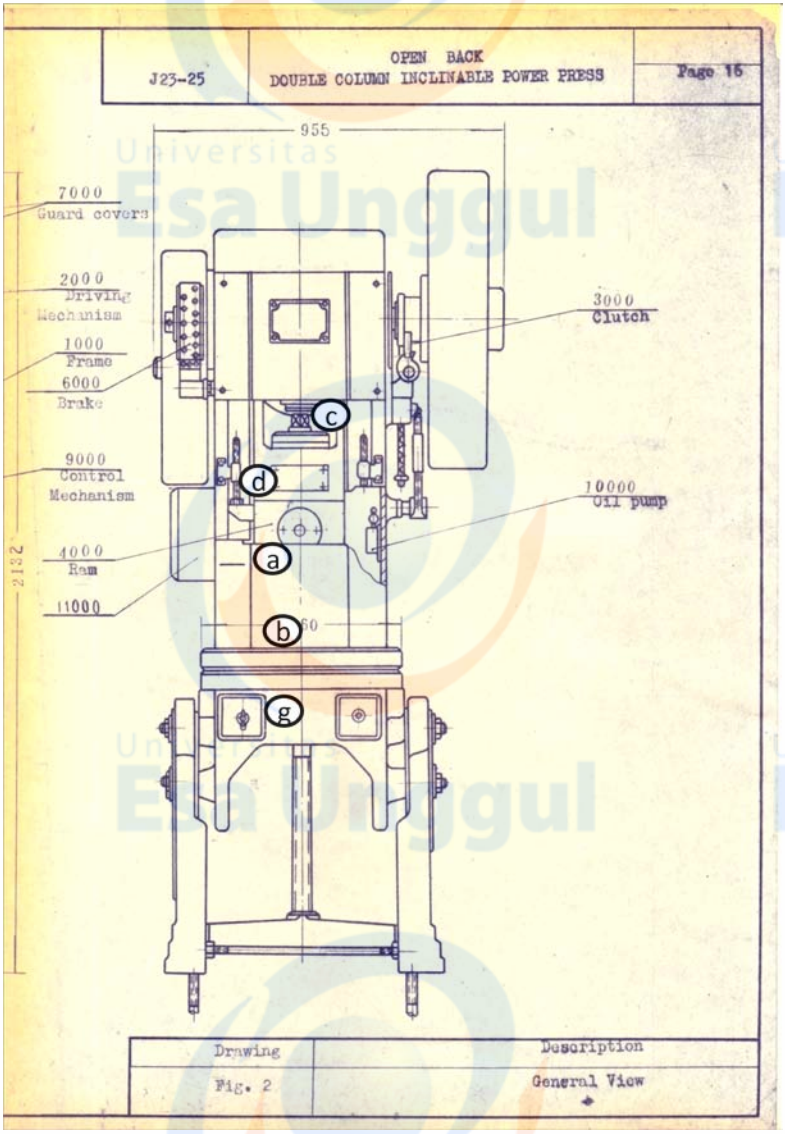
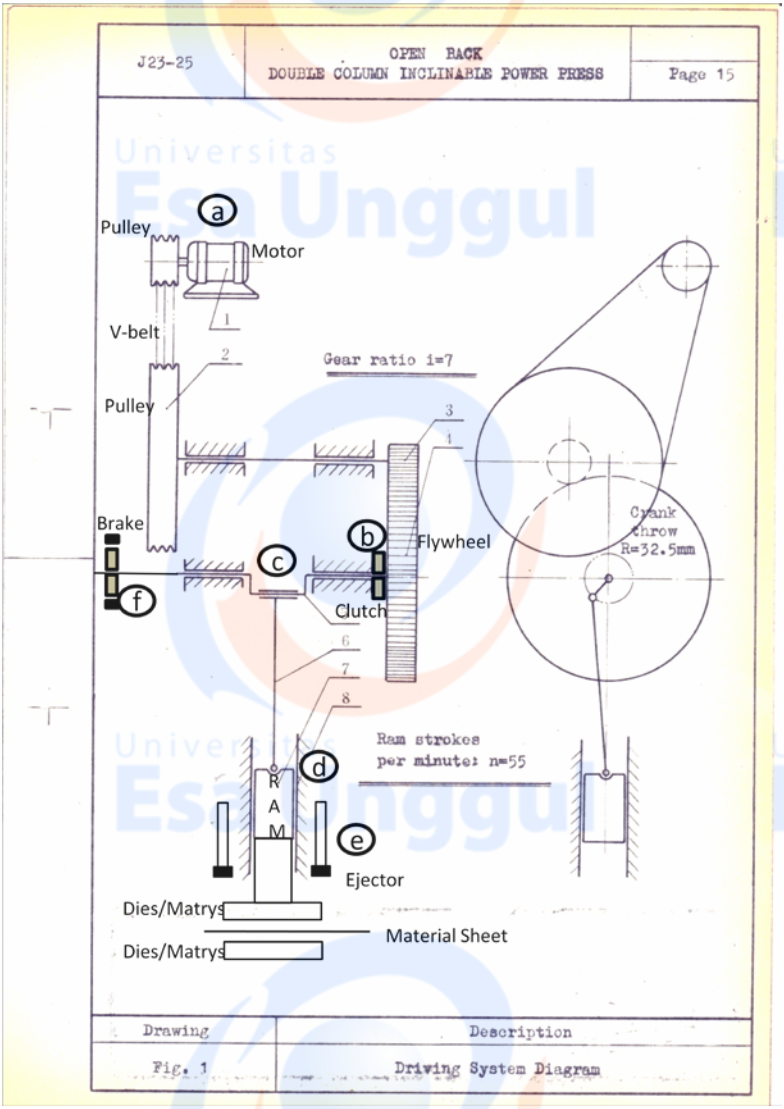
Lampiran 4.1 Setup Mesin Press Manual



Lampiran 4.2 Sistem Kerja Press Manual



Lampiran 4.3 Lembar Kerja FMEA Mesin Press Manual No. 1 (PM 01)

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM	PRESS MANUAL			Facilitator :	Date:		Sheet No.		
		SUB SYSTEM	CLUTCH			Auditor:	Date:				
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK
1	Kopling yang berfungsi meneruskan (*enganged*) atau memutuskan (*disengaged*) tenaga putaran *flywheel* ke *crankshaft* yang akan menggerakkan ram.	A	Tidak dapat meneruskan tenaga putaran dari *flywheel* ke *crankshaft.* (tidak bisa *engaged*)	1	***Rolling key clutch*** patah atau aus sehingga bentuk sudah mengecil dan tidak dapat mengunci *clutch sleeve* (*engaged)*.	Tidak dapat melakukan posisi *engaged* dan *disenganged* dengan sempurna. *Crankshaft* seharusnya berputar dengan *flywheel* tetapi tetap diam sehingga efek kegagalannya adalah tidak dapat melakukan press (produksi)	8	5	8	320	1
				2	***Clutch spring*** patah karena kecepatan produksi yang melebihi kapasitas mesin**.**	Tidak dapat menarik *key clutch* ke posisi *engaged*, sehingga posisi selalu *disengaged.* sehingga efek kegagalannya adalah tidak dapat melakukan press (produksi)	8	1	3	24	20
				3	***Clutch sleeve***, bagian dalam *clutch sleeve* sudah aus / kemakan karena gesekan keras dan terus menerus dengan *rolling key clutch*.	Tidak dapat menggerakkan *crankshaft* pada posisi *clutch engaged* sehingga efek kegagalannya adalah tidak dapat melakukan press (produksi)	8	1	8	64	*6*

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:		Sheet No.			
		SUB SYSTEM		CONTROL MECHANISM		Auditor:	Date:					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK	
1	*Control mechanism* berfungsi mengatur clutch untuk posisi *engaged* (mesin beroperasi) atau *disengaged* (mesin tidak beroperasi)	A	Tidak dapat mengatur posisi clutch enganged (disengaged terus menerus)	1	*Rack and Pinion*, roda gigi *pinion* tidak dapat memutar *camshaft* meskipun *rack* bergerak. Gigi pada pinion atau rack sudah aus sehingga macet tidak dapat saling menggerakkan.	Posisi camshaft tidak berubah sehingga jika cam kondisi *engaged* maka *crankshaft* selalu berputar dan ram akan naik turun terus menerus atau jika cam kondisi *disengaged* maka *crankshaft* tidak dapat berputar sama sekali. Kedua kondisi ini tidak dapat dilakukan proses press (produksi)	9	1	6	54	11
		B	Tidak dapat mengatur posisi clutch disengaged, (engaged terus menerus)	1	*Shaft Cam*, patah atau bengkok karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft* sehingga tidak dapat menahan *rolling key clutch* pada posisi *disengaged* sehingga *crankshaft* berputar terus menerus.	Tidak dapat melakukan produksi karena tidak dapat meletakkan material sheet dan karena ram bergerak terus turun naik maka matrys berpotensi rusak dan membahayakan keselamatan operator (pada kondisi ini motor press manual harus segera dimatikan)	9	1	8	72	3

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:			Sheet No.		
		SUB SYSTEM		CONTROL MECHANISM		Auditor:	Date:					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK	
1		C	Posisi clutch tidak stabil, engaged dan disengaged dengan sendirinya.	1	*Pin Cam*, Patah karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft.*	ram terkadang naik turun terus menerus atau ram berhenti namun tiba-tiba naik dan turun. Hal ini membahayakan keselamatan operator (pada kondisi ini motor press manual harus segera dimatikan)	9	1	8	72	4	

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:			Sheet No.		
		SUB SYSTEM		BRAKE		Auditor:	Date:					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK	
1	Brake berfungsi memperlambat putaran *crankshaft* pada posisi ram paling tas (*top death center*)	A	Tidak dapat memperlambat putaran crankshaft	1	*Brake Band steel* patah atau kampas pada band sudah tipis.	Tidak dapat menahan gerakan *crankshaft* untuk berhenti di titik mati atas. Hal ini akan mengakibatkan putaran *crankshaft* tidak melambat sehingga pada saat cam menahan *rolling key clutch* menghasilkan bunyi yang keras dan berpotensi mematahkan shaft cam	8	4	6	192	2
				2	Brake Wheel, bentuk wheel sudah aus, posisi cam tidak sesuai, karena selalu bergesekan dengan *brake band* terus menerus.	Hal ini akan mengakibatkan gesekan dengan brake band tidak maksimal sehingga putaran *crankshaft* kurang lambat sehingga pada saat cam menahan *rolling key clutch* menghasilkan bunyi yang sedikit keras	2	1	8	16	22

