Flashes by pressing the SET PBL after pressing the function PBL. Also, SET PBL lights up during control at the HOLD position. Pressing the RESET PBL allows the cushion to go up, turning off the SET PBL.</p>	

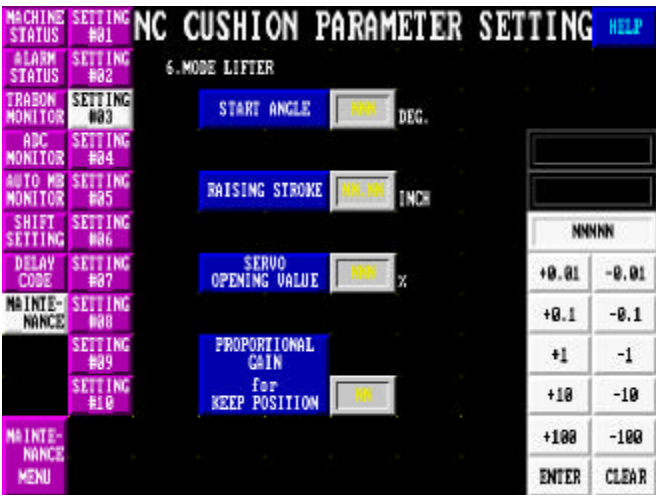
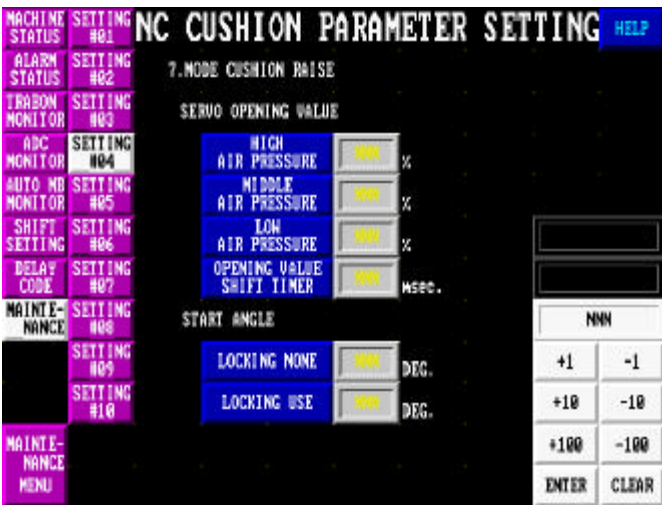


