



Project Saraswati: Operator Training & Evaluation (Licensing) for World-Class Operational Excellence

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ABSTRACT

In the pursuit of Manufacturing Excellence, DivgiWarner follows Quality System Basics which includes operator training as one of the key elements. Any manufacturing process consists of 5M's. Out of these 5M's, Machine, Material, Method, Measurement can be engineered to get the desired output. Required control is possible with the fifth 'M' i.e. Man by providing Standardized Training, resulting in Repeatability & Reproducibility from each process.

DivgiWarner has designed, developed and been practicing the unique process of Operator Training and Licensing. This paper describes the Operator Licensing process.

The process is divided into seven subsections inclusive of:

1. Induction Training
2. Classroom Training
3. On-Job Training
4. Written Test and Evaluation
5. Issue Operator License i.e. Certification
6. Monitoring operator through Layered Process Audits (Effectiveness of Training Process)
7. Renewal of license

As an operator goes through this process, his/her skill level and competency increases with continuous practice.

Following are four levels on which skill up-gradation is done

1. I (Informed) level - Knows the basic operation

2. L (Learned) level - Can operate under guidance

3. U (Understanding) level - Employee can operate without guidance

4. O (Operate) level - Operator can guide others as a coach, able to solve quality and process issues

This process ensures common and structured training to all operators and to increase the number of multi skilled operators.

Objectives achieved through this system have been summarized as:

- Zero unsafe incidence
- Customer (Parts Per Million) PPM reduced by 64%
- Increase in actual run rate and product quality which in turn increased OEE (Overall Equipment Efficiency) from 41% to 82.9%
- Reduced operation lead time, to ensure 100% On Time Delivery to customers
- This training increases operator involvement and enables him to give valuable suggestions for continuous improvement

1. INTRODUCTION

Achieving the highest level of product quality in any organization requires a well developed standardized process. Apart from the Standard Operating Sheet, Job Element Sheet, operator training and licensing is also one of the most important parts of work center standardization. This is the only element which is dependent on man and varies as per the

capabilities of an individual. Therefore effective training of the operator and subsequent evaluation is required. To achieve this, we have developed an operator licensing system which is implemented effectively and is in operation for the last five years.

Operator training and licensing at Divgi Warner is an extensive and continuous process which starts from the day an employee joins the company. We believe that operator training is essential for safe and efficient execution of any manufacturing process. Hence, operator training is mandatory for each operator.

Operator training covers each and every element which is essential for an operator. This process not only simplifies day-to-day activities but on practicing, it results in Repeatability & Reproducibility. Once an operator goes through the operator licensing process, only then, he/she is allowed to operate the machine. As the skill level of an operator increases his/her level in the skill matrix is updated accordingly.

2. NEED OF OPERATOR TRAINING

Training is needed in an organization to strengthen the team members and nurture their knowledge and skills up as per the company's requirement. Training is essential in any business to keep it strong and maintain its prime objective of satisfying its customer. As many things throughout a business can change, the team members need to be kept up-to-date and be given a refresher on previous training; this helps in increasing the motivation levels and in turn helps the company to run smoothly and successfully.

Some may question the necessity of having such an extensive training procedure which involves the understanding of the company's process and policies. The general view is that employees should be taught only the work they need to perform in the company and anything else is considered as a waste of time and resources. But we consider operator education and training as a *long term investment* for world class performance.

As stated earlier, most of an operator's job is manual and it is essential that he/she must follow a standard operating procedure and should know why it needs to be followed. Once an operator goes through this training it gives us confidence that he/she is doing what is being taught to him. We will see with an example that if Standard Operating Procedure is not followed or circumvented, then the probability of getting a Non-conforming part increases.

For example, pressing of a bearing or oil seal which requires specific side to face a particular direction, if pressed in wrong side these types of failures cannot be detected easily. Secondly, on the safety front, we cannot overlook the risk of physical injury if improper methods are followed.

Operator training helps familiarize associates with the organizational mission, vision, rules and regulations and the working methods thus preventing the generation of unnecessary wastes.

The highlights of Operator Training and Licensing are:

1. Simplified Standard operating procedure - covers what, why and how the job is to be done
2. Repeatability and Reproducibility in the process
3. The quality of the job is predictable
4. Increase in operator's confidence level
5. Continual improvement in the process
6. Standardized Operator Training procedure assures that all operators have adequate and similar training
7. Trained operators can train others
8. Operators can be a part of problem solving team

Most importantly, it ensures that parts delivered to the customer are defect free.

Importance: Training is crucial for organizational development and success. It is fruitful to both employers and employees of an organization. An employee will become more efficient and productive if he/she is well-trained.

Though the operator training course requires time and resources, the amount is comparatively very less compared to the losses because of waste generation through Non conforming products. All these benefits have become driving factors for us to have this Training course.