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM	PRESS MANUAL		Facilitator :	Date:	Sheet No.					
		SUB SYSTEM	DRIVING MECHANISM		Auditor:	Date:						
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK	
1	*Driving mechanism* berfungsi sebagai penggerak utama dari mesin press. Memindahkan tenaga dari putaran motor sampai menggerakkan *pulley* dan *flywheel*.	A	Flywheel tidak dapat berputar meskipun motor telah berputar	1	*V-Belt*, sudah mulur sehingga kendor atau kondisi karet belt sudah retak hingga putus	Hal ini berakibat *flywheel* tidak berputar sehingga mesin tidak dapat melakukan proses press (produksi)	8	2	3	48	12	
				2	*FlyWheel*, putaran macet, Gigi-gigi pada *flywheel* gompal atau aus.	Hal ini mengakibatkan putaran *flywheel* tidak stabil dan berhenti sehingga tidak dapat melakukan proses press (produksi)	8	1	6	48	13	
				3	*Inside Bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Hal ini mengakibatkan putaran *flywheel* tidak stabil (goyang) namun hasil press masuk standard spesifikasi, tetapi jika dibiarkan terus menerus flywheel akan macet.	6	1	7	42	14	
				4	*Outside Bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Hal ini mengakibatkan putaran *flywheel* tidak stabil (goyang) namun hasil press masuk standard spesifikasi, tetapi jika dibiarkan terus menerus flywheel akan macet.	6	1	7	42	15	

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:			Sheet No.		
		SUB SYSTEM		ELECTRIC PART		Auditor:	Date:					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK	
1	Mengatur dan mengalirkan arus listrik ke motor sehingga motor dapat bergerak (merubah tenaga listrik menjadi tenaga putaran)	A	Tidak dapat mengatur dan menggerakkan motor.	1	*Induction Motor*, bearing motor macet Motor, gulungan motor short	As motor tidak berputar. Hal ini berarti sumber tenaga mesin press tidak ada sehingga tidak dapat beroperasi.	8	1	8	64	7	
				2	*Electrical Contactor*, kontak kuningan pada *contactor* sudah tipis dan aus sehingga tidak kontak dengan sisi yang lain Contactor, coil magnet *contactor* tidak bekerja	Tidak dapat mengalirkan satu phase atau lebih aliran listrik ke motor. Motor tidak berputar. Hal ini berarti sumber tenaga mesin press tidak ada sehingga tidak dapat beroperasi.	8	1	8	64	8	
				3	*Push Button*, kontak kuningan pada *push button* patah atau aus	Tidak dapat menyambungkan atau memutuskan aliran listrik, sehingga *contactor* dan motor tidak beroperasi dan mesin press	8	1	8	64	9	

RCM INFORMATION WORKSHEET (FMEA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:			Sheet No.		
		SUB SYSTEM		MANUAL LUBRICATION PUMP		Auditor:	Date:					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		FAILURE EFFECT	SEV	OCC	DET	RPN	RANK
1	Memompa dan mengalirkan oli pelumas ke titik-titik pelumasan mesin	A	Tidak dapat mengalirkan oli ke titik pelumasan mesin.	1	*Seal Pump* pompa sudah aus/sobek	Tidak cukup tekanan untuk mendorong oli mengalir ke titik pelumasan. Komponen yang membutuhkan pelumas menjadi kerung dan menyebabkan aus.	6	1	5	30	17
				2	*Pump Tube*, Selang kapiler menuju titik pelumasan mesin mampet atau putus.	Komponen yang membutuhkan pelumas menjadi kerung dan menyebabkan aus.	6	1	5	30	17

Lampiran 4.4 Summary FMEA Mesin Press Manual No. 1 – 96

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 05 – PM 18)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 05	1	20	1	32	1	56	3	192	1	24	1	12
PM 06	1	20	1	32	1	56	3	192	1	24	1	12
PM 07	1	20	1	32	1	56	3	192	1	24	1	12
PM 08	1	20	1	32	2	112	2	128	1	24	1	12
PM 09	1	20	2	64	1	56	1	64	1	24	1	12
PM 10	1	20	1	32	1	56	1	64	1	24	1	12
PM 13	2	40	1	32	1	56	2	128	1	24	1	12
PM 14	2	40	1	32	1	56	1	64	1	24	1	12
PM 15	1	20	1	32	1	56	1	64	1	24	1	12
PM 16	2	40	1	32	1	56	1	64	1	24	1	12
PM 17	1	20	1	32	1	56	1	64	1	24	1	12
PM 18	1	20	1	32	2	112	2	128	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 05 – PM 18)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3	RK	SEV = 8	CS	SEV = 8	CL	SEV = 8	RP	SEV = 9	SC	SEV = 9
		DET = 4		DET = 8		DET = 3		DET = 8		DET = 6		DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 05	1	12	1	64	1	24	1	64	1	54	1	72
PM 06	1	12	1	64	1	24	1	64	1	54	1	72
PM 07	1	12	3	192	1	24	1	64	1	54	1	72
PM 08	1	12	2	128	1	24	1	64	1	54	1	72
PM 09	1	12	2	128	1	24	1	64	1	54	1	72
PM 10	1	12	1	64	1	24	1	64	1	54	1	72
PM 13	1	12	2	128	1	24	1	64	1	54	1	72
PM 14	1	12	2	128	1	24	1	64	1	54	1	72
PM 15	1	12	4	256	1	24	1	64	1	54	1	72
PM 16	1	12	4	256	1	24	1	64	1	54	2	144
PM 17	1	12	3	192	1	24	1	64	1	54	2	144
PM 18	1	12	2	128	3	72	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 05 – PM 18)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 05	1	72	1	48	1	16	1	24	1	48	1	42
PM 06	1	72	1	48	1	16	1	24	1	48	1	42
PM 07	1	72	1	48	1	16	1	24	1	48	1	42
PM 08	1	72	1	48	1	16	1	24	1	48	1	42
PM 09	1	72	2	96	1	16	1	24	1	48	1	42
PM 10	1	72	1	48	1	16	1	24	1	48	1	42
PM 13	1	72	1	48	1	16	1	24	1	48	1	42
PM 14	1	72	5	240	1	16	1	24	1	48	1	42
PM 15	1	72	2	96	1	16	1	24	1	48	1	42
PM 16	1	72	1	48	1	16	1	24	1	48	1	42
PM 17	1	72	3	144	1	16	1	24	1	48	2	84
PM 18	1	72	3	144	1	16	1	24	1	48	1	42

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 05 – PM 18)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 05	1	42	1	64	1	64	1	64	1	30	1	30
PM 06	1	42	1	64	1	64	1	64	1	30	1	30
PM 07	1	42	1	64	1	64	1	64	1	30	1	30
PM 08	1	42	1	64	1	64	1	64	1	30	1	30
PM 09	1	42	1	64	1	64	1	64	1	30	1	30
PM 10	1	42	1	64	1	64	1	64	1	30	1	30
PM 13	1	42	1	64	1	64	1	64	1	30	1	30
PM 14	1	42	1	64	1	64	1	64	1	30	1	30
PM 15	1	42	1	64	1	64	1	64	1	30	1	30
PM 16	1	42	1	64	1	64	1	64	1	30	1	30
PM 17	2	84	1	64	1	64	1	64	1	30	1	30
PM 18	1	42	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 20 – PM 33)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 20	1	20	1	32	2	112	2	128	1	24	1	12
PM 21	1	20	1	32	1	56	1	64	1	24	1	12
PM 23	1	20	1	32	1	56	1	64	1	24	1	12
PM 24	1	20	1	32	1	56	1	64	1	24	1	12
PM 25	1	20	1	32	1	56	1	64	1	24	1	12
PM 26	2	40	1	32	2	112	1	64	1	24	1	12
PM 27	1	20	1	32	1	56	1	64	1	24	1	12
PM 28	1	20	1	32	1	56	1	64	1	24	1	12
PM 29	1	20	1	32	1	56	1	64	1	24	1	12
PM 30	1	20	1	32	1	56	1	64	1	24	1	12
PM 32	2	40	1	32	3	168	1	64	1	24	1	12
PM 33	1	20	1	32	2	112	1	64	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 20 – PM 33)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 20	1	12	2	128	2	48	1	64	1	54	1	72
PM 21	1	12	1	64	2	48	1	64	1	54	1	72
PM 23	1	12	1	64	1	24	1	64	2	108	1	72
PM 24	1	12	2	128	1	24	1	64	1	54	1	72
PM 25	1	12	3	192	1	24	1	64	1	54	1	72
PM 26	1	12	1	64	1	24	1	64	1	54	1	72
PM 27	1	12	4	256	1	24	1	64	1	54	1	72
PM 28	1	12	2	128	1	24	1	64	1	54	1	72
PM 29	1	12	2	128	1	24	1	64	1	54	1	72
PM 30	1	12	2	128	1	24	1	64	1	54	1	72
PM 32	1	12	3	192	1	24	1	64	1	54	1	72
PM 33	1	12	2	128	3	72	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 20 – PM 33)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 20	1	72	4	192	1	16	1	24	1	48	1	42
PM 21	1	72	2	96	1	16	1	24	1	48	1	42
PM 23	1	72	5	240	1	16	1	24	1	48	1	42
PM 24	1	72	4	192	1	16	1	24	1	48	1	42
PM 25	1	72	4	192	1	16	1	24	1	48	1	42
PM 26	1	72	2	96	1	16	1	24	1	48	1	42
PM 27	1	72	2	96	1	16	1	24	1	48	1	42
PM 28	1	72	3	144	1	16	1	24	1	48	1	42
PM 29	1	72	2	96	1	16	1	24	1	48	3	126
PM 30	1	72	5	240	1	16	1	24	1	48	1	42
PM 32	1	72	4	192	1	16	1	24	1	48	2	84
PM 33	1	72	4	192	1	16	1	24	1	48	2	84