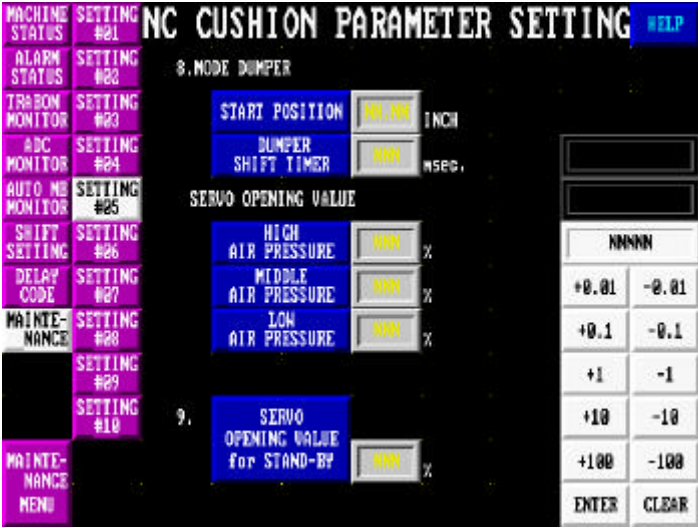
No.	Function & Operation	Description	Sequence & Interlock
6.	<p>Cushion Independent (Single) Operation</p> <p>MANUAL CUSHION LOWER PB ( PANEL VIEW #3 CUSHION OPERATION SCREEN )</p> <p>MANUAL CUSHION RAISE PB ( PANEL VIEW #3 CUSHION OPERATION SCREEN )</p>	<p>In this operation, the cushion is raised or lowered independently.</p> <p><u>Lowering the cushion</u></p> <ol style="list-style-type: none"> <li>1) Select "OFF" for the press operation mode.</li> <li>2) By pressing the "CUSHION LOWER" PB, the butterfly valve is closed SOL(1-O25515 OFF), and after the LS for checking the closing of the butterfly valve is turned on, the air cylinder air exhaust SOL (1-O25516) is turned off to lower the cushion.</li> <li>3) Turning-on of the die cushion lower limit LS (1-I26706) completes the lowering of the cushion.</li> <li>4) This PB flashes the PBL in the touch panel during operation, and lights it up upon completion of the cushion lowering.</li> </ol> <p><u>Raising the cushion</u></p> <ol style="list-style-type: none"> <li>1) Select "OFF" for the press operation mode.</li> <li>2) By pushing the "CUSHION RAISE" PBL, the air cylinder exhaust SOL (1-O25516) is turned on to activate the differential pressure SOL (1-O25517).</li> <li>3) Open the butterfly valve. SOL (1-O25515 ON)</li> <li>4) During the above-mentioned operation, this PBL flashes the PBL in the touch panel and lights it up when the LS for checking the butterfly valve is turned on.</li> <li>5) Starting up the hydraulic pump motor for NC cushion (The pump is stopped by the butterfly close LS and cushion Lower limit LS when the cushion is lowered.)</li> </ol>	<p>Start-up and operation requirements</p> <ol style="list-style-type: none"> <li>(1) Not emergency stop</li> <li>(2) Press operation mode to be "OFF"</li> <li>(3) Safety shutters to be all closed</li> <li>(4) W1 - MB touchdown on the bed to be completed</li> </ol> <p>Start-up and operation requirements</p> <ol style="list-style-type: none"> <li>(1) Not emergency stop</li> <li>(2) Press operation mode to be "OFF"</li> <li>(3) The slide to stop at HOME POSITION</li> <li>(4) The feeder to be at an angle of 340 deg or more and 220 deg or less</li> <li>(3) Safety shutters to be all closed</li> <li>(4) W1 - MB touchdown on the bed to be completed</li> </ol>

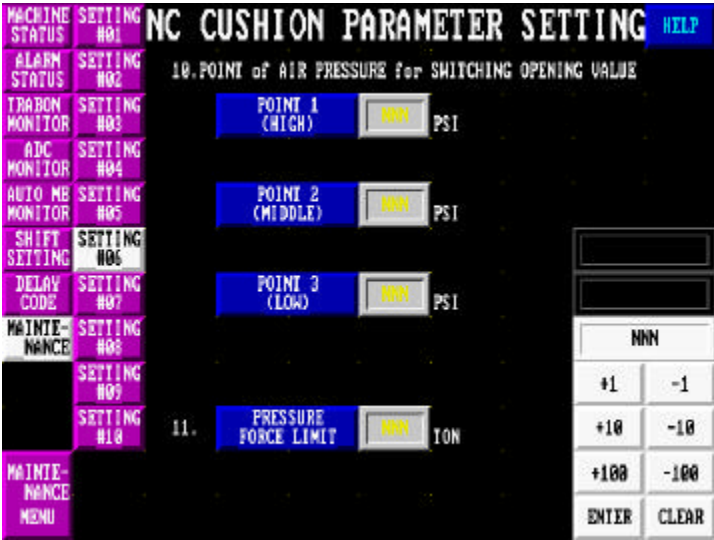
No.	Function & Operation	Description	Sequence & Interlock
7.	Pre Acceleration	<p>The function of pre acceleration is to lower the cushion when the upper die comes in contact with the lower die, and thereby reduce the impact of the collision.</p> <p>Select "MANUAL" for the press operation mode. The set value is changed by using the DIGI key after selecting PRE ACCELERATION START ANGLE. After this change, pressing "DIGI KEY ENTER" PB allows the set value to be changed.</p>	 <p>The graph plots Cushion stroke (mm) on the vertical axis against Pre acceleration starting angle Press Angle on the horizontal axis. The horizontal axis has markings at 115, 120, 130, and 140. A horizontal line represents the standard cushion stroke. A diagonal line starting from the top left and sloping downwards represents the pre acceleration down stroke. The region between the horizontal line and the diagonal line is labeled 'Pre acceleration implementation range'. The diagonal line itself is labeled 'Pre acceleration down stroke'.</p>
	<p>1) Basic operation PREACCELERATION START ANGLE selecting PB</p> <p>SETTING VALUE DIGI KEY</p> <p>( PANEL VIEW #3 CUSHION OPERATION SCREEN )</p>		
	2) Setting values	<p>Pre acceleration operates in accordance with each setting value. "PRE ACCELERATION PULL-DOWN STROKE" Actual stroke : 1.2 inch</p> <p>"PRE ACCELERATION START ANGLE: To be set as ADC data The cushion lowering speed is preset and not adjustable from ADC data.</p>	<p>Advance angle compensation is provided for angle setting. Compensation by air pressure is provided to servo valve opening setting.</p>

