Support from

Autonomous Maintenance

(Jishu Hozen)

for Breakdown Elimination

Conference on Maintenance Practices through TPM to achieve ZERO Breakdown

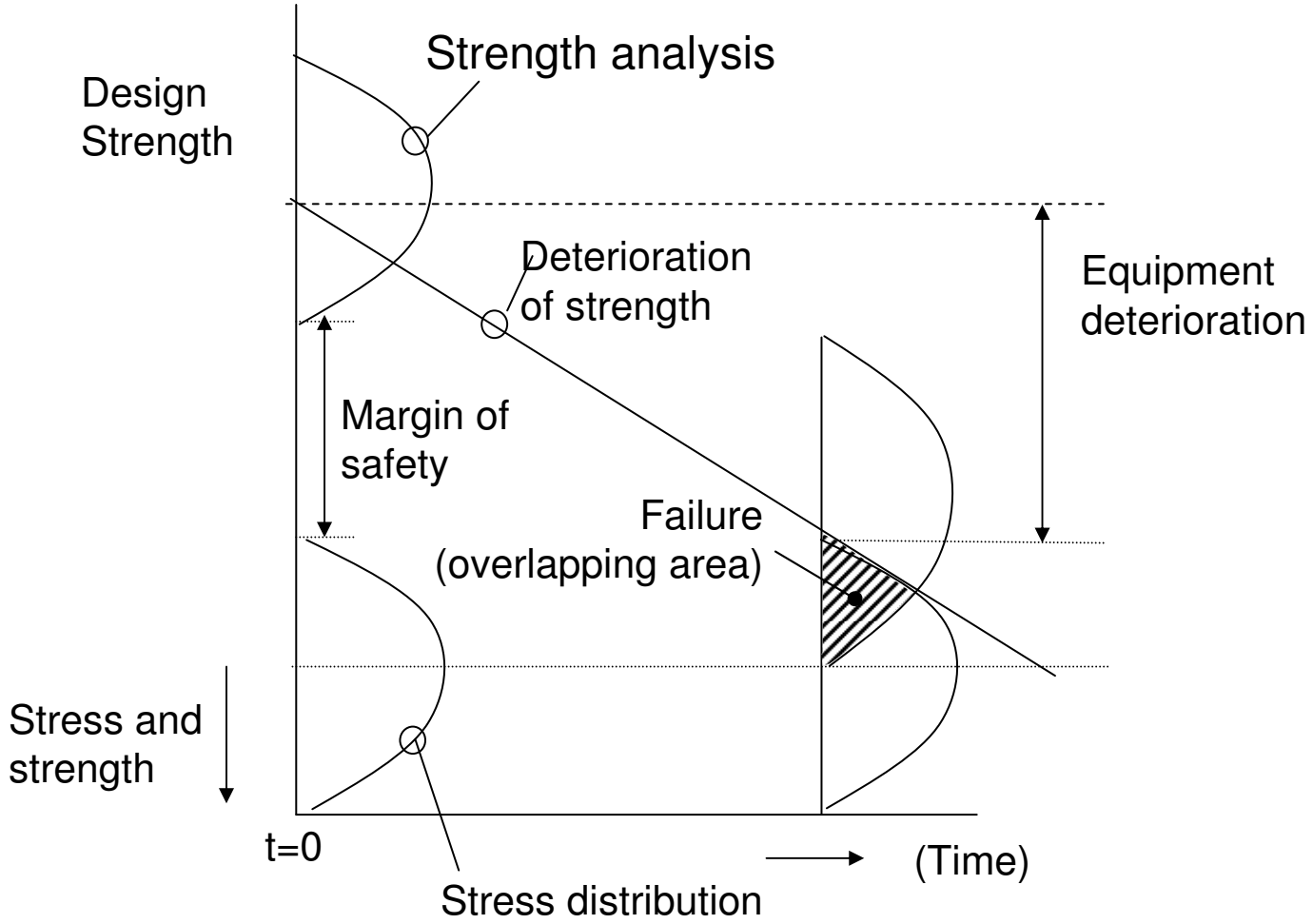
4 August 2010: NSIC Exhibition Complex, New Delhi

Why Breakdown?

It’s only due to Deterioration.