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 20 – PM 33)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6	IM	SEV =8	EC	SEV = 8	PB	SEV = 8	SP	SEV = 6	PT	SEV = 6
		DET = 7		DET = 8		DET = 8		DET = 8		DET = 5		DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 20	1	42	1	64	1	64	1	64	1	30	1	30
PM 21	1	42	1	64	1	64	1	64	1	30	1	30
PM 23	1	42	1	64	1	64	1	64	1	30	1	30
PM 24	1	42	1	64	1	64	1	64	1	30	1	30
PM 25	2	84	1	64	1	64	1	64	1	30	1	30
PM 26	1	42	1	64	1	64	1	64	1	30	1	30
PM 27	1	42	1	64	1	64	1	64	1	30	1	30
PM 28	1	42	1	64	1	64	1	64	1	30	1	30
PM 29	4	168	1	64	1	64	1	64	1	30	1	30
PM 30	1	42	1	64	1	64	1	64	1	30	1	30
PM 32	2	84	1	64	1	64	1	64	1	30	1	30
PM 33	2	84	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 34 – PM 48)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 34	1	20	1	32	2	112	1	64	1	24	1	12
PM 35	1	20	1	32	1	56	1	64	1	24	1	12
PM 36	1	20	1	32	2	112	1	64	1	24	1	12
PM 38	1	20	1	32	1	56	1	64	1	24	1	12
PM 39	1	20	1	32	1	56	1	64	1	24	1	12
PM 41	1	20	1	32	1	56	3	192	1	24	1	12
PM 42	1	20	1	32	1	56	2	128	1	24	1	12
PM 43	1	20	1	32	1	56	2	128	1	24	1	12
PM 44	1	20	1	32	1	56	1	64	1	24	1	12
PM 45	1	20	1	32	1	56	1	64	1	24	1	12
PM 46	1	20	1	32	1	56	2	128	1	24	1	12
PM 48	1	20	1	32	1	56	2	128	2	48	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 34 – PM 48)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 34	1	12	3	192	1	24	1	64	1	54	1	72
PM 35	1	12	1	64	1	24	1	64	2	108	1	72
PM 36	1	12	2	128	1	24	1	64	1	54	1	72
PM 38	1	12	2	128	1	24	1	64	1	54	1	72
PM 39	1	12	4	256	1	24	1	64	1	54	1	72
PM 41	1	12	4	256	1	24	1	64	1	54	1	72
PM 42	1	12	2	128	1	24	1	64	1	54	1	72
PM 43	1	12	2	128	1	24	1	64	2	108	1	72
PM 44	1	12	2	128	1	24	1	64	1	54	1	72
PM 45	1	12	3	192	1	24	1	64	1	54	1	72
PM 46	1	12	1	64	1	24	1	64	1	54	1	72
PM 48	1	12	1	64	2	48	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 34 – PM 48)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 34	1	72	3	144	1	16	1	24	1	48	1	42
PM 35	1	72	1	48	1	16	1	24	1	48	1	42
PM 36	1	72	1	48	1	16	1	24	2	96	1	42
PM 38	1	72	5	240	1	16	1	24	1	48	1	42
PM 39	1	72	2	96	1	16	1	24	1	48	1	42
PM 41	1	72	3	144	1	16	1	24	1	48	1	42
PM 42	2	144	4	192	1	16	1	24	2	96	1	42
PM 43	1	72	5	240	1	16	1	24	1	48	1	42
PM 44	1	72	5	240	1	16	1	24	1	48	1	42
PM 45	1	72	5	240	1	16	1	24	1	48	1	42
PM 46	1	72	3	144	1	16	1	24	1	48	1	42
PM 48	1	72	3	144	1	16	1	24	1	48	1	42

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 34 – PM 48)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 34	1	42	1	64	1	64	1	64	1	30	1	30
PM 35	1	42	1	64	1	64	1	64	1	30	1	30
PM 36	1	42	2	128	1	64	1	64	1	30	1	30
PM 38	1	42	1	64	1	64	1	64	1	30	1	30
PM 39	1	42	1	64	1	64	1	64	1	30	1	30
PM 41	1	42	1	64	1	64	1	64	1	30	1	30
PM 42	1	42	1	64	1	64	1	64	1	30	1	30
PM 43	1	42	1	64	1	64	1	64	1	30	1	30
PM 44	1	42	1	64	1	64	1	64	1	30	1	30
PM 45	1	42	1	64	1	64	1	64	1	30	1	30
PM 46	1	42	1	64	1	64	1	64	1	30	1	30
PM 48	2	84	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 49 – PM 64)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 49	1	20	1	32	1	56	3	192	2	48	1	12
PM 50	1	20	1	32	3	168	1	64	1	24	1	12
PM 51	1	20	1	32	1	56	2	128	1	24	1	12
PM 52	1	20	1	32	1	56	1	64	1	24	1	12
PM 53	1	20	1	32	1	56	2	128	1	24	1	12
PM 54	1	20	1	32	1	56	1	64	1	24	1	12
PM 56	1	20	1	32	1	56	1	64	1	24	1	12
PM 57	1	20	1	32	1	56	1	64	1	24	1	12
PM 61	1	20	1	32	1	56	1	64	1	24	1	12
PM 62	1	20	1	32	1	56	1	64	1	24	1	12
PM 63	1	20	1	32	1	56	1	64	1	24	1	12
PM 64	1	20	1	32	1	56	1	64	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 49 – PM 64)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 49	2	24	1	64	1	24	1	64	1	54	1	72
PM 50	1	12	1	64	4	96	1	64	1	54	1	72
PM 51	1	12	1	64	1	24	1	64	1	54	1	72
PM 52	1	12	2	128	2	48	1	64	1	54	1	72
PM 53	1	12	2	128	2	48	1	64	1	54	1	72
PM 54	1	12	1	64	2	48	1	64	1	54	1	72
PM 56	1	12	1	64	1	24	1	64	1	54	1	72
PM 57	1	12	1	64	1	24	1	64	1	54	1	72
PM 61	1	12	1	64	1	24	1	64	1	54	1	72
PM 62	1	12	1	64	1	24	1	64	1	54	1	72
PM 63	1	12	1	64	4	96	1	64	1	54	1	72
PM 64	1	12	2	128	3	72	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 49 – PM 64)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 49	1	72	5	240	1	16	1	24	1	48	1	42
PM 50	1	72	3	144	1	16	1	24	1	48	2	84
PM 51	1	72	4	192	1	16	1	24	1	48	1	42
PM 52	1	72	2	96	1	16	1	24	1	48	1	42
PM 53	1	72	2	96	1	16	1	24	1	48	2	84
PM 54	1	72	1	48	1	16	1	24	2	96	1	42
PM 56	1	72	1	48	1	16	1	24	2	96	1	42
PM 57	1	72	1	48	1	16	1	24	2	96	2	84
PM 61	1	72	1	48	1	16	1	24	2	96	1	42
PM 62	1	72	1	48	1	16	1	24	3	144	1	42
PM 63	1	72	1	48	1	16	1	24	2	96	2	84
PM 64	2	144	3	144	1	16	1	24	2	96	1	42

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 49 – PM 64)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 49	1	42	1	64	1	64	1	64	1	30	1	30
PM 50	2	84	1	64	1	64	1	64	1	30	1	30
PM 51	1	42	1	64	1	64	1	64	1	30	1	30
PM 52	1	42	1	64	1	64	1	64	1	30	1	30
PM 53	2	84	1	64	1	64	1	64	1	30	1	30
PM 54	1	42	1	64	1	64	1	64	1	30	1	30
PM 56	1	42	1	64	1	64	1	64	1	30	1	30
PM 57	2	84	1	64	1	64	1	64	1	30	1	30
PM 61	1	42	1	64	1	64	1	64	1	30	1	30
PM 62	1	42	1	64	1	64	1	64	1	30	1	30
PM 63	1	42	1	64	1	64	1	64	1	30	1	30
PM 64	1	42	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 65 – PM 86)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 65	1	20	1	32	1	56	1	64	1	24	1	12
PM 70	1	20	1	32	1	56	1	64	1	24	1	12
PM 71	1	20	1	32	1	56	1	64	1	24	1	12
PM 72	1	20	1	32	1	56	1	64	1	24	1	12
PM 73	1	20	1	32	1	56	1	64	1	24	1	12
PM 74	1	20	1	32	1	56	1	64	1	24	1	12
PM 75	1	20	1	32	1	56	1	64	1	24	1	12
PM 76	1	20	1	32	1	56	1	64	1	24	1	12
PM 83	1	20	1	32	1	56	1	64	1	24	1	12
PM 84	1	20	1	32	1	56	1	64	1	24	1	12
PM 85	1	20	1	32	1	56	1	64	1	24	1	12
PM 86	1	20	1	32	1	56	1	64	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 65 – PM 86)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 65	1	12	1	64	2	48	1	64	1	54	1	72
PM 70	1	12	6	384	3	72	1	64	1	54	1	72
PM 71	1	12	1	64	1	24	1	64	1	54	1	72
PM 72	1	12	1	64	1	24	1	64	1	54	1	72
PM 73	1	12	1	64	2	48	1	64	1	54	1	72
PM 74	1	12	1	64	2	48	1	64	1	54	1	72
PM 75	1	12	1	64	1	24	1	64	1	54	1	72
PM 76	1	12	1	64	1	24	1	64	1	54	1	72
PM 83	1	12	3	192	3	24	1	64	1	54	1	72
PM 84	1	12	4	254	1	24	1	64	1	54	1	72
PM 85	1	12	4	256	1	96	1	64	1	54	1	72
PM 86	1	12	5	320	1	72	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 65 – PM 86)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 65	1	72	2	96	1	16	1	24	1	48	1	42
PM 70	1	72	4	192	1	16	4	96	1	48	1	42
PM 71	1	72	2	96	1	16	1	24	1	48	1	42
PM 72	1	72	1	48	1	16	1	24	1	48	1	42
PM 73	1	72	1	48	1	16	1	24	1	48	1	42
PM 74	1	72	1	48	1	16	1	24	1	48	1	42
PM 75	1	72	1	48	1	16	1	24	1	48	1	42
PM 76	1	72	1	48	1	16	1	24	1	48	1	42
PM 83	1	72	1	48	1	16	1	24	1	48	1	42
PM 84	1	72	2	96	1	16	1	24	1	48	1	42
PM 85	1	72	2	96	1	16	1	24	1	48	1	42
PM 86	1	72	1	48	1	16	1	24	1	48	3	126

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 25 TON (PM 65 – PM 86)		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 65	1	42	1	64	1	64	1	64	1	30	1	30
PM 70	1	42	1	64	1	64	1	64	1	30	1	30
PM 71	1	42	1	64	1	64	1	64	1	30	1	30
PM 72	1	42	1	64	1	64	1	64	1	30	1	30
PM 73	1	42	1	64	1	64	1	64	1	30	1	30
PM 74	1	42	1	64	1	64	1	64	1	30	1	30
PM 75	1	42	1	64	1	64	1	64	1	30	1	30
PM 76	1	42	1	64	1	64	1	64	1	30	1	30
PM 83	2	84	1	64	1	64	1	64	1	30	1	30
PM 84	1	42	1	64	1	64	1	64	1	30	1	30
PM 85	1	42	1	64	1	64	1	64	1	30	1	30
PM 86	1	42	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 01	1	20	1	32	1	56	1	64	1	24	1	12
PM 02	1	20	1	32	1	56	1	64	1	24	1	12
PM 03	1	20	1	32	1	56	1	64	1	24	1	12
PM 04	1	20	1	32	1	56	2	128	1	24	1	12
PM 67	1	20	1	32	1	56	2	128	1	24	1	12
PM 68	1	20	1	32	1	56	1	64	1	24	1	12
PM 77	1	20	1	32	1	56	1	64	1	24	1	12
PM 78	1	20	1	32	1	56	1	64	1	24	1	12
PM 79	1	20	1	32	1	56	1	64	1	24	1	12
PM 80	1	20	1	32	1	56	1	64	1	24	1	12
PM 91	1	20	1	32	1	56	1	64	1	24	1	12
PM 92	1	20	1	32	1	56	1	64	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 01	1	12	5	320	1	24	1	64	1	54	1	72
PM 02	1	12	3	192	1	24	1	64	1	54	2	144
PM 03	2	24	5	320	1	24	1	64	1	54	1	72
PM 04	1	12	3	192	1	24	1	64	1	54	1	72
PM 67	1	12	3	192	1	24	1	64	1	54	1	72
PM 68	1	12	4	256	1	24	1	64	1	54	1	72
PM 77	1	12	4	256	1	24	1	64	1	54	1	72
PM 78	1	12	4	256	2	48	1	64	1	54	1	72
PM 79	1	12	6	384	2	48	1	64	1	54	1	72
PM 80	1	12	2	128	1	24	1	64	1	54	1	72
PM 91	1	12	5	320	2	48	1	64	1	54	1	72
PM 92	1	12	2	128	1	24	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9 DET = 8	BB	SEV = 8 DET = 6	BW	SEV = 2 DET = 8	VB	SEV = 8 DET = 3	FW	SEV = 8 DET = 6	IB	SEV = 6 DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 01	1	72	4	192	1	16	2	24	1	48	1	42
PM 02	1	72	6	288	1	16	2	96	2	96	1	42
PM 03	1	72	4	192	1	16	1	24	2	96	1	42
PM 04	1	72	6	288	1	16	1	24	3	144	1	42
PM 67	1	72	5	240	1	16	1	24	1	48	1	42
PM 68	1	72	5	240	1	16	1	24	1	48	1	42
PM 77	1	72	1	48	1	16	1	24	2	96	1	42
PM 78	1	72	3	144	1	16	1	24	3	144	1	42
PM 79	1	72	2	96	1	16	1	24	3	144	1	42
PM 80	1	72	2	96	1	16	1	24	1	48	1	42
PM 91	1	72	1	48	1	16	1	24	1	48	1	42
PM 92	1	72	1	48	1	16	1	24	1	48	1	42