No.	Function & Operation	Description	Sequence & Interlock
	<p>“MANUAL AUX. LIFTER POSITION HOLD” PBL</p> <p>“SET” PBL</p> <p>“RRESET” PBL</p> <p>( PANEL VIEW #3 CUSHION OPERATION SCREEN )</p>	<p>After passing the slide bottom dead center, the cushion performs locking operation and then holds the lifter position.</p> <p>After the press angle passes the cushion rise angle, the cushion is raised up to the cushion upper limit.</p> <p>While usually a series of the above operation is performed, the use of this PBL allows the LIFTER HOLD position to be held even after the press angle passes the CUSHION RAISING ANGLE position.</p> <p><u>Operation method</u></p> <p>The mechanical positions for performing this operation are as follows.</p> <p style="padding-left: 40px;">PTO : Must be disconnected</p> <p style="padding-left: 40px;">Slide: HOME position</p> <p style="padding-left: 40px;">Feeder: HOME position or WAIT position</p> <p>First, push the "MANUAL AUX. LIFTER POSITION HOLD" PBL and then push the "SET" PBL. This operation completes selection.</p> <p>The cushion position can be held at the AUX LIFTER position by moving the slide by one stroke after the above-mentioned selection.</p> <p>To clear the held AUX. LIFTER POSITION, push the "RESET" PBL at the above-mentioned machine position, and then the cushion is raised to the cushion upper limit position.</p>	<p>Start-up and operation requirements</p> <p>(1) Not emergency stop</p> <p>(2) The press operation mode to be "OFF"</p> <p>(3) Safety shutters to be all closed</p> <p>(4) W1 - MB touchdown on the bed to be completed</p>

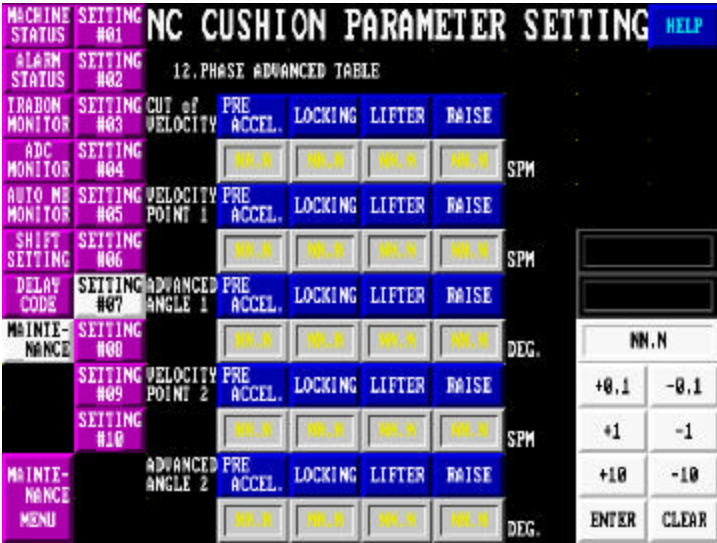
No.	Function & Operation	Description	Sequence & Interlock
	<p>PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #1)</p> <p>PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #2)</p>	 	<ol style="list-style-type: none"> <li>1. NC control proportional gain</li> <li>2. NC control integral gain</li> <li>3. Pre Acceleration Down Stroke (1.2 inch) Servo valve opening value for pre-acceleration at air cushion high capacity Servo valve opening value for pre acceleration at air cushion medium capacity Servo valve opening value for pre-acceleration at air cushion low capacity</li> <li>4. NC control start angle (backup for NC control starting) Usually, NC control starts when the actual cushion capacity exceeds the set cushion capacity. This NC control starting angle is used for backup in cases where the establishment of the above-mentioned relationship has failed. If this value is set at an angle smaller than the die contact angle in the selected pre acceleration mode, NC control starts before pre acceleration, and thus no pre acceleration is performed. In general, this angle is set at about 175°.</li> <li>5. Locking start angle (which is the bottom dead center of the press = 200°) Locking down stroke: usually 0.2 inch</li> </ol> <p>The servo valve opening value for locking is set differently according to the use or non-use of NC control since the pressure applied on the cylinder before reaching the servo valve opening value for locking differs significantly depending on the use or non-use of NC control.</p> <p>Servo valve opening value for locking at air cushion high capacity Servo valve opening value for locking at air cushion medium capacity Servo valve opening value for locking at air cushion low capacity</p> <p>Setting the cushion-raising stroke when lifter is not used The stroke for raising the cushion from its position at the start of locking is set.</p>