Concept of Equipment Breakdown

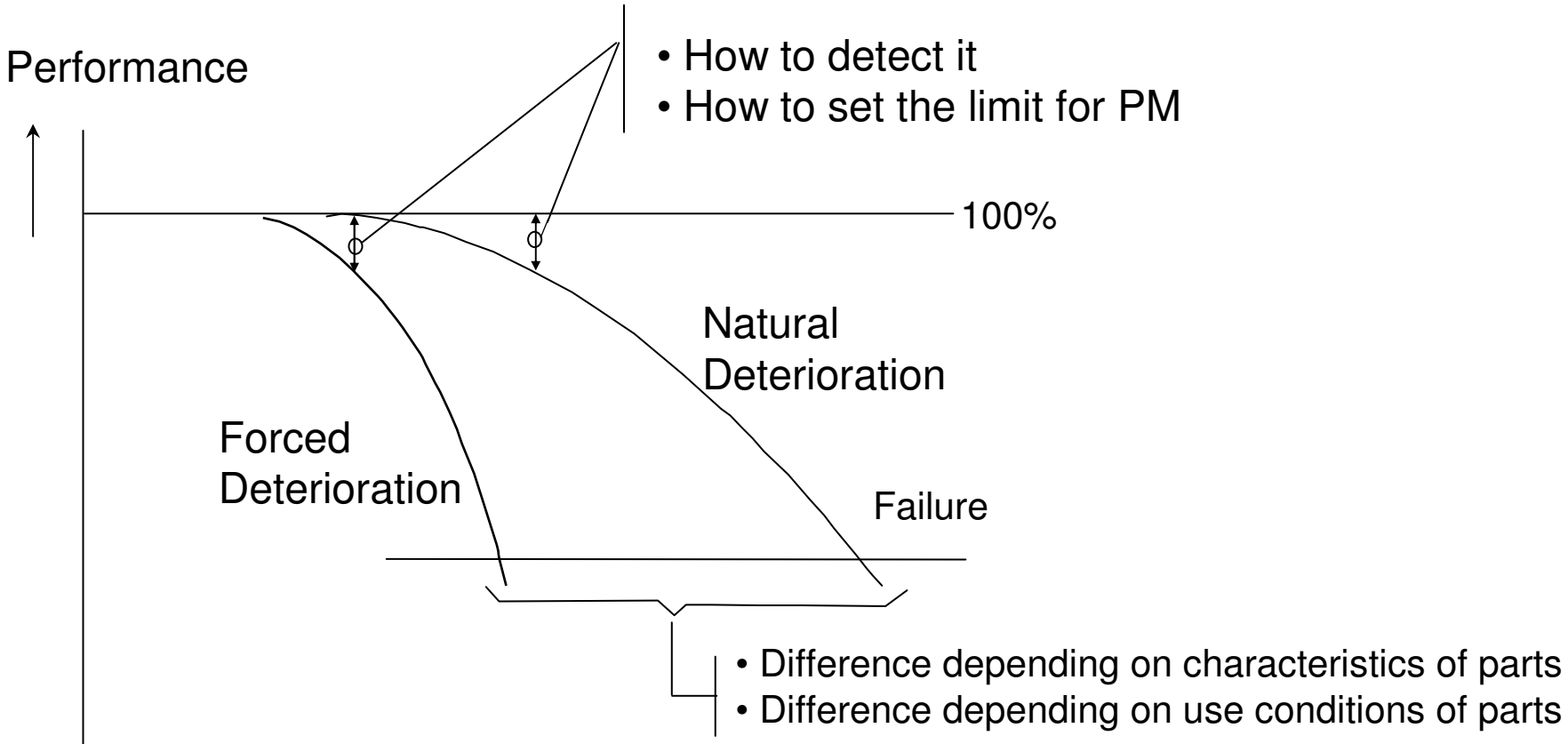
Stress and Strength Model



Even if
“Preventive Maintenance”
is Implemented thoroughly

then
“Why Breakdown?”

Concept of Deterioration



Forced Deterioration Happens

Only If

1. **Basic Conditions/ Requirements are not Fulfilled**

2. **Basic Rules are not Followed**

8 OPTIMAL CONDITION OF EQUIPMENT

Phase	
Design	• MATERIAL & STRENGTH OF PARTS
	• GEOMETRY & SIZE OF PARTS
	• SHAPE & SIZE OF EQUIPMENT
Assembly	• ASSEMBLY
Installation	• INSTALLATION
Usage	• FUNCTION
	• OPERATION
	• ENVIRONMENT

ZERO BREAKDOWN STRATEGY

Natural Deterioration

Planned Maintenance

Extend Life Time

Corrective Maintenance

- Prevent breakdown by improving TBM
- Improve part life by doing corrective maintenance & Repair Quality
- Improve safety & Reliability

Forced Deterioration

Autonomous Maintenance

Eliminate Causes

Establish Basic Condition

- Cleaning : Eliminate all dust & Dirt
- Lubricating : Keep lubricants clean and replenished
- Tightening : Keep bolts tight
- Inspection: Required parameters