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 01	1	42	1	64	1	64	1	64	1	30	1	30
PM 02	1	42	1	64	1	64	1	64	1	30	1	30
PM 03	1	42	1	64	1	64	1	64	1	30	1	30
PM 04	4	168	1	64	1	64	1	64	1	30	1	30
PM 67	1	42	1	64	1	64	1	64	1	30	1	30
PM 68	2	84	1	64	1	64	1	64	1	30	1	30
PM 77	2	84	1	64	1	64	1	64	1	30	1	30
PM 78	2	84	1	64	1	64	1	64	1	30	1	30
PM 79	1	42	1	64	1	64	1	64	1	30	1	30
PM 80	1	42	1	64	1	64	1	64	1	30	1	30
PM 91	1	42	1	64	1	64	1	64	1	30	1	30
PM 92	1	42	1	64	1	64	1	64	1	30	1	30

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON + 60 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	TB	SEV = 4	AS	SEV = 4	BS	SEV = 7	SD	SEV = 8	SR	SEV = 6	EP	SEV = 3
		DET = 5		DET = 8		DET = 8		DET = 8		DET = 4		DET = 4
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 93	1	20	1	32	1	56	1	64	1	24	1	12
PM 94	1	20	1	32	1	56	1	64	1	24	1	12
PM 95	1	20	1	32	1	56	1	64	1	24	1	12
PM 96	1	20	1	32	1	56	1	64	1	24	1	12
		GROUP 63 TON										
PM 11	1	20	2	64	1	56	1	64	1	24	1	12
PM 12	1	20	1	32	1	56	3	192	1	24	1	12
PM 22	1	20	1	32	1	56	1	64	1	24	1	12
PM 31	1	20	1	32	1	56	2	128	1	24	1	12
PM 69	1	20	1	32	1	56	3	192	1	24	1	12
PM 81	1	20	1	32	1	56	2	128	1	24	1	12
PM 82	1	20	1	32	1	56	1	64	1	24	1	12

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON + 60 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	BE	SEV = 3 DET = 4	RK	SEV = 8 DET = 8	CS	SEV = 8 DET = 3	CL	SEV = 8 DET = 8	RP	SEV = 9 DET = 6	SC	SEV = 9 DET = 8
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 93	1	12	5	320	1	24	1	64	1	54	1	72
PM 94	1	12	1	64	1	24	1	64	1	54	1	72
PM 95	1	12	3	192	1	24	1	64	1	54	1	72
PM 96	1	12	2	128	1	24	1	64	1	54	1	72
		GROUP 63 TON										
PM 11	1	12	2	128	1	24	1	64	1	54	1	72
PM 12	1	12	1	64	1	24	1	64	3	162	1	72
PM 22	1	12	2	128	1	24	1	64	3	162	1	72
PM 31	4	48	1	64	1	24	1	64	4	216	3	216
PM 69	2	24	1	64	1	24	1	64	1	54	2	144
PM 81	2	24	1	64	1	24	1	64	1	54	2	144
PM 82	1	12	2	128	1	24	1	64	1	54	1	72

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON + 60 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	PC	SEV = 9	BB	SEV = 8	BW	SEV = 2	VB	SEV = 8	FW	SEV = 8	IB	SEV = 6
		DET = 8		DET = 6		DET = 8		DET = 3		DET = 6		DET = 7
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 93	1	72	1	48	1	16	2	48	2	96	1	42
PM 94	1	72	1	48	1	16	3	72	1	48	1	42
PM 95	1	72	1	48	1	16	1	24	1	48	1	42
PM 96	1	72	1	48	1	16	2	48	1	48	1	42
		GROUP 63 TON										
PM 11	1	72	1	48	1	16	1	24	1	48	1	42
PM 12	1	72	2	96	1	16	1	24	1	48	1	42
PM 22	1	72	1	48	1	16	1	24	1	48	1	42
PM 31	1	72	1	48	1	16	1	24	1	48	1	42
PM 69	1	72	1	48	1	16	1	24	1	48	1	42
PM 81	1	72	1	48	1	16	1	24	1	48	1	42
PM 82	1	72	2	96	1	16	1	24	1	48	1	42

Summary FMEA Mesin Press Manual No. 1 – 96 (Lanjutan)

RCM INFORMATION WORKSHEET (FMEA)	SYSTEM	PRESS MANUAL	Facilitator :	Date:	Sheet No.
	GROUP 40 TON + 63 TON		Auditor:	Date:	

FAILURE MODE (*Cause of failure part*)

TB = Top Bottom half bush AS= Adjusting Screw BS = Ball Seat SD = Safety Disk SR = Sliding Ram	EP = Ejector Plate BE = Bracket Ejector RK = Rolling Key clutch CS = Clutch Spring CL = Clutch Sleeve	RP = Rack Pinion SC =Shaft Cam PC = Pin Cam BB = Brake Band BW = Brake Wheel	VB = V-Belt FW = FlyWheel IB = Inside Bush OB = Outside Bush IM = Induction Motor	EC = Electric Contactor PB = Push Button SP = Seal Pump PT = Pump Tube

Machine No.	OB	SEV = 6 DET = 7	IM	SEV =8 DET = 8	EC	SEV = 8 DET = 8	PB	SEV = 8 DET = 8	SP	SEV = 6 DET = 5	PT	SEV = 6 DET = 5
	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN	OCC	RPN
PM 93	1	42	1	64	1	64	1	64	1	30	1	30
PM 94	1	42	1	64	1	64	1	64	1	30	1	30
PM 95	1	42	1	64	1	64	1	64	1	30	1	30
PM 96	1	42	1	64	1	64	1	64	1	30	1	30
		GROUP 63 TON										
PM 11	1	42	1	64	1	64	1	64	1	30	1	30
PM 12	1	42	1	64	1	64	1	64	1	30	1	30
PM 22	1	42	1	64	1	64	1	64	1	30	1	30
PM 31	1	42	1	64	1	64	1	64	1	30	1	30
PM 69	1	42	1	64	1	64	1	64	1	30	1	30
PM 81	1	42	1	64	1	64	1	64	1	30	1	30
PM 82	1	42	1	64	1	64	1	64	1	30	1	30

Lampiran 4.5 Lembar Kerja LTA Mesin Press Manual

RCM INFORMATION WORKSHEET (LTA)		SYSTEM	PRESS MANUAL		Facilitator :	Date:	Sheet No.
		SUB SYSTEM	CLUTCH		Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)	CRITICAL ANALYSIS		
					Evident	Safety	Outage	Category
1	Kopling yang berfungsi meneruskan (*enganged*) atau memutuskan (*disengaged*) tenaga putaran *flywheel* ke *crankshaft* yang akan menggerakkan ram.	A	Tidak dapat meneruskan tenaga putaran dari *flywheel* ke *crankshaft*. (tidak bisa *engaged*)	1 *Rolling key clutch* patah atau aus sehingga bentuk sudah mengecil dan tidak dapat mengunci *clutch sleeve* (*engaged)*.	Yes	No	Yes	B
				2 *Clutch spring* patah karena kecepatan produksi yang melebihi kapasitas mesin**.**	Yes	No	Yes	B
				3 *Clutch sleeve*, bagian dalam *clutch sleeve* sudah aus/kemakan karena gesekan keras dan terus menerus dengan *rolling key clutch*.	*No*	*No*	*Yes*	*D/B*

Lembar Kerja LTA (Lanjutan)

RCM INFORMATION WORKSHEET (LTA)		SYSTEM	PRESS MANUAL			Facilitator :	Date:	Sheet No.
		SUB SYSTEM	CONTROL MECHANISM			Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		CRITICAL ANALYSIS		
						Evident	Safety	Outage	Category
1	*Control mechanism* berfungsi mengatur clutch untuk posisi *engaged* (mesin beroperasi) atau *disengaged* (mesin tidak beroperasi)	A	Tidak dapat mengatur posisi clutch enganged (disengaged terus menerus)	1	*Rack and Pinion*, roda gigi *pinion* tidak dapat memutar *camshaft* meskipun *rack* bergerak. Gigi pada pinion atau rack sudah aus sehingga macet tidak dapat saling menggerakkan.	Yes	Yes	Yes	A/B
		B	Tidak dapat mengatur posisi clutch disengaged, (engaged terus menerus)	1	*Shaft cam*, patah atau bengkok karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft* sehingga tidak dapat menahan *rolling key clutch* pada posisi *disengaged* sehingga *crankshaft* berputar terus menerus.	Yes	Yes	Yes	A/B
		C	Posisi clutch tidak stabil, engaged dan disengaged dengan sendirinya.	1	*Pin cam*, Patah karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft.*	Yes	Yes	Yes	A/B

Lembar Kerja LTA (Lanjutan)

RCM INFORMATION WORKSHEET (LTA)		SYSTEM		PRESS MANUAL		Facilitator :	Date:	Sheet No.
		SUB SYSTEM		BRAKE		Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		CRITICAL ANALYSIS		
						Evident	Safety	Outage	Category
1	Brake berfungsi memperlambat putaran *crankshaft* pada posisi ram paling tas (*top death center*)	A	Tidak dapat memperlambat putaran crankshaft	1	*Brake band steel* patah atau kampas pada band sudah tipis.	Yes	No	Yes	B
				2	Brake wheel, bentuk wheel sudah aus, posisi cam tidak sesuai, karena selalu bergesekan dengan *brake band* terus menerus.	No	No	No	D/C
		SUB SYSTEM		DRIVING MECHANISM					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		CRITICAL ANALYSIS		
						Evident	Safety	Outage	Category
1	*Driving mechanism* berfungsi sebagai penggerak utama dari mesin press. Memindahkan tenaga dari putaran motor sampai menggerakkan *pulley* dan *flywheel*.	A	Flywheel tidak dapat berputar meskipun motor telah berputar	1	*V-belt*, sudah mulur sehingga kendor atau kondisi karet belt sudah retak hingga putus	Yes	No	Yes	B
				2	*Flywheel*, putaran macet, Gigi-gigi pada *flywheel* gompal atau aus.	No	No	Yes	D/B
				3	*Inside bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Yes	No	No	C
				4	*Outside bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Yes	No	No	C