No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #3)		<p>6. Lifter-raising stroke</p> <p>The cushion-raising stroke from its position at the start of locking is set. (usually 1 inch) Servo valve opening value at the rise of the lifter Lifter position holding (CPC control) gain</p>
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #4)		<p>7. Servo valve opening value for raising the cushion at air cushion high capacity Servo valve opening value for raising the cushion at air cushion medium capacity Servo valve opening value for raising the cushion at air cushion low capacity Time required to change the servo valve opening value (the time required to switch the value for lifter control to that for raising the cushion)</p> <p>The cushion-raising start angle (when locking is not used) Usually the press bottom dead center = 200° The cushion-raising start angle when locking is used, Usually the angle where the rising of the cross bar lift is completed = 340°</p>

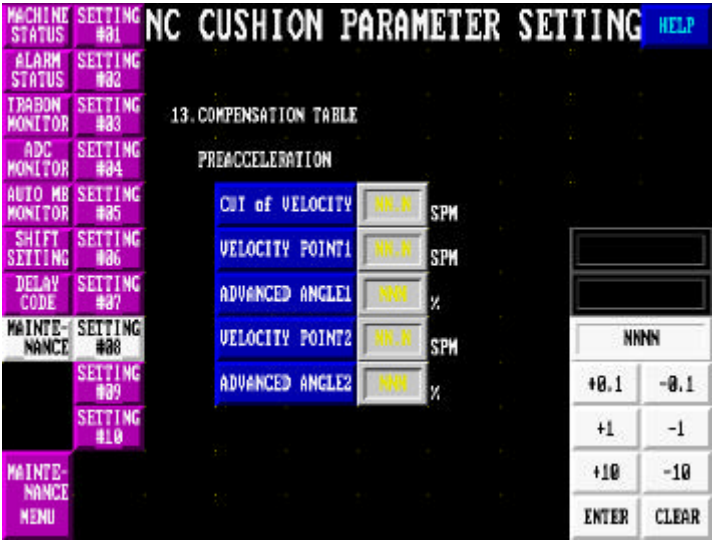
No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #5)		<p>8. Damper starting position (position from cushion upper limit) Time required to change the servo valve opening value (the time required to switch the value for raising the cushion to that for starting the damper)</p> <p>Servo valve opening value for damper at air cushion high capacity Servo valve opening value for damper at air cushion medium capacity Servo valve opening value for damper at air cushion low capacity</p> <p>9. Servo valve opening value for standby during NC control The servo valve is kept open to a certain degree, to adjust the response of NC control. Keeping the servo valve closed speeds up the start-up of NC control, while keeping it open reduces overshooting of actual cushion force.</p>