JISHU HOZEN

JISHU => AUTONOMOUS => SELF CONTROLLED

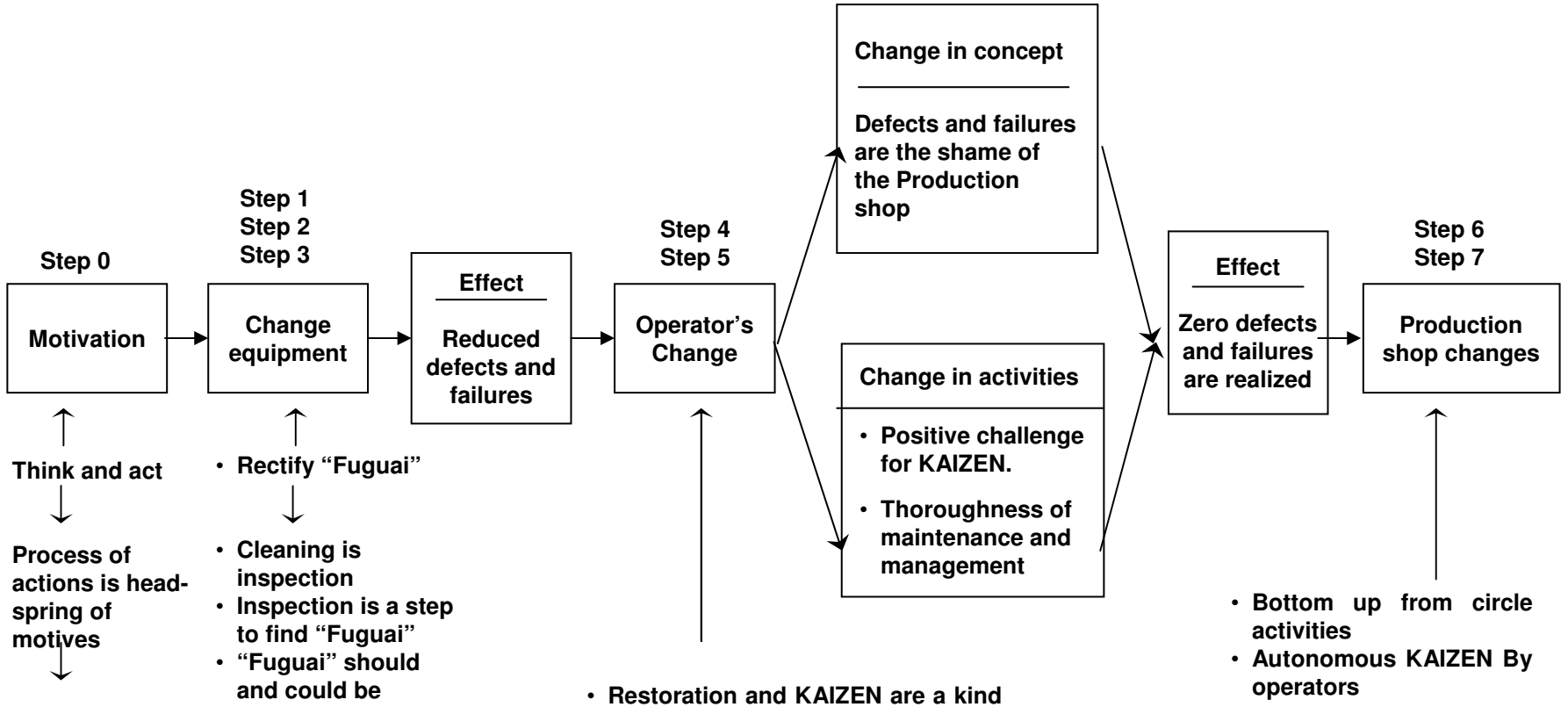
HOZEN => MAINTENANCE => SUSTAINANCE

FOCUS IS TOWARDS ??

OPERATOR ? **OR** **EQUIPMENT ?**

BOTH ?

Concept of "Jishu-Hozen"



How to Implement JH?

Preparation (Step-0)

Motivation
= Motive + Action
Think & act process
Forced deterioration

- Explain the motive of Autonomous Maintenance and its benefits to operators.
- Explain that 'maintaining Basic Conditions' is operator's duty, 'Why & How'.
- Explain the possible troubles that can occur due to forced deterioration.

Understanding Equipment
Simple illustration of Equipment

- Sketching the Equipment Structure, labeled properly
- Identifying equipment mechanism
- Understanding the types of possible troubles

Safety

- Explain the safety measures to be taken before going to machine (i.e.switching off main power, sharp edges)

Knowledge & Skill Needed for Step-1

- Detail knowledge of 'Abnormalities'.
- Methods for cleaning skillfully and finding out abnormalities & defects in equipment through cleaning.
- Purpose, type, quantity & method of lubrication
- Purpose, method & tools needed for Retightening

Meetings
Circle Members & Leaders

- Weekly meeting of circle members & circle leaders.

Examples of Steps for Evolving Autonomous Maintenance

Step	Name	
1	Initial clean-up	All-around clean-up of dust and dirt, centering on equipment proper, and implementation of lubrication, and machine parts adjustment; discovery and repair of malfunctions in equipment
2	Countermeasures against causes of Forced Deterioration and Hard to Access areas	Prevent causes of dust and dirt and scattering, improve places which are difficult to clean and lubricate and reduce the time required for clean-up and lubrication.
3	Formulation of clean-up and lubrication standards	Formulate behavioral standards so that it is possible to steadily sustain clean-up, lubrication and machine parts adjustment in a short period (Necessary to indicate a time frame-work that can be used daily or periodically)….
4	Overall inspection	Training in check-up skills through check-up manuals; exposure and restoration of minor equipment defects through overall check-ups
5	Autonomous check-up	Formulation and implementation of autonomous check-up sheets
6	Orderliness and tidiness	Standardize various types of on-the job management items and devise complete systematization of up-keep management. • Standards for clean-up, check-ups and lubrication • Standards for physical distribution in the workplace • Standardization of data records • Standardization of die management, jigs and tools
7	All-out autonomous management	Development of corporate policies and goals, and making improvement activities routine : Steadily record MTBF analysis, analyze these, and carry out equipment improvements

Step-1: Initial Cleaning

The purpose of initial cleaning

1. Equipment

The actual cleaning and finding out abnormalities & rectifying them makes the equipment healthy to achieve zero failure & defect.