3. TRAINING PROCEDURE

Our training procedure is accurately defined and standardized so that each person gets the same knowledge and experience after completing his/her training. This brings them to a same level and eliminates any chances of giving different training to different people.

The training process is finely divided into seven subsections which include:

1. Induction Training
2. Classroom Training
3. On Job Training
4. Written test and evaluation
5. Issue Operator License i.e. Certification.
6. Monitoring operator
7. Upgrade the operator by evaluating his/her skill

Table: 1. shows the induction training areas on which the different departments focus:

S.NO	Department	Training Area
1.	Quality System / Supplier Technical Assistance / Global Supply Chain Management	1.Awareness of DWPL quality, environment & safety systems (policy, related procedures & documentation structure) 2.Introduction to supplier performance monitoring activities
2	Engineering	1.Introduction to Divgi Warner engineering procedure
3	Manufacturing Engineering	1. Overview of the process in the Manufacturing Engineering dept.
4	PPC and Subcontracting	1. Material procurement scheduling. 2. Product planning 3.Communication with the customer and customer follow up
5	Machine Shop and Assembly	1. Importance of safety and health programs. 2. Manufacturing process in Machine Shop.
6	Stores	1. Briefing on procedure of Stores Department
7	Sales and Services	1. Briefing on sales and service activities
8	Supply Chain Management	1. Briefing on SCM activities

The four different skill levels for competency judgment are:

1. I (Informed) level - Knows the basic operation.
2. L (Learned) level - Trained but still needs guidance
3. U (Understanding) level - Employee competent in all operations without outside help
4. O (operate) level - Can be a coach, solve quality issues and can handle the line independently

An operator begins at level-I and as his/her skill increases he/she is transferred to the next level.

Refer [Appendix 1](#), flow chart explains the complete operator training and the licensing procedure.

3.1. Induction Training

As the word “induction” suggests, Induction training marks the formal entry of a new employee into the organization. Firstly, Human resources department welcomes them to the organization and gives a brief introduction about the company. They are introduced to our organization's culture and are clearly explained about what the organization expects from them in terms of their performance and behavior.

The introduction includes:

1. **History of the company**- Important milestones achieved by the company since its genesis.
2. **Values and Beliefs**-The fundamental pillars which guide our work practices and direct us towards building an ethical work environment.
3. **Mission and Vision Statement**- Details about our organization's goals and aspirations, to achieve which, we work incessantly
4. **Products Manufactured**- Explanation of the various products manufactured and their functions.
5. **Customers**- List of our end customers and products supplied to them.
6. **Manufacturing Excellence**- Expertise in all gear and shaft manufacturing processes and super finishing operations like Shaving, Grinding and Honing.

After the basic introduction is complete, new operators go to all the department heads where they are given an overview of the departmental policies and procedures. The operator may not work in these departments, but it is essential that he/she should have a complete knowledge of the functioning of the whole company to become a part of the organization.

After the induction training is complete, an operator has a brief knowledge about the functioning of all the key departments in the company and how they work in tandem to produce excellent quality product.



Figure: 1. Induction Training

Induction Training sows the basic seeds of Divgi-Warner's culture in our employees and slowly, with time, operators start to assimilate them which are reflected in their work.

3.2. Class Room Training

Induction training is followed by classroom training. After a new operator gets an overview of the organization, he/she is prepared for gaining a basic knowledge of industrial management. Classroom training covers all the points related to company policy, safety issue and understanding of the important industrial documents.

The aim of the Classroom training is to impart theoretical knowledge which is the basis of the day-to-day work. Divgi-Warner's top management ensures that the classroom training is given by an experienced person or a trained tutor who understands the Divgi-Warner's system and can pass the same knowledge to the employees.

Classroom training is the same for each person. The idea is to give a continuous Process training to the operators with different levels of experience. An operator, who may have work experience in any other organization, must also start from Level I.

The contents of the of classroom training are:

1. Company policy

- a. Environment and Safety
- b. Quality Policy

2. Documents to be referred to while operating

- a. Standard operation sheet
- b. Job element sheet
- c. Manufacturing Process Layout
- d. Control plan
- e. Potential failure mode effect analysis
- f. Action taken on previous customer Complaints
- g. Drop gauge policy
- h. 8-D Awareness

3. Records to be maintained while operating

- a. Daily preventive maintenance
- b. Work instruction
- c. Setup check sheet
- d. Job measurement Check Sheet as per frequency
- e. Process Monitoring Chart for critical or Special Characteristics dimension
- f. Tool Life History Cards

g. First Piece & Last Piece Measurement Check sheet

4. About company

- a. Who are our customers
- b. How many products
- c. Variety of machines

5. Discipline

- a. Company rules, ethics, and instructions
- b. Use of safety equipments
- c. Punctuality
- d. Shift timings
- e. Maintain cleanliness and personal grooming
- f. Inventory Management at station as defined

6. General

- a. Takt time calculation
- b. Overall equipment efficiency calculations
- c. PPM calculations
- d. Gauge Calibration Status to be seen before using gauges
- e. Kaizen activity (suggestions)



Figure 2. Classroom Training

3.3. On-Job Training

On-job training is given to an operator immediately after his/her classroom training is over. It involves the practical training on the shop floor in which an operator gets hands-on experience of working on machines. He/she gets an opportunity to see how an operation takes place on the shop floor and how every minor detail is given attention while

performing a job. This gives him an initial motivation to learn the job and later perform the job with the same determination.