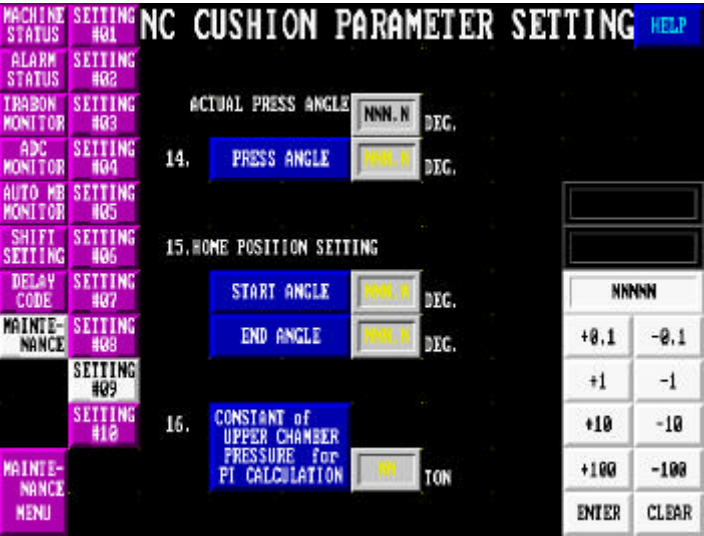
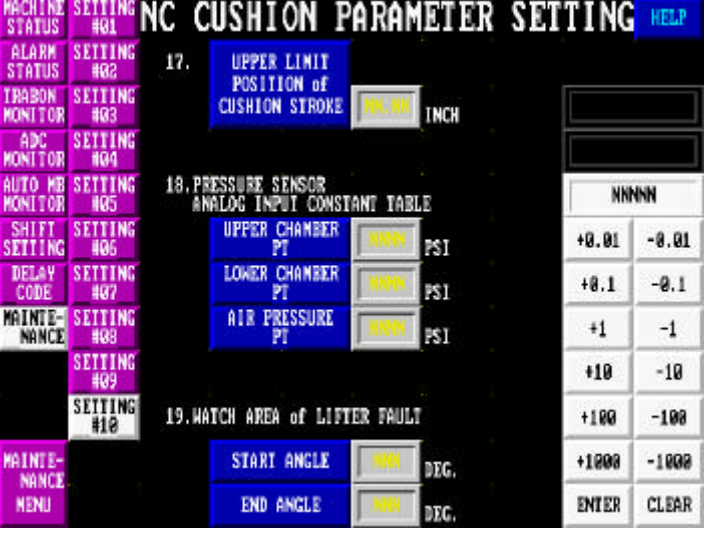
No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #6)		<p>10. Point of air pressure for switching servo valve opening value according to cushion air capacity</p> <p>Linear interpolation is made between the preset servo valve opening values for each air pressure. The data should be entered in such a way that the following relationship can be established: Point1&gt;=Point2&gt;=Point3</p> <p>Air pressure for switching the servo valve opening value for cushion high capacity</p> <p>Air pressure for switching the servo valve opening value for cushion medium capacity</p> <p>Air pressure for switching the servo valve opening value for cushion low capacity</p> <p>11. Cushion overload detection value (Default: 450 ton) If actual cushion capacity exceeds this value, the NC controller will recognize it as a cushion overload and start the safety procedure.</p> <p>The solenoid valve SOL(40629,40630) for the hydraulic cylinder lower chamber is turned on, the servo unload valve SOL(40639) is turned off, and the servo valve is opened to 100%. Thus the oil pressure in the hydraulic cylinder lower chamber is released (to oil pressure tank). SOL(40627,40628) is turned off to cut off cushion oil pressure to the cylinder.</p>