Lembar Kerja LTA (Lanjutan)

RCM INFORMATION WORKSHEET (LTA)		SYSTEM	PRESS MANUAL		Facilitator :	Date:	Sheet No.
		SUB SYSTEM	ELECTRIC PART		Auditor:	Date:	

FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		CRITICAL ANALYSIS			
						Evident	Safety	Outage	Category
1	Mengatur dan mengalirkan arus listrik ke motor sehingga motor dapat bergerak (merubah tenaga listrik menjadi tenaga putaran)	A	Tidak dapat mengatur dan menggerakkan motor.	1	Motor, bearing motor macet	No	No	Yes	D/B
					Motor, gulungan motor short				
				2	Contactor, kontak kuningan pada *contactor* sudah tipis dan aus sehingga tidak kontak dengan sisi yang lain	No	No	Yes	D/B
					Contactor, coil magnet *contactor* tidak bekerja				
				3	Push button, kontak kuningan pada *push button* patah atau aus	No	No	Yes	D/B
		SUB SYSTEM	MANUAL LUBRICATION PUMP						
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		CRITICAL ANALYSIS			
						Evident	Safety	Outage	Category
1	Memompa dan mengalirkan oli pelumas ke titik-titik pelumasan mesin	A	Tidak dapat mengalirkan oli ke titik pelumasan mesin.	1	Seal pompa sudah aus/sobek	No	No	No	D/C
				2	Selang kapiler menuju titik pelumasan mesin mampet atau putus.	No	No	No	D/C

Lampiran 4.6 Lembar Kerja Kategori Tugas

RCM INFORMATION WORKSHEET		SYSTEM	PRESS MANUAL			Facilitator :	Date:	Sheet No.
		SUB SYSTEM	CLUTCH			Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION	PREVENTIVE TASK	
1	Kopling yang berfungsi meneruskan (*enganged*) atau memutuskan (*disengaged*) tenaga putaran *flywheel* ke *crankshaft* yang akan menggerakkan ram.	A	Tidak dapat meneruskan tenaga putaran dari *flywheel* ke *crankshaft*. (tidak bisa *engaged*)	1	*Rolling key clutch* patah atau aus sehingga bentuk sudah mengecil dan tidak dapat mengunci *clutch sleeve* (*engaged)*.	Yes	Scheduled Discard Task	
				2	*Clutch spring* patah karena kecepatan produksi yang melebihi kapasitas mesin**.**	Hidden	No Scheduled Maitenance	
				3	*Clutch sleeve*, bagian dalam *clutch sleeve* sudah aus/kemakan karena gesekan keras dan terus menerus dengan *rolling key clutch*.	*Hidden*	*Failure Finding Task*	

Lembar Kerja Kategori Tugas (Lanjutan)

RCM INFORMATION WORKSHEET		SYSTEM	PRESS MANUAL			Facilitator :	Date:	Sheet No.
		SUB SYSTEM	CONTROL MECHANISM			Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION		PREVENTIVE TASK
1	*Control mechanism* berfungsi mengatur clutch untuk posisi *engaged* (mesin beroperasi) atau *disengaged* (mesin tidak beroperasi)	A	Tidak dapat mengatur posisi clutch enganged (disengaged terus menerus)	1	*Rack and Pinion*, roda gigi *pinion* tidak dapat memutar *camshaft* meskipun *rack* bergerak. Gigi pada pinion atau rack sudah aus sehingga macet tidak dapat saling menggerakkan.	No		Combination of Task On Condition and Discard task
		B	Tidak dapat mengatur posisi clutch disengaged, (engaged terus menerus)	1	*Shaft cam*, patah atau bengkok karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft* sehingga tidak dapat menahan *rolling key clutch* pada posisi *disengaged* sehingga *crankshaft* berputar terus menerus.	No		Combination of Task On Condition and Discard task
		C	Posisi clutch tidak stabil, engaged dan disengaged dengan sendirinya.	1	*Pin cam*, Patah karena benturan yang keras pada saat menahan dan menghentikan putaran *crankshaft.*	No		Combination of Task On Condition and Discard task

Lembar Kerja Kategori Tugas (Lanjutan)

RCM INFORMATION WORKSHEET		SYSTEM	PRESS MANUAL		Facilitator :	Date:	Sheet No.
		SUB SYSTEM	BRAKE		Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION	PREVENTIVE TASK
1	Brake berfungsi memperlambat putaran *crankshaft* pada posisi ram paling tas (*top death center*)	A	Tidak dapat memperlambat putaran crankshaft	1	*Brake band steel* patah atau kampas pada band sudah tipis.	Yes	Scheduled On Condition Task
				2	Brake wheel, bentuk wheel sudah aus, posisi cam tidak sesuai, karena selalu bergesekan dengan *brake band* terus menerus.	Hidden	No Scheduled Maintenance
		SUB SYSTEM	DRIVING MECHANISM				
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION	PREVENTIVE TASK
1	*Driving mechanism* berfungsi sebagai penggerak utama dari mesin press. Memindahkan tenaga dari putaran motor sampai menggerakkan *pulley* dan *flywheel*.	A	Flywheel tidak dapat berputar meskipun motor telah berputar	1	*V-belt*, sudah mulur sehingga kendor atau kondisi karet belt sudah retak hingga putus	Yes	Scheduled On Condition Task
				2	*Flywheel*, putaran macet, Gigi-gigi pada *flywheel* gompal atau aus.	Hidden	Failure Finding Task
				3	*Inside bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Yes	Scheduled Discard Task
				4	*Outside bush* aus dan terjadi kelonggaran diameter dalam dan diameter luar	Yes	Scheduled Discard Task

Lembar Kerja Kategori Tugas (Lanjutan)

RCM INFORMATION WORKSHEET		SYSTEM	PRESS MANUAL			Facilitator :	Date:	Sheet No.
		SUB SYSTEM	ELECTRIC PART			Auditor:	Date:	
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION		PREVENTIVE TASK
1	Mengatur dan mengalirkan arus listrik ke motor sehingga motor dapat bergerak (merubah tenaga listrik menjadi tenaga putaran)	A	Tidak dapat mengatur dan menggerakkan motor.	1	Motor, bearing motor macet	Hidden		No Scheduled Maintenenace
					Motor, gulungan motor short			
				2	Contactor, kontak kuningan pada *contactor* sudah tipis dan aus sehingga tidak kontak dengan sisi yang lain	Hidden		No Scheduled Maintenance
					Contactor, coil magnet *contactor* tidak bekerja			
				3	Push button, kontak kuningan pada *push button* patah atau aus	Hidden		No Scheduled Maintenance
		SUB SYSTEM	MANUAL LUBRICATION PUMP					
FUNCTION		FUNCTIONAL FAILURE *(Loss of functions)*		FAILURE MODE (*Cause of failure*)		LIFE TIME RELATION		PREVENTIVE TASK
1	Memompa dan mengalirkan oli pelumas ke titik-titik pelumasan mesin	A	Tidak dapat mengalirkan oli ke titik pelumasan mesin.	1	Seal pompa sudah aus/sobek	Hidden		Scheduled On Condition Task
				2	Selang kapiler menuju titik pelumasan mesin mampet atau putus.	Hidden		Scheduled on Condition Task

Lampiran 4.7 Lembar Kerja RCM Mesin Press Manual

RCM INFORMATION WORKSHEET							SYSTEM	PRESS MANUAL			Facilitator :	Date:	Sheet No.
							SUB SYSTEM	CLUTCH			Auditor:	Date:	
FMEA			LTA				PREVEN.			DEFAULT			PROPOSED TASK	INITIAL INTERVAL			PIC
F	FF	FM	H	S	E	O	H1 S1 O1 N1	H2 S2 O2 N2	H3 S3 O3 N3	H4	H5	S4		25 Ton	40 Ton	63 Ton	
1	A	1	Y	N	N	Y	N	N	Y				Penggantian Rolling key clutch secara berkala	6 bln	6 bln	6 bln	MTC
1	A	2	Y	N	N	Y	N	N	N				Tidak ada kegiatan perawatan dan perbaikan terjadwal	-	-	-	MTC
1	A	3	N	N	N	Y	N	N	N	Y			Pengecekan secara berkala apakah Clutch sleeve sudah mengalami aus.	1 thn	1 thn	1 thn	MTC
							SUB SYSTEM	CONTROL MECHANISM									
1	A	1	Y	Y	N	Y	N	N	N			Y	Pengecekan rack dan pinion secara berkala dan penggantian komponen tersebut sesuai waktu yang ditetapkan.	1 bln 2 thn	1 bln 2 thn	1 bln 1 thn	MTC
1	B	2	Y	Y	N	Y	N	N	N			Y	Pengecekan shaft cam secara berkala dan penggantian komponen tersebut sesuai waktu yang ditetapkan.	1 bln 2 thn	1 bln 2 thn	1 bln 1 thn	MTC
1	C	3	Y	Y	N	Y	N	N	N			Y	Pengecekan pin cam secara berkala dan penggantian komponen tersebut sesuai waktu yang ditetapkan.	1 bln 2 thn	1 bln 2 thn	1 bln 1 thn	MTC
							SUB SYSTEM	BRAKE									
1	A	1	Y	N	N	Y	Y						Pengecekan kondisi ketebalan kampas dan band steel secara berkala apakah sudah tipis dan ada retakan pada steel.	1 bln	1 bln	1 bln	MTC
1	A	2	N	N	N	N	N	N	N	N	N		Tidak ada kegiatan perawatan dan perbaikan terjadwal	-	-	-	MTC

Lembar Kerja RCM Mesin Press Manual (Lanjutan)