2. Operator

The small work groups are able to join together in accomplishing a common goal, cleaning of a particular equipment to find out and correct the abnormality makes operator proficient (i.e. professionally efficient)

HOW TO PROCEED WITH STEP 1

Activities on the Equipment

- The Leader should give Safety Instructions.
- Open the 'Covers' for Cleaning (don't dismantle the machine).
- Distribute the different areas of equipment among different team members.
- Clean the most contaminated area first
- Clean top to bottom and inside to outside of whole equipment including chronically hidden and neglected areas.
- Take special care of critical parts of equipment and loose and missed 'Nuts & Bolts'.
- Keep all Five senses present and perform "cleaning as inspection".
- Remember that it is your machine and cleaning is done to find out abnormalities.
- Each member to must participate in cleaning and finding out abnormalities in their area.
- While cleaning keep the theme and target in your mind.
  (i.e. Wet to dry, Zero breakdowns and Zero defects)
- Put white tags for the abnormalities you can rectify.
- Put pink or red tags for the abnormalities where experts support is needed.
- Restore abnormalities on the spot whichever are possible.

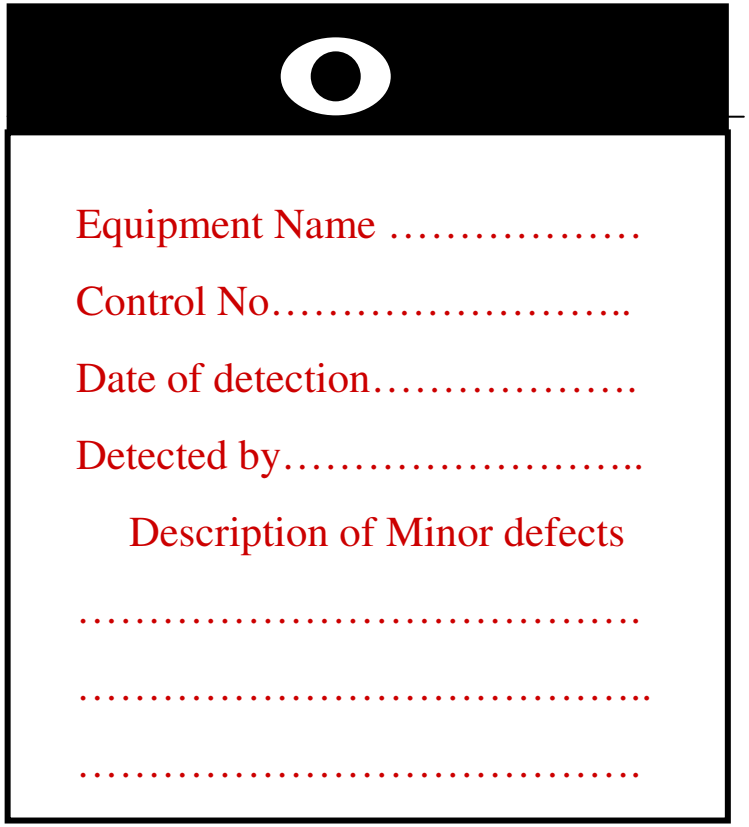
HOW TO PROCEED WITH STEP 1

Activities after cleaning of Equipment

- After cleaning session, all the team members must sit together to complete following activities
  - Compile the tags in 'Tag matrix'.
  - Write down the action plan to remove the tags in 5W & 1H sheet.
  - Clearly mention the effect of each abnormality if it is not rectified.
  - Use "Why - why" analysis if needed to find out root cause.
  - Make a cleaning schedule to regularly maintain the cleanliness achieved and find out more abnormalities.
  - Plan few Kaizens to make Cleaning easy.

- The corrective measures must be taken according to the plan.
- The "One point lesson" sheet must be made as and when required and it should be kept in record after training all members.
- Audit of Step 1 to be conducted.

White tags for operators



Red Tags to be attended by Maint.

Table 4-6. Sample Manual on Exposing Seven Types of Abnormality

Abnormality	Examples
1.Minor Flaws	
• Contamination	Dust, dirt, powder, oil, grease, rust, paint
• Damage	Cracking, crushing, deformation, chipping, bending
• Play	Shaking, falling out, tilting, eccentricity, wear, distortion, corrosion
• Slackness	Belts, chains
• Abnormal phenomena	Unusual noise, overheating, vibration, strange smells, discoloration, incorrect pressure or current
• Adhesion	Blocking, hardening, accumulation of debris, peeling, malfunction
2.Unfulfilled Basic conditions	
• Lubrication	Insufficient, dirty, unidentified, unsuitable, or leaking lubricant
• Lubricant supply	Dirty, damaged, or deformed lubricant inlets, faulty lubricant pipes
• Oil level gauges	Dirty, damaged, leaking; no indication of correct level
• Tightening	Nuts and bolts; slackness, missing, cross-threaded, too long, crushed, corroded. Washer unsuitable, wing nuts on backward
3.Inaccessible Places	
• Cleaning	Machine construction, covers, layout, footholds, space
• Checking	Covers, construction, layout, instrument position and orientation, operating-range display
• Lubricating	Position of lubricant inlet, construction, height footholds, lubricant outlet, space
• Tightening	Covers, construction, layout, size, footholds, space
• Operation	Machine layout; position of valves, switches, and levers; footholds
• Adjustment	Position of pressure gauges, thermometers, flowmeters, moisture gauges, vacuum gauges, etc.
4.Contamination Sources	
• Product	Leaks, spills, spurts, scatter, overflow
• Raw materials	Leaks, spills, spurts, scatter, overflow
• Lubricants	Leaking, spilt, and seeping lubricating oils, hydraulic fluids, fuel oil, etc.
• Gases	Leaking compressed air, gases, steam, vapors, exhaust fumes, etc.
• Liquids	Leaking, spilt and spurting cold water, hot water, half-finished products, cooling water waste water, etc.
• Scrap	Flashes, cuttings, packaging materials,and nonconforming product
• Other	Contaminants brought in by people, fork-lift trucks, etc. and infiltrating through cracks in buildings