No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #7)	 <p>Advanced Angle Compensation Data for Each Item</p> <p>Each item should be entered in such a way that the following relationship can be established:</p> <p style="padding-left: 40px;">Cut of Velocity &lt;= Velocity Point 1 &lt;= Velocity Point 2</p> <p>The compensation data on the advanced angle for pre acceleration based on each press speed is available only for SOL40627,40628.</p> <p>Reference press speed for compensating the advanced angle for pre acceleration (press speed for starting compensation)</p> <p>Press speed 1 for compensating the advanced angle for pre acceleration</p> <p>Amount of compensation 1 for the advanced angle for pre acceleration</p> <p>Press speed 2 for compensating the advanced angle for pre acceleration</p> <p>Amount of compensation 2 for the advanced angle for pre acceleration</p> <p>The compensation data on the advanced angle for locking based on each press speed is available only for SOL40627,40628.</p> <p>Reference press speed for compensating the advanced angle for locking (press speed for starting compensation)</p> <p>Press speed 1 for compensating the advanced angle for locking</p> <p>Amount of compensation 1 for the advanced angle for locking</p> <p>Press speed 2 for compensating the advanced angle for locking</p> <p>Amount of compensation 2 for the advanced angle for locking</p>	<p>The compensation data on the advanced angle for lifter ending (SOL40627,40628 Off) based on each press speed is available only for SOL40627,40628.</p> <p>Reference press speed for compensating the advanced angle for lifter ending (SOL40627,40628 Off) (press speed for starting compensation)</p> <p>Press speed 1 for compensating the advanced angle for lifter ending (SOL40627,40628 Off)</p> <p>Amount of compensation 1 for the advanced angle for lifter ending (SOL40627,40628 Off)</p> <p>Press speed 2 for compensating the advanced angle for lifter ending (SOL40627,40628 Off)</p> <p>Amount of compensation 2 for the advanced angle for lifter ending (SOL40627,40628 Off)</p> <p>The compensation data on the advanced angle for the cushion-raising position based on press speed is available for servo valve operation.</p> <p>Reference press speed for compensating the advanced angle for the cushion-raising position (press speed for starting compensation)</p> <p>Press speed 1 for compensating the advanced angle for raising the cushion</p> <p>Amount of compensation 1 for the advanced angle for raising the cushion</p> <p>Press speed 2 for compensating the advanced angle for raising the cushion</p> <p>Amount of compensation 2 for the advanced angle for raising the cushion</p>



No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #8)		<p>13. Compensation data on the advanced angle for pre acceleration opening value</p> <p>Each item should be entered in such a way that the following relationship can be established:</p> $\text{Cut of Velocity} \leq \text{Velocity Point 1} \leq \text{Velocity Point 2}$ <p>Amount of compensation for the pre acceleration opening value based on each press speed (The servo valve opening value for pre acceleration means the value obtained by compensating the pre acceleration opening value according to each press speed)</p> <p>Reference press speed for compensating the pre acceleration opening value (press speed for starting compensation)</p> <p>Press speed 1 for compensating the pre acceleration opening value</p> <p>Amount of compensation 1 for the pre acceleration opening value</p> <p>Press speed 2 for compensating the pre acceleration opening value</p> <p>Amount of compensation 2 for the pre acceleration opening value</p>

No.	Function & Operation	Description	Sequence & Interlock
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #9)		<p>14. NC cushion current angle setting data            This data from the sequencer is used as an angle for NC cushion.            The NC cushion current angle is sent back to the sequencer.            When the most significant bit of the data is ON, the NC cushion recognizes the data, from which this most significant bit is subtracted, as being the current angle of the press, and thus corrects the NC cushion current angle.</p> <p>15. Setting data on the home position (HP) in the NC cushion            HP start angle <math>\leq</math> HP <math>\leq</math> HP-ending angle            NC cushion HP starting angle            NC cushion HP ending angle</p> <p>16. Fixed constant for the upper chamber pressure generating capacity for calculating the actual cushion capacity            A fixed value is used as the upper chamber pressure generating capacity for GM.</p>
	PANEL VIEW #3 NC CUSHION MAINTENANCE SCREEN (PARAMETER SETTING #10)		<p>17. Cushion upper limit            First, enter the mechanical drawing dimensions, and after the completion of cushion raising/lowering adjustment, enter the cushion stroke sensor value. (about 17.9 inch)</p> <p>18. Pressure sensor conversion coefficient            Pressure sensor capacity for hydraulic cylinder upper chamber: Pressure detected during 20 mA output            Pressure sensor capacity for hydraulic cylinder lower chamber: Pressure detected during 20 mA output            Cushion air pressure sensor capacity: Pressure detected during 20 mA output</p> <p>19. Press angle range for detecting a lifter position (height) error            For preventing the interference between the cushion and the cross bar;            The data should be entered in such a way that the following relationship can be established:            Start angle <math>&lt;</math> End Angle            The press angle for starting detection of a lifter position (height) error            The press angle for ending detection of a lifter position (height) error</p>