RCM INFORMATION WORKSHEET							SYSTEM	PRESS MANUAL				Facilitator :	Date:	Sheet No.
							SUB SYSTEM	DRIVING MECHANISM				Auditor:	Date:	
FMEA			LTA				PREVEN.			DEFAULT				
F	FF	FM	H	S	E	O	H1 S1 O1 N1	H2 S2 O2 N2	H3 S3 O3 N3	H4	H5	S4	PROPOSED TASK	INITIAL INTERVAL 25 Ton	40 Ton	63 Ton	PIC
1	A	1	Y	N	N	Y	Y						Pengecekan secara berkala kondisi belt apakah sudah kendor dan crack (retak)	2 bln	2 bln	2 bln	MTC
1	A	2	N	N	N	Y	N	N	N	Y			Pengecekan secara berkala terhadap gigi gear flywheel apakah ada gompal atau sudah tajam.	1 thn	1 thn	1 thn	MTC
1	A	3	Y	N	N	N	N	N	Y				Penggantian Inside bush dengan waktu yang ditetapkan	2 thn	2 thn	2 thn	MTC
1	A	4	Y	N	N	N	N	N	Y				Penggantian Outside bush dengan waktu yang ditetapkan	2 thn	2 thn	2 thn	MTC
							SUB SYSTEM	ELECTRIC PART									
1	A	1	N	N	N	Y	N	N	N	N	N		Tidak ada kegiatan perawatan dan perbaikan terjadwal	-	-	-	MTC
1	A	2	N	N	N	Y	N	N	N	N	N		Tidak ada kegiatan perawatan dan perbaikan terjadwal	-	-	-	MTC
1	A	3	N	N	N	Y	N	N	N	N	N		Tidak ada kegiatan perawatan dan perbaikan terjadwal	-	-	-	MTC
							SUB SYSTEM	MANUAL LUBRICATION PUMP									
1	A	1	N	N	N	N	Y						Pengecekan kondisi pompa secara berkala	1 bln	1 bln	1 bln	MTC
1	A	2	N	N	N	N	Y						Pengecekan pipa kapiler titik pelumasan secara berkala	1 bln	1 bln	1 bln	MTC

Lampiran 4.8 Penentuan Distribusi Kerusakan dan Waktu Perbaikan

Komponen *Brake Band* Press Manual (PM 04 40 Ton)

No.	Kerusakan *Brake Band* PM 04 (hari)	Waktu Perbaikan *Brake Band* PM 04 (menit)
1	130	120
2	76	90
3	116	65
4	127	100
5	5	75
6	98	125
7	31	135
8	62	140
9	107	110
10	101	60
11	62	100
12	87	120
13		105

Distribution ID Plot: Interval Kerusakan Brake Band

Goodness-of-Fit

Distribution	Anderson-Darling (adj)	Correlation Coefficient
Normal	1.255	0.971
Lognormal	2.275	0.819
Exponential	4.053	*
Weibull	1.767	0.898

Dari hasil perhitungan Minitab 14 distribusi terpilih = Distribusi Normal

Tabel Kerusakan *Brake Band* PM 04 Distribusi Normal

N	Ti	F(Ti)	Yi	Ti^2	Yi^2	Ti .Yi	Ti - $\bar{T}i$	$(Ti - \bar{T}i)^2$
1	5	0.0565	-1.580	25	2.496	-7.900	-78.500	6162.250
2	31	0.1371	-1.090	961	1.188	-33.790	-52.500	2756.250
3	62	0.2177	-0.780	3844	0.608	-48.360	-21.500	462.250
4	62	0.2984	-0.530	3844	0.281	-32.860	-21.500	462.250
5	76	0.3790	-0.310	5776	0.096	-23.560	-7.500	56.250
6	87	0.4597	-0.100	7569	0.010	-8.700	3.500	12.250
7	98	0.5403	0.100	9604	0.010	9.800	14.500	210.250
8	101	0.6210	0.310	10201	0.096	31.310	17.500	306.250
9	107	0.7016	0.530	11449	0.281	56.710	23.500	552.250

N	Ti	F(Ti)	Yi	Ti^2	Yi^2	Ti .Yi	$Ti - \overline{Ti}$	$(Ti - \overline{Ti})^2$
10	116	0.7823	0.780	13456	0.608	90.480	32.500	1056.250
11	127	0.8629	1.090	16129	1.188	138.430	43.500	1892.250
12	130	0.9435	1.580	16900	2.496	205.400	46.500	2162.250
TOTAL	1002	6.00	0.000	99758	9.360	376.960	0	16091.000
AVG	83.50	0.50	0	8313.167	0.780	31.413	0	1340.917

Diketahui :

N = 12

$\Sigma(Ti) = 1002$

$\Sigma(Ti-Ti)^2 = 16091$

Maka,

$\mu = \Sigma(Ti) / N$

$= 1002 / 12 = 83.50$

$$s = \sqrt{\frac{\sum(Ti - \overline{Ti})^2}{n-1}}$$

$$= \sqrt{\frac{16091}{12-1}} = 38.246$$

$$\sigma = \sqrt{\frac{(n-1)s^2}{n}}$$

$$= \sqrt{\frac{(12-1)38.246^2}{12}} = 36.61$$

MTTF $= \mu$

$= 83.50$ hari

Distribution ID Plot: Waktu Perbaikan Brake Band

Goodness-of-Fit

Distribution	Anderson-Darling (adj)	Correlation Coefficient
Normal	1.114	0.984
Lognormal	1.293	0.964
Exponential	6.917	*
Weibull	1.075	0.986

Dari hasil perhitungan Minitab 14 distribusi terpilih = Distribusi Weibull

Tabel Waktu Perbaikan *Brake Band* PM 04 Distribusi Weibull

i	ti	F(ti)	Ti =LN(ti)	Yi=LN(-LN[1-F(Ti)])	Ti^2	Yi^2	Ti .Yi	Ti - $\overline{Ti}$	(Ti - $\overline{Ti}$)^2
1	60	0.0522	4.094	-2.925	16.764	8.557	-11.977	-43.462	1888.905
2	65	0.1269	4.174	-1.998	17.426	3.990	-8.339	-38.462	1479.290
3	75	0.2015	4.317	-1.492	18.641	2.225	-6.440	-28.462	810.059
4	90	0.2761	4.500	-1.130	20.248	1.276	-5.083	-13.462	181.213
5	100	0.3507	4.605	-0.839	21.208	0.705	-3.866	-3.462	11.982
6	100	0.4254	4.605	-0.591	21.208	0.349	-2.719	-3.462	11.982
7	105	0.5000	4.654	-0.367	21.659	0.134	-1.706	1.538	2.367
8	110	0.5746	4.700	-0.157	22.095	0.025	-0.738	6.538	42.751
9	120	0.6493	4.787	0.047	22.920	0.002	0.223	16.538	273.521
10	120	0.7239	4.787	0.252	22.920	0.064	1.208	16.538	273.521
11	125	0.7985	4.828	0.471	23.313	0.222	2.275	21.538	463.905
12	135	0.8731	4.905	0.725	24.062	0.526	3.556	31.538	994.675
13	140	0.9478	4.942	1.082	24.420	1.172	5.349	36.538	1335.059
TOTAL	1345	6.5000	59.901	-6.920	276.882	19.246	-28.256	0.000	7769.231
AVG	103.462	0.5000	4.608	-0.532	21.299	1.480	-2.174	0.000	597.633

Diketahui :

N = 13

Σ TiYi = -28.256

Σ Ti = 59.901

Σ Yi = -6.920

Σ Ti^2 = 276.882

Maka,

$$b = \frac{\sum TiYi - \frac{\sum Ti \sum Yi}{N}}{\sum Ti^2 - \frac{(\sum Ti)^2}{N}}$$

$$= \frac{-28.256 - \frac{(59.901)(-6.920)}{13}}{276.882 - \frac{59.901^2}{13}}$$

$$= 4.162$$

$$a = \frac{\sum Yi}{N} - b\frac{\sum Ti}{N}$$

$$= \frac{-6.920}{13} - (4.162)\left(\frac{59.901}{13}\right)$$

$$= -19.709$$

Parameter bentuk (β) = b = 4.162
Parameter skala (θ) = η = exp -(a/b)
= exp -(-19.709/4.162)
= 113.916

$$MTTR = \eta\Gamma\left(\frac{1}{\beta} + 1\right)$$

$$= 113.916\ \Gamma\left(\frac{1}{4.162} + 1\right)$$

$$= 113.916\ \Gamma\ (1.24)$$

$$= 113.916\ (0.90852)$$

$$= 103.494 \text{ menit}$$

Komponen *Rack and Pinion* Press Manual (PM 31 63 Ton)

Tabel Interval Kerusakan dan Waktu Perbaikan *Rack and Pinion*

No.	Interval Kerusakan *Rack Pinion* PM 31 (hari)	Waktu Perbaikan *Rack Pinion* PM 31 (menit)
1	125	240
2	118	225
3	94	285
4	240	270
5	156	255
6		240

Distribution ID Plot: Interval Kerusakan RackPinion

Goodness-of-Fit

Distribution	Anderson-Darling (adj)	Correlation Coefficient
Normal	2.494	0.930
Lognormal	2.382	0.969
Exponential	3.442	*
Weibull	2.658	0.936

Dari hasil perhitungan Minitab 14 distribusi terpilih = Distribusi Lognormal

Tabel Kerusakan *Rack and Pinion* PM 31 Distribusi Lognormal

i	ti	F(Ti)	Ti=Ln(ti)	Yi	Ti^2	Yi^2	Ti .Yi	$Ti - \overline{Ti}$	$(Ti - \overline{Ti})^2$
1	94	0.1296	4.543	-1.130	20.642	1.277	-5.134	-0.3913	0.153
2	118	0.3148	4.771	-0.480	22.759	0.230	-2.290	-0.1639	0.027
3	125	0.5000	4.828	0.000	23.313	0.000	0.000	-0.1062	0.011
4	156	0.6852	5.050	0.480	25.501	0.230	2.424	0.1153	0.013
5	240	0.8704	5.481	1.130	30.037	1.277	6.193	0.5461	0.298
TOTAL	733	2.500	24.673	0.000	122.252	3.015	1.193	0.0000	0.503
AVG	146.6	0.500	4.935	0	24.450	0.603	0.239	0.0000	0.101

Diketahui :

N = 5

$\Sigma \ln(ti)$ = 24.673

$\Sigma[\ln(ti)-\mu]^2$ = 0.503

Maka,

$\mu = \Sigma \ln(ti) / N$

$= 24.673 / 5 = 4.935$

$t_{med} = e^{\mu}$

$= e^{4.935} = 139.073$

$$s = \sqrt{\frac{\sum(\ln(ti) - \mu)^2}{n}}$$

$$= \sqrt{\frac{0.503}{5}}$$

$= 0.317$

MTTF $= t_{med} \exp(s^2/2)$

$= 139.073 \cdot \exp(0.317^2 / 2)$

$= 146.239$ hari

Distribution ID Plot: Waktu Perbaikan RackPinion

Goodness-of-Fit

Distribution	Anderson-Darling (adj)	Correlation Coefficient
Normal	2.038	0.981
Lognormal	2.031	0.984
Exponential	5.164	*
Weibull	2.166	0.963