Table 4-6. Sample Manual on Exposing Seven Types of Abnormality

Abnormality	Examples
5.Quality Defect Sources	
• Foreign matter	Inclusion, infiltration, and entrainment of rust, chips, wire scraps, insects, etc.
• Shock	Dropping, jolting, collision, vibration
• Moisture	Too much, too little, infiltration, defective elimination
• Grain size	Abnormalities in screens, centrifugal separators, compressed-air separators, etc.
• Concentration	Inadequate warning, heating, compounding, mixing, evaporation, stirring, etc.
• viscosity	Inadequate warning, heating, compounding, mixing, evaporation, stirring, etc.
6.Unnecessary and Non-urgent Items	
• Machinery	Pumps, fans, compressors, columns, tanks, etc.
• Piping equipment	Pipes, hoses, ducts, valves, dampers, etc.
• Measuring instrument	Temperatures, pressure gauges, vacuum gauges, ammeters, etc.
• Electrical equipment	Wiring, piping, power leads,switches, plugs, etc.
• Jigs and tools	General tools, cutting tools, jigs, molds, dies, frames, etc.
• Spare parts	Standby equipment, spares, permanent stocks, auxiliary materials, etc.
• Makeshift repairs	Tape, string, wire, metal plates, etc.
7.Unsafe Places	
• Floors	Unevenness, ramps, projections, cracking, peeling, wear (steel deckplates)
• Steps	Too steep, irregular, peeling anti-slip covering, corrosion, missing handrails
• Lights	Dim,out of position, dirty or broken covers, not properly explosion-proofed
• Rotating machinery	Displaced, fallen off or broken covers, no safety or emergency stop devices
• Lifting gear	Wires, hooks, brakes, and other parts of cranes and hoists
• Other	Special substances, solvents, toxic gases, insulating materials, danger signs, protective clothing, etc.

Table 4-3. (1) Checkpoints for Nuts and Bolts

Slight Defects	☐ Are any nuts or bolts loose? ☐ Are any nuts or bolts missing?
Bolts Lengths	☐ Do all bolts protrude from nuts by 2-3 thread lengths?
Washers	☐ Are flat washers used on long holes? ☐ Are tapered washers used on angle bars and channels? ☐ Are spring washers used where parts are subject to vibration? ☐ Are identical washers used on identical parts?
Attachment of Nuts and Bolts	☐ Are bolts inserted from below, and are nuts visible from the outside? ☐ Are devices such as limit switches secured by at least two bolts? ☐ Are wing nuts on the right way around?

Table 4.3 (2) Lubrication Checkpoints

Lubricant Storage	☐ Are lubricant stores always kept clean, tidy, and well-organized by thorough application of the 5S principles? ☐ Are lubricant containers always capped? ☐ Are lubricant types clearly indicated and is proper stock control practiced?
Lubricant Inlets	☐ Are grease nipples, speed-reducer lubricant ports, and other lubricant inlets always kept clean? ☐ Are lubricant inlets dust proofed? ☐ Are lubricant inlets labeled with the correct type and quantity of lubricant?
Oil-level Gauges	☐ Are oil-level gauges and lubricators always kept clean, and are oil levels easy to see? ☐ Is the correct oil level clearly marked? ☐ Is equipment free of oil leaks, and are oil pipes breathers and obstructed?
Automatic Lubricating Devices	☐ Are automatic lubricating devices operating correctly and supplying the right amount of lubricant? ☐ Are any oil or grease pipes blocked, crushed or spilt?
Lubrication Condition	☐ Are rotating parts, sliding parts, and transmissions (e.g. chains) always clean and well-oiled? ☐ Are the surroundings free of contamination by excess lubricant?

Table 4-3 (3) Transmission System Checkpoints

V-belts and Pulleys	☐ Are any belts cracked, swollen, worn, or contaminated by oil or grease? ☐ Are any belts twisted or missing? ☐ Are any belts stretched or slack? ☐ Are multiple belts under uniform tension and all of the same type? ☐ Are top surfaces of belts protruding above the pulley rims? Are the bottoms of any pulley grooves shiny (indicating a worn belt or pulley)? ☐ Are pulleys correctly aligned?
Roller Chains	☐ Are any chains stretched (indicating worn pins or bushings)? ☐ Are any sprocket teeth worn, missing, or damaged? ☐ Is lubrication between pins and bushings sufficient? ☐ Are sprockets correctly aligned?
Shafts, Bearings, and Couplings	☐ Is there any overheating, vibration, or abnormal noise due to excessive play or poor lubrication? ☐ Are any keys or set bolts loose or missing? ☐ Are any couplings misaligned or wobbly? ☐ Are any coupling seals worn? Are any bolts slack?
Gears	☐ Are gears properly lubricated with the right amount of lubricant? Are the surroundings clean? ☐ Are any teeth worn, missing, damaged, or jammed? ☐ Is there any unusual noise or vibration?