Dari hasil perhitungan Minitab 14 distribusi terpilih = Distribusi Lognormal

Tabel Waktu Perbaikan *Rack and Pinion* PM 31 Distribusi Lognormal

i	ti	F(Ti)	Ti=Ln(ti)	Yi	Ti^2	Yi^2	Ti .Yi	$Ti - \overline{Ti}$	$(Ti - \overline{Ti})^2$
1	225	0.1094	5.416	-1.230	29.334	1.513	-6.662	-0.1122	0.013
2	240	0.2656	5.481	-0.630	30.037	0.397	-3.453	-0.0476	0.002
3	240	0.4219	5.481	-0.200	30.037	0.040	-1.096	-0.0476	0.002
4	255	0.5781	5.541	0.200	30.706	0.040	1.108	0.0130	0.000
5	270	0.7344	5.598	0.630	31.342	0.397	3.527	0.0702	0.005
6	285	0.8906	5.652	1.230	31.951	1.513	6.953	0.1242	0.015
TOTAL	1515	3.000	33.170	0.000	183.408	3.900	0.377	0.0000	0.038
AVG	252.5	0.500	5.528	0	30.568	0.650	0.063	0.0000	0.006

Diketahui :

N $= 6$

$\Sigma \ln(ti) = 33.170$

$\Sigma[\ln(ti)-\mu]^2 = 0.038$

Maka,

μ $= \Sigma \ln(ti) / N$

$= 33.170 / 6 = 5.528$

t_{med} $= e^{\mu}$

$= e^{5.528} = 251.640$

$$s = \sqrt{\frac{\sum(\ln(ti) - \mu)^2}{n}}$$

$$= \sqrt{\frac{0.038}{6}}$$

$= 0.0796$

$MTTF = t_{med} \exp(s^2/2)$

$= 251.640 \cdot \exp(0.0796^2 / 2)$

$= 252.438$ menit

Lampiran 4.9

Perhitungan Total Biaya Minimum dengan Interval Perawatan

***Brake Band* PM 04**

a. Biaya tenaga kerja

Untuk perbaikan komponen ini membutuhkan 1 orang teknisi dengan rincian sebagai berikut :

Tabel Biaya Tenaga Kerja

Tenaga Kerja	Gaji (Rp)	Jumlah Personel	Total Gaji (Rp)	
			Per Bulan	Per Jam
Teknisi	3.310.000,-	1	3.310.000,-	20.687,-

b. Biaya kehilangan produksi

Biaya bahan baku 1 pcs produk (Ø 190) = Rp 6.100,-

Jumlah produksi per jam = 875 pcs

Biaya operator per jam = Rp 20.687,-

Biaya kehilangan produksi / jam = (6100 x 875) + 20687

= Rp 5.358.187,- / jam

c. Biaya komponen

Data dari bagian pembelian untuk part *Brake Band* adalah Rp. 840.000,-

d. Biaya satu siklus *failure* (Cf)

Nilai MTTR *Brake Band* = 113.916 menit = 1.89 jam

Cf = ((biaya tenaga kerja/jam + biaya kehilangan produksi /jam) x MTTR) + biaya komponen

= (20687 + 5358187) 1.89 + 840000

= 22806425.76 + 840000

= Rp 11.006.071,86

e. Waktu standar pemeliharaan/perbaikan

Sesuai dengan data pada departemen maintenance , waktu standar pemeliharaan komponen *Brake Band* adalah 60 menit = 1 jam

f. Biaya satu siklus *preventive* (Cp)

Cp = (biaya tenaga kerja/jam x waktu standar pemeliharaan) + biaya komponen

= (20687 x 1) + 840000

= Rp 860.687,-

g. Interval Perawatan dengan Total Biaya Minimum

Perhitungan *total cost* dengan

tp = 1 hari = 24 jam ;

MTTF = 83.5 hari = 2004 jam

μ = 83.50

σ = 36.61

$$R(tp) = 1 - \Phi\left(\frac{t - \mu}{\sigma}\right)$$

$$= 1 - \Phi\left(\frac{1 - 83.50}{36.61}\right)$$

$$= 1 - \Phi(-2.253)$$

$$= 0.9878$$

$$Tc\ (tp) = \frac{Cp\ \times R(tp) + \ Cf \times (1 - R(tp))}{tp\ \times\ R(tp) + \ MTTF(1 - R(tp))}$$

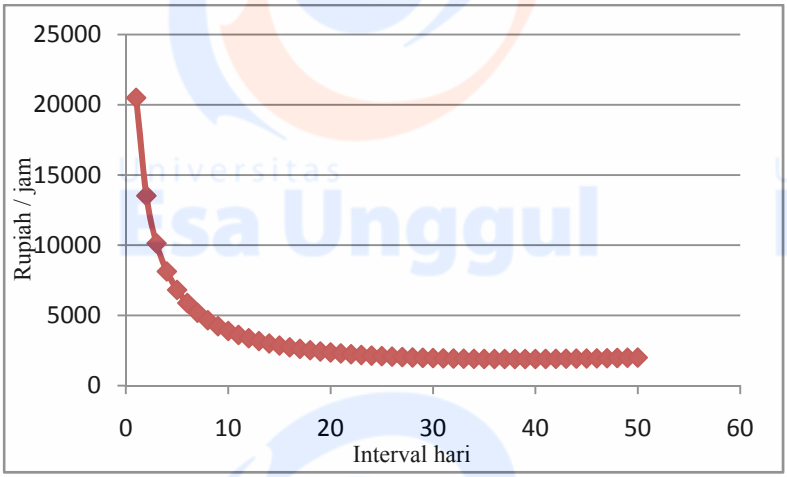
$$Tc\ (24) = \frac{(860687\ \times 0.9878) + 11006071.86 \times (1 - 0.9878)}{(24\ \times\ 0.9878) + \ 2004\ (1 - 0.9878)}$$

$$= \frac{983591.9}{47.98645}$$

= 20497 ≈ Rp 20.497,- / jam

Dari perhitungan Excel didapatkan nilai Tc terendah adalah Rp 1.891,40 dengan interval perawatan 38 hari (912 jam).

Grafik Total Biaya Perawatan *Brake Band* PM 04



***Rack and Pinion* PM 31**

a. Biaya tenaga kerja

Untuk perbaikan komponen ini membutuhkan 1 orang teknisi dengan rincian sebagai berikut :

Tabel Biaya Tenaga Kerja

Tenaga Kerja	Gaji (Rp)	Jumlah Personel	Total Gaji (Rp)	
			Per Bulan	Per Jam
Teknisi	3.310.000,-	1	3.310.000,-	20.687,-

b. Biaya kehilangan produksi

Biaya bahan baku 1 pcs produk (Ø 270) = Rp 9.400,-

Jumlah produksi per jam = 675 pcs

Biaya operator per jam = Rp 20.687,-

Biaya kehilangan produksi / jam = (9400 x 675) + 20687

= Rp 6.365.687,- / jam

c. Biaya komponen

Data dari bagian pembelian untuk part Rack and Pinion adalah Rp. 700.000,-

d. Biaya satu siklus *failure* (Cf)

Nilai MTTR *Rack and Pinion* = 252.438 menit = 4.20 jam

Cf = ((biaya tenaga kerja/jam + biaya kehilangan produksi /jam) x MTTR) + biaya komponen

= (20687 + 6365687) 4.20 + 700000

= 26756572.4 + 700000

= Rp 27.456.572,4

e. Waktu standar pemeliharaan/perbaikan

Sesuai dengan data pada departemen maintenance , waktu standar pemeliharaan komponen *Rack and Pinion* adalah 180 menit = 3 jam

f. Biaya satu siklus *preventive* (Cp)

Cp = (biaya tenaga kerja/jam x waktu standar pemeliharaan) + biaya komponen

= (20687 x 3) + 700000

= Rp 762.061,-

g. Interval Perawatan dengan Total Biaya Minimum

Perhitungan *total cost* dengan

tp	= 1 hari	= 24 jam ;
MTTF	= 146.239 hari	= 3509.736 jam
t_{med}	= 139.073	
s	= 0.317	

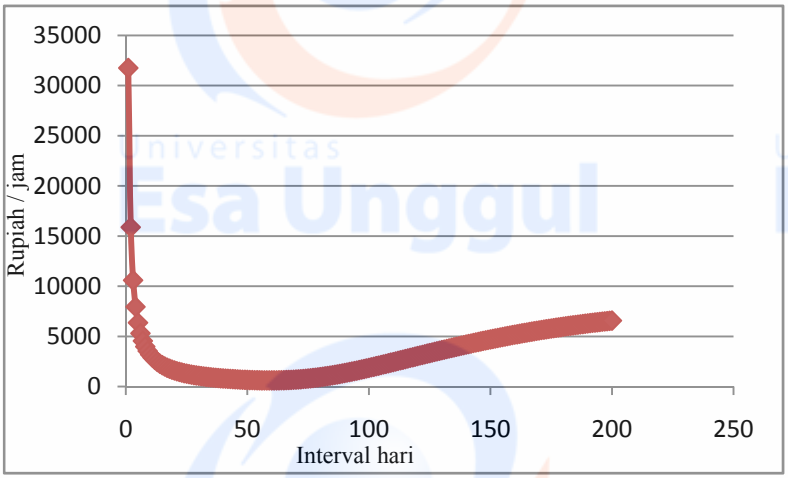
$$R(tp) = 1 - \Phi\left(\frac{1}{s}\ln\frac{t}{t_{med}}\right)$$

$$= 1 - \Phi\left(\frac{1}{0.317}\ln\frac{1}{139.073}\right)$$
$$= 1 - \Phi(-15.5678)$$
$$= 1$$

$$Tc\ (tp) = \frac{Cp\ \times R(tp) + \ Cf \times (1 - R(tp))}{tp\ \times\ R(tp) + \ MTTF(1 - R(tp))}$$
$$Tc\ (24) = \frac{(762061\ \times 1) + 27456572.4 \times (1 - 1)}{(24\ \times\ 1) + \ 3509.736\ (1 - 1)}$$
$$= \frac{762061}{24}$$
$$= \ 31752.54 \approx \text{Rp } 31.752{,}54\ \text{/ jam}$$

Dari perhitungan Excel didapatkan nilai Tc terendah adalah Rp 599,54 dengan interval perawatan 59 hari (1416 jam).

Grafik Total Biaya Perawatan *Rack and Pinion* PM 31



Lampiran 4.10

Tabel Excel Perhitungan *Total Cost Minimum Rolling Key Clutch* PM 70

Interval hari	Interval jam	R(tp)	Tc(tp)
1	24	0.99215	103961.42509
2	48	0.96954	46327.88147
3	72	0.94030	31280.73919
4	96	0.90867	24942.81005
5	120	0.87662	21589.86954
6	144	0.84514	19561.72874
7	168	0.81471	18222.22888
8	192	0.78555	17281.16684
9	216	0.75774	16589.21244
10	240	0.73129	16062.41448
11	264	0.70618	15650.26189
12	288	0.68235	15320.68514
13	312	0.65974	15052.41502
14	336	0.63828	14830.82624
15	360	0.61790	14645.55150
16	384	0.59853	14489.04866
17	408	0.58011	14355.70660
18	432	0.56258	14241.26855
19	456	0.54589	14142.44931
20	480	0.52997	14056.67467
21	504	0.51479	13981.89999
22	528	0.50030	13916.48141
23	552	0.48645	13859.08271
24	576	0.47320	13808.60689
25	600	0.46052	13764.14516
26	624	0.44838	13724.93842
27	648	0.43674	13690.34773

Tabel Excel Perhitungan *Total Cost Minimum Rolling Key Clutch* PM 70 (lanjutan)

Interval hari	Interval jam	R(tp)	Tc(tp)
28	672	0.42557	13659.83158
29	696	0.41485	13632.92804
30	720	0.40456	13609.24072
31	744	0.39467	13588.42758
32	768	0.38515	13570.19197
33	792	0.37599	13554.27534
34	816	0.36717	13540.45137
35	840	0.35868	13528.52109
36	864	0.35049	13518.30892
37	888	0.34259	13509.65931
38	912	0.33497	13502.43400
39	936	0.32761	13496.50968
40	960	0.32050	13491.77605
41	984	0.31362	13488.13413
42	1008	0.30698	13485.49490
43	1032	0.30055	13483.77804
44	1056	0.29433	13482.91091
45	1080	0.28831	13482.82770
46	1104	0.28248	13483.46860
47	1128	0.27682	13484.77917
48	1152	0.27134	13486.70974
49	1176	0.26603	13489.21492
50	1200	0.26088	13492.25316

Tabel Excel *Perhitungan Total Cost Minimum Brake Band* PM 04

Interval hari	Interval jam	R(tp)	Tc (tp)
1	24	0.9879	20497.2861
2	48	0.9870	13517.3636
3	72	0.9861	10128.9099
4	96	0.9851	8130.0071
5	120	0.9840	6813.4120
6	144	0.9829	5882.3144
7	168	0.9817	5190.3299
8	192	0.9804	4656.9221
9	216	0.9791	4234.1209
10	240	0.9777	3891.5742
11	264	0.9762	3609.1408
12	288	0.9746	3372.9301
13	312	0.9729	3173.0526
14	336	0.9712	3002.2766
15	360	0.9693	2855.1918
16	384	0.9674	2727.6701
17	408	0.9653	2616.5075
18	432	0.9632	2519.1792
19	456	0.9609	2433.6687
20	480	0.9586	2358.3466
21	504	0.9561	2291.8817
22	528	0.9535	2233.1758
23	552	0.9508	2181.3151
24	576	0.9479	2135.5329
25	600	0.9450	2095.1815
26	624	0.9419	2059.7095
27	648	0.9386	2028.6448
28	672	0.9352	2001.5808

Tabel Excel *Perhitungan Total Cost Minimum Brake Band* PM 04 (lanjutan)

Interval hari	Interval jam	R(tp)	Tc (tp)
29	696	0.9317	1978.1654
30	720	0.9280	1958.0920
31	744	0.9242	1941.0924
32	768	0.9202	1926.9310
33	792	0.9161	1915.4000
34	816	0.9118	1906.3150
35	840	0.9074	1899.5121
36	864	0.9028	1894.8450
37	888	0.8980	1892.1826
38	912	0.8930	1891.4069
39	936	0.8879	1892.4114
40	960	0.8826	1895.0999
41	984	0.8772	1899.3850
42	1008	0.8715	1905.1869
43	1032	0.8657	1912.4329
44	1056	0.8597	1921.0563
45	1080	0.8535	1930.9960
46	1104	0.8472	1942.1954
47	1128	0.8406	1954.6024
48	1152	0.8339	1968.1687
49	1176	0.8270	1982.8494
50	1200	0.8199	1998.6028

Tabel Excel Perhitungan *Total Cost Minimum Rack and Pinion* PM 31

Interval hari	Interval jam	R(tp)	Tc(tp)
1	24	1.0000	31752.5417
2	48	1.0000	15876.2708
3	72	1.0000	10584.1806
4	96	1.0000	7938.1354
5	120	1.0000	6350.5083
6	144	1.0000	5292.0903
7	168	1.0000	4536.0774
8	192	1.0000	3969.0677
9	216	1.0000	3528.0602
10	240	1.0000	3175.2542
11	264	1.0000	2886.5947
12	288	1.0000	2646.0451
13	312	1.0000	2442.5032
14	336	1.0000	2268.0387
15	360	1.0000	2116.8361
16	384	1.0000	1984.5339
17	408	1.0000	1867.7966
18	432	1.0000	1764.0301
19	456	1.0000	1671.1864
20	480	1.0000	1587.6271
21	504	1.0000	1512.0258
22	528	1.0000	1443.2975
23	552	1.0000	1380.5456
24	576	1.0000	1323.0232
25	600	1.0000	1270.1029
26	624	1.0000	1221.2539
27	648	1.0000	1176.0243
28	672	1.0000	1134.0268

Tabel Excel Perhitungan *Total Cost Minimum Rack and Pinion* PM 31(lanjutan)

Interval hari	Interval jam	R(tp)	Tc(tp)
29	696	1.0000	1094.9281
30	720	1.0000	1058.4396
31	744	1.0000	1024.3107
32	768	1.0000	992.3227
33	792	1.0000	962.2846
34	816	1.0000	934.0293
35	840	1.0000	907.4102
36	864	1.0000	882.2990
37	888	1.0000	858.5835
38	912	1.0000	836.1662
39	936	1.0000	814.9627
40	960	1.0000	794.9005
41	984	0.9999	775.9182
42	1008	0.9999	757.9649
43	1032	0.9999	740.9990
44	1056	0.9999	724.9882
45	1080	0.9998	709.9086
46	1104	0.9998	695.7444
47	1128	0.9997	682.4874
48	1152	0.9996	670.1365
49	1176	0.9995	658.6974
50	1200	0.9994	648.1820
51	1224	0.9992	638.6082
52	1248	0.9990	629.9989
53	1272	0.9988	622.3820
54	1296	0.9986	615.7896
55	1320	0.9983	610.2577
56	1344	0.9979	605.8252

Tabel Excel Perhitungan *Total Cost Minimum Rack and Pinion* PM 31(lanjutan)

Interval hari	Interval jam	R(tp)	Tc(tp)
57	1368	0.9976	602.5337
58	1392	0.9971	600.4266
59	1416	0.9966	599.5486
60	1440	0.9960	599.9454
61	1464	0.9953	601.6624
62	1488	0.9946	604.7446
63	1512	0.9938	609.2362
64	1536	0.9928	615.1793
65	1560	0.9918	622.6142
66	1584	0.9906	631.5783
67	1608	0.9894	642.1060
68	1632	0.9880	654.2282
69	1656	0.9865	667.9719
70	1680	0.9848	683.3601

Lampiran 4.11

Tabel Standar Normal Probability

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Tabel Standar Normal Probability (Lanjutan)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Lampiran 4.12
Tabel Fungsi Gamma

x	$\Gamma(x)$	x	$\Gamma(x)$	x	$\Gamma(x)$	x	$\Gamma(x)$
1.01	.99433	1.51	.88659	2.01	1.00427	2.51	1.33875
1.02	.98884	1.52	.88704	2.02	1.00862	2.52	1.34830
1.03	.98355	1.53	.88757	2.03	1.01306	2.53	1.35798
1.04	.97844	1.54	.88818	2.04	1.01758	2.54	1.36779
1.05	.97350	1.55	.88887	2.05	1.02218	2.55	1.37775
1.06	.96874	1.56	.88964	2.06	1.02687	2.56	1.38784
1.07	.96415	1.57	.89049	2.07	1.03164	2.57	1.39807
1.08	.95973	1.58	.89142	2.08	1.03650	2.58	1.40844
1.09	.95546	1.59	.89243	2.09	1.04145	2.59	1.41896
1.10	.95135	1.60	.89352	2.10	1.04649	2.60	1.42962
1.11	.94740	1.61	.89468	2.11	1.05161	2.61	1.44044
1.12	.94359	1.62	.89592	2.12	1.05682	2.62	1.45140
1.13	.93993	1.63	.89724	2.13	1.06212	2.63	1.46251
1.14	.93642	1.64	.89864	2.14	1.06751	2.64	1.47377
1.15	.93304	1.65	.90012	2.15	1.07300	2.65	1.48519
1.16	.92980	1.66	.90167	2.16	1.07857	2.66	1.49677
1.17	.92670	1.67	.90330	2.17	1.08424	2.67	1.50851
1.18	.92373	1.68	.90500	2.18	1.09000	2.68	1.52040
1.19	.92089	1.69	.90678	2.19	1.09585	2.69	1.53246
1.20	.91817	1.70	.90864	2.20	1.10180	2.70	1.54469
1.21	.91558	1.71	.91057	2.21	1.10785	2.71	1.55708
1.22	.91311	1.72	.91258	2.22	1.11399	2.72	1.56964
1.23	.91075	1.73	.91467	2.23	1.12023	2.73	1.58237
1.24	.90852	1.74	.91683	2.24	1.12657	2.74	1.59528
1.25	.90640	1.75	.91906	2.25	1.13300	2.75	1.60836
1.26	.90440	1.76	.92137	2.26	1.13954	2.76	1.62162
1.27	.90250	1.77	.92376	2.27	1.14618	2.77	1.63506
1.28	.90072	1.78	.92623	2.28	1.15292	2.78	1.64868
1.29	.89904	1.79	.92877	2.29	1.15976	2.79	1.66249
1.30	.89747	1.80	.93138	2.30	1.16671	2.80	1.67649
1.31	.89600	1.81	.93408	2.31	1.17377	2.81	1.69068
1.32	.89464	1.82	.93685	2.32	1.18093	2.82	1.70506
1.33	.89338	1.83	.93969	2.33	1.18819	2.83	1.71963
1.34	.89222	1.84	.94261	2.34	1.19557	2.84	1.73441
1.35	.89115	1.85	.94561	2.35	1.20305	2.85	1.74938
1.36	.89018	1.86	.94869	2.36	1.21065	2.86	1.76456
1.37	.88931	1.87	.95184	2.37	1.21836	2.87	1.77994
1.38	.88854	1.88	.95507	2.38	1.22618	2.88	1.79553
1.39	.88785	1.89	.95838	2.39	1.23412	2.89	1.81134
1.40	.88726	1.90	.96177	2.40	1.24217	2.90	1.82736
1.41	.88676	1.91	.96523	2.41	1.25034	2.91	1.84359
1.42	.88636	1.92	.96877	2.42	1.25863	2.92	1.86005
1.43	.88604	1.93	.97240	2.43	1.26703	2.93	1.87673
1.44	.88581	1.94	.97610	2.44	1.27556	2.94	1.89363
1.45	.88566	1.95	.97988	2.45	1.28421	2.95	1.91077
1.46	.88560	1.96	.98374	2.46	1.29298	2.96	1.92814
1.47	.88563	1.97	.98769	2.47	1.30188	2.97	1.94574
1.48	.88575	1.98	.99171	2.48	1.31091	2.98	1.96358
1.49	.88595	1.99	.99581	2.49	1.32006	2.99	1.98167
1.50	.88623	2.00	1	2.50	1.32934	3.00	2