Table 4-3 (4) Hydraulic Checkpoints

Hydraulic Units	☐ Is the correct quantity of fluid in hydraulic reservoirs, and is the correct level indicated? ☐ Is fluid at the correct temperature? Are the maximum and minimum permissible temperatures indicated? ☐ Is fluid cloudy (indicating air entrainment) ☐ Are all fluid inlets and strainers clean? ☐ Are any suction filters blocked? ☐ Are any fluid reservoir breather filters blocked? ☐ Are all fluid pumps operating normally without any unusual noise or vibration? ☐ Are hydraulic pressures correct, and are operating ranges clearly displayed?
Heat Exchangers	☐ Is any fluid or water leaking from fluid coolers or pipes? ☐ Are temperature differences between fluid and water inlets and outlets correct? Are any tubes blocked?
Hydraulic Equipment	☐ Are there any fluid leaks? ☐ Are hydraulic devices properly secured without any makeshift fastenings? ☐ Are hydraulic devices operating correctly without speed losses or breathing? ☐ Are hydraulic pressures correct, and are all pressure gauges working correctly (zero points, deflection)?
Piping and Wiring	☐ Are all pipes and hoses securely attached? ☐ Are there any fluid leaks? Are any hoses cracked or damaged? ☐ Are all valves operating correctly? It is easy to see whether valves are open or shut? ☐ Are any pipes, wirers, or valves unnecessary?

Table 4-3 (5). Pneumatic Checkpoints

FRLs	☐ Are FRLs always kept claen? Is it easy to see inside them? Are they fitted the right way around? ☐ Is there sufficient oil, and are the drains clear? ☐ Is the oil drip rate correct (approximately 1 drop for every 10 strokes)? ☐ Are FLRs installed no more than 3m from the pneumatic equipment? ☐ Are pressures adjusted to the correct value and are operating ranges clearly indicated?
Pneumatic Equipment	☐ Is any compressed air leaking from pneumatic cylinders or solenoid valves? ☐ Are all pneumatic cylinders and solenoid valves firmly attached? ☐ Are any makeshift fixings in use (wire, adhesive tape, etc.)? ☐ Are any pistons dirty, worn, or damaged? ☐ Are speed controllers installed the right way around? ☐ Is there any abnormal noise or overheating of solenoid valves, and are any lead wires chafed or trailing?
Piping and Wiring	☐ Are there any places in pneumatic pipes or hoses where fluid is liable to collect? ☐ Are all pipes and hoses clipped firmly into place? ☐ Are there any compressed-air leaks? Are any hoses cracked or damaged? ☐ Are all valves operating correctly? Is it easy to see whether valves are open or closed? ☐ Are any pipes, wires, or valves unnecessary?

Table 4-3 (6). Electrical Checkpoints

Control Panels	☐ Are the interiors of distribution boards, switchboards, and control panels kept clean, tidy, and well-organized by the application of the 5S principles? Have any extraneous objects or flammable materials been left inside? ☐ Is the wiring inside control panels in good condition? Are any wires coiled or trailing? ☐ Are all ammeters and voltmeters operating correctly and clearly marked? ☐ Are any instruments or display lamps broken? Are any bulbs faulty? ☐ Are any switched broken? Do all switches work correctly? ☐ Are control panel doors in good condition? Do they open and close easily? ☐ Are there any unused holes? Are control panels waterproof and dustproof?
Electrical Equipment	☐ Are all motors free of overheating, vibration, and unusual noise and smells? ☐ Are all motor cooling fans and fins clean? ☐ Are any attachment bolts loose? Are pedestals free of cracks and other damage?
Sensors	☐ Are all limit switches clean and free of excessive play? ☐ Are the interiors of all limit switches clean? Are any wires trailing? Are all covers in good condition? ☐ Are any limit switches incorrectly installed? ☐ Are any limit switch dogs worn, deformed, or the wrong shape? ☐ Are all photoelectric switches and proximity switches clean and free of excessive play? ☐ Are any sensors out of position? Are correct positions clearly indicated? ☐ Are all lead wires unchafed, and is insulation intact at entry points?
Switches	☐ Are all manual switches clean, undamaged, and free of excessive play? ☐ Are all switches installed in the correct position? ☐ Are emergency stop switches installed in appropriate locations, and are they working correctly?
Piping and Wiring	☐ Are any pipes, wires, or power leads loose or unsecured? ☐ Are any ground wires damaged or disconnected? ☐ Are any pipes corroded or damaged? Are there any bare wires or wires with damaged insulation? ☐ Are any wires coiled on the floor or dangling overhead?

Table 4-3 (7) Checkpoints for General-Purpose Equipment

Pumps	☐ Are pumps and their stands free of unusual noise, vibration, and play? ☐ Are pedestal bolts tight, corrosion-free, and undamaged? ☐ Are stands and pedestals free of corrosion, cracking, and other damage? ☐ Is any liquid leaking or spraying from gland packings? ☐ Is any liquid leaking or spraying from pipes or valves? ☐ Are any pipes or valves blocked? ☐ Are all pressure gauges, vacuum gauges, flowmeters, thermometers, and other measuring instruments working properly and marked with the correct operating ranges? ☐ Are starting current and operating current values are open or closed? ☐ Are all valves operating correctly? Is it easy to see whether valves are open or closed?
Fans	☐ Are fans and their stands free of unusual noise, vibration, and play? ☐ Are all pedestal bolts tight, corrosion-free, and undamaged? ☐ Are all stands and pedestals free of corrosion, cracking, and other damage? ☐ Are any gland packings leaking air or gas? ☐ Are any ducts or dampers leaking air or gas? ☐ Are any ducts blocked or clogged? ☐ Are all pressure gauges, vacuum gauges, flowmeters, thermometers, and other measuring instruments working properly and marked with the correct operating ranges? ☐ Are starting current and operating current values correct? Are these clearly indicated? ☐ Are all dampers operating correctly? Is it easy to see whether dampers are opened or closed?

RESULTS & BENEFITS EXPECTED AFTER STEP 1

EQUIPMENT

1. CLEAN MACHINE
2. ZERO LEAKAGE
3. ZERO LOOSE 'NUTS & BOLTS'
3. ALL ABNORMALITIES TO BE TAGGED
4. ALL WHITE TAGS TO BE REMOVED
5. TAG MATRIX AND ACTION PLAN FOR ALL TAGS MUST BE READY.

OPERATOR

1. ALL OPERATORS MUST UNDERSTAND THE PURPOSE OF 'AUTONOMOUS MAINTENANCE'.
2. ALL MEMBERS MUST PARTICIPATE IN THE ACTIVITY.

Step-2: Countermeasures against sources of contamination & Hard to access areas

The Purpose of Step-2

1. Equipment

- Remove all abnormalities found in step 1 to eliminate forced deterioration to achieve zero failure & defect.
- Eliminate the sources of contamination.
- Implementation of Kaizen to make equipment easy to clean, lubricate, inspect & tighten bolts.
- Make the machine visual

Step-2: Countermeasures against sources of contamination & Hard to access areas

The Purpose of Step-2

2. Operator

- Develop habit of analyzing and thinking to solve the problems (problem solving attitude).
- Develop habit of doing Kaizen for making C, L, I & T easy (sharpening their brain).
- Enjoy hand made taste (personal delight)

HOW TO PROCEED WITH STEP 2

Activities

- **Understand the basics of cleaning.**
  - ***Why to clean?***
  - ***How to stop or minimize cleaning?***

- **Measure cleaning time & implement Kaizen to reduce it.**

- **Implement Kaizen for hard - to - access areas to make them approachable.**

- **Prepare temporary standards and check sheet for cleaning, lubrication, inspection & tightening of bolts.**

- **Find out more abnormality during regular cleaning, lubrication, inspection & tightening of bolts activities and rectify them.**

- **Take before & after photographs**

- **Analyze all JH failure, and plan preventive activity, follow the plan of implementation of countermeasure & Kaizen and fill up corresponding 'Kaizen sheet' or 'OPL'.**

- **Audit to be conducted.**

Goals for Contamination Sources and Inaccessible Places

Preventing Leaks and Spills

Prevent leaking, spilling, spraying, or scattering of:

- **products**
- **lubricants**
- **hydraulic fluids**
- **powders**
- **vapors**
- **other process materials**

Improving Inaccessibility

Improve accessibility of places that are hard to:

- **clean**
- **check**
- **lubricate**
- **tighten**
- **operate**
- **adjust**

GOAL: reduce the time it takes to clean, check, and lubricate

RESULTS & BENEFITS EXPECTED AFTER STEP 2

EQUIPMENT

1. CLEAN & DRY MACHINE
2. LOCALIZED GUARDS AND VISUAL MACHINE
3. ZERO JH BREAKDOWN
4. ZERO JH DEFECT
5. HIGH AVAILABILITY & RELIABILITY

OPERATOR

1. ANALYSING & PROBLEM SOLVING ATTITUDE AMONG THE MEMBERS

2. HABIT OF TAKING 'PREVENTIVE ACTION'

Step-3: Preparation of Tentative Cleaning, Lubrication, Inspection & tightening Standards

The Purpose of Step-3

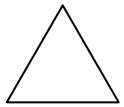
- Continuously Maintaining and Management of Basic equipment conditions, (i.e. Cleaning, Lubrication, Inspection & Tightening)
- Enhancing Equipment Reliability & Maintainability
- Preparing standards that can be followed easily
- Ideas for Visual Improvement

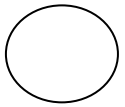
STEP 3 PREPARE TENTATIVE STANDARDS

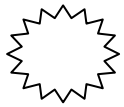
- **STANDARDS FOR CLEANING, LUBRICATION, INSPECTION ,TIGHTENING & ADJUSTMENT**
- **STANDARDS ARE MADE BY OPERATORS THEMSELVES WITH GUIDENCE BY PM**
- **STANDARDS ARE MADE BY USING 5W +1H (WHERE,WHAT,WHICH,WHEN, WHOM+HOW)**
- **STANDARDS SHOULD BE EASILY UNDERSTOOD BY EVERY ONE**
- **INTRODUCE EXTENSIVE VISUAL CONTROLS**

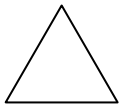
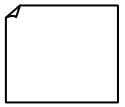
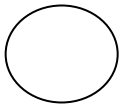
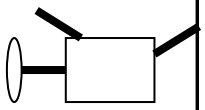
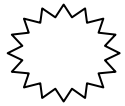
HOW TO PROCEED WITH STEP 3

CLEANING LUBRICATION & INSPECTION STANDARDS

Cleaning activities : 

Lubrication activities : 

Inspection activities : 

Sl. No.	Route Reference	Criteria	Sub - Assembly	Where	What	How	Time	Responsibility (Who)	Remarks (Impact of overlooking)
1		Cleaning	Dual Ext. steel belt	Steel belt	Dust & dirt		20 Sec	Operator	Quality defect
2		Lubrication	Dual Ext. skiver	Driven roll bearing	EP-2 grease		30 Sec	Operator	Equipment failure
3		Inspection	Head stock	Inside pull out ring	No damage		5 Sec	Operator	UNSAFE

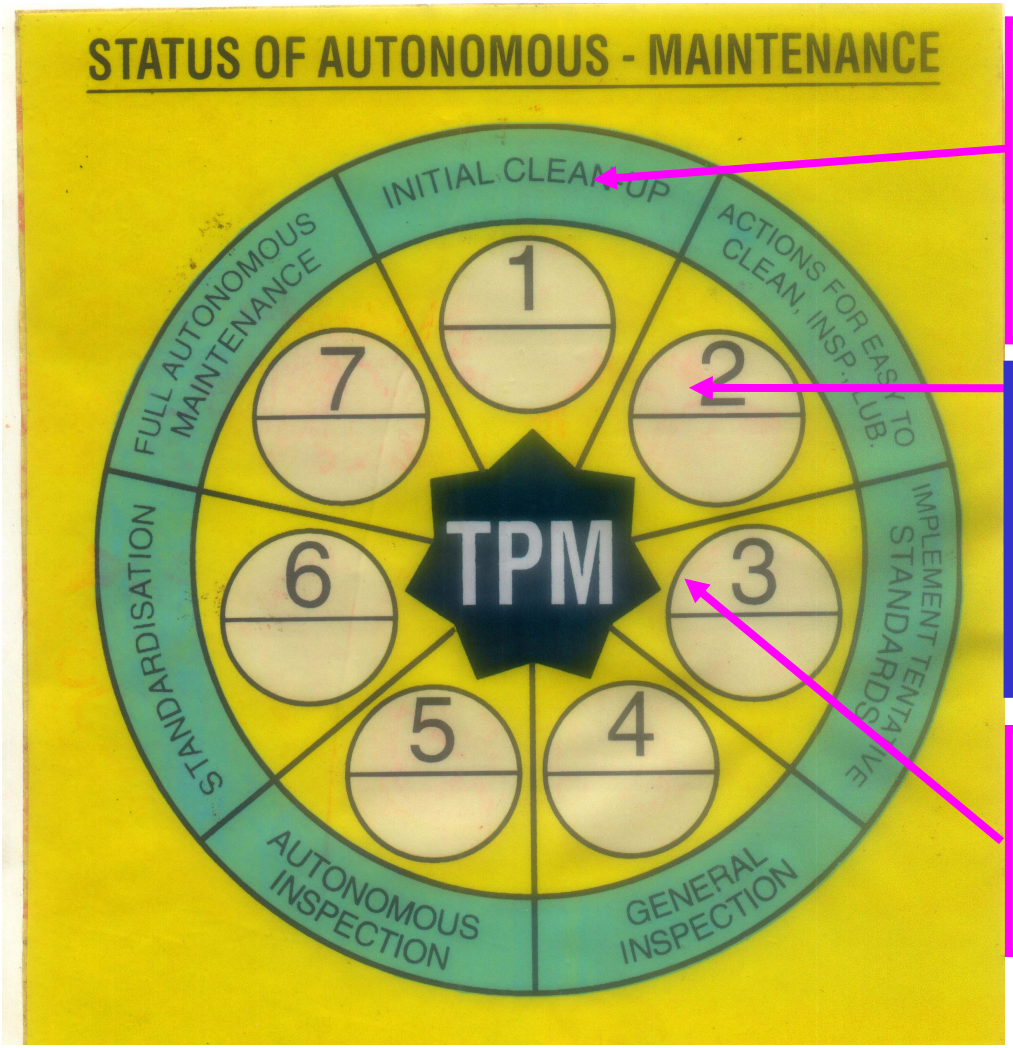
JISHU-HOZEN CHECK SHEET

POINT NO. 3 HYDRAULIC TANK FRONT,LUB TANK,FRL AND WORK HEAD BACK

MACHINE : C P BORING **CELL : CONNECTING ROD** **PLANT : ENGINE PLANT** **MONTH : JANUARY**

SL. NO	CHECK ITEM	D	W	M	STND. VALUE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	HYDRAULIC TANK FRONT																																		
1a	Outer body				No dirt & dust																														
1b	Pipe Joints				No Leak																														
1c	Oil level indicator				btwn. Max & Min.																														
1d	Oil pressure Gauge				in Green Zone																														
2	LUBRICATION TANK																																		
2a	Tank outer body				No dirt & dust																														
2b	Level indicator				btwn. Max & Min.																														
2c	El. Jn. Wiring			3M																															
2d	Lub Pipe joints				No Leak																														
					Checked By :																														
					Sign. Of Supervisor																														
	REVISION NO.	1						2										3										4							

LEGENDS - (✓) - OK , (◯) - NOT OK , (⊘) - NOT OK,RECTIFIED BY SELF ⊗ ( ) - NOT OK, INFORMED SUPERVISO Ⓟ ( ) - PLANNED.



Initial Clean-up
(Cleaning is Inspection)
(Cleaning with meaning)
(Doing with purpose)

Taking countermeasure for forced deterioration and improving hard to access area

Preparing tentative standards for cleaning and lubrication