This course is led by an authorized trainer who has achieved U or O skill level. The course itself is structured to follow the basic training format. First the trainer explains and shows the method, then the operator tries on his/her own and the instructor guides him through it. This gives the trainer an opportunity to correct whatever mistakes the operator makes while performing a job before it lingers and becomes a habit.



Figure 3. On-Job Training

The trainer has to follow a standardized method of training, which is a tried and tested one. It involves the use of Manufacturing Process Layout, Standard Operation Sheet (SOS) and Job Element Sheet (JES) for explaining a process.

Refer [Appendix 2](#), *Manufacturing Process Layout (MPL)*

The first step is to divide the job into various steps, which is done with the help of Standard Operation Sheet. This sheet is based on standardized work. A “Critical” work step on the Standardized Work Sheet is divided into two or more training steps. These sub-steps or “Small” steps can be taught without overwhelming the operators.

Every step which is defined on the SOS is performed by the trainer and while performing the job he/she also explains the details related to that job. Details such as operation time and the type of operation are mentioned in the SOS and the trainer mentions them while training. One more significant teaching aid which is provided in the SOS is the visual representation of the work flow diagram. This helps the operator to visualize the whole operation during training and even when he/she is performing the job by himself. During this training, the trainer closely observes the operator to determine how well he/she has learned.

Refer [Appendix 3](#), *Standard Operating Sheet (SOS)*

The trainer also takes up the major steps which are explained in the Job Element Sheet (JES). Each step is analyzed to determine the key points. These points are the heart of the job

instruction method and are developed to explain the following critical aspects of the work:

1. What to Do?
2. How to Do?
3. Why to Do?

Refer [Appendix 4](#), *Job Element Sheet (JES)*

The safety and quality issues are taken into account for defining the key points. Key points are essential for the successful completion of the work and must be considered carefully. In most cases, they are developed based on past experience and they elaborate the correct method to perform the work in order to prevent the problem. In developing key points for new jobs or processes it is important to evaluate the work and attempt to assess potential problem areas. As the new job or process is actually performed, additional key points may be developed based on results.

These key points are very carefully explained to the operators. The trainer teaches an operator “how to do this” rather than “don’t do this.” This is a more effective teaching methodology as because there can be a number of ways in which an operator “should not” do an operation. If we give him wrong guidance, the operator may commit some other errors. So the possibility of error still remains. For example, in an operation of pressing a ring gear, the ring gear should be placed such that the groove on the gear should be at the top. Therefore, rather than stating “Avoid placing the gear in the wrong orientation”, it is stated as, “Place the gear with the grooves at the top”. During the next step of training, when the reasons behind the key points are explained, it can be said that the purpose of the key point is to “Avoid the burrs from interfering.”

While working on the machine it is assured that the following points are distinctly mentioned:

1. Daily preventive maintenance
2. First piece and last piece approval
3. Non Conformance Impact on next operation/ end user
4. Tooling & fixtures setting
5. Parameters / setting
6. Poka - yoke (Mistake-proofing system) verification
7. Instruments handling, calibration & its uses
8. Gauge zero setting, handling & drop gauge policy
9. Job in & out procedure
10. Acquire data as per checking frequency and record keeping
11. Monitoring of special parameters

During on-job training, operators are also taught how to acquire data and maintain documents. Operators while performing their regular job are also expected to fill up documents such as First Piece Approval- Last Piece Approval, Process Monitoring Chart (PMC), Daily Preventive Maintenance (DPM) Check Sheet, Setup Approval Check Sheet and etc. Operators have to be trained right from the start, so that they don't face any problem of document maintenance in the future.

Finally they are taught about the discipline and ergonomics that have to be maintained in the working environment which include

1. Use of Safety
2. Punctuality
3. Follow the instructions
4. Shift timings
5. Maintaining the cleanliness and personal grooming

3.4. Written Test and Evaluation

After the Classroom Training and On-job training is over, the operator licensing process starts. An operator has to go through a series of theoretical and practical examinations before getting a level-I operator license. These examinations are conducted to test how much an operator has grasped and retained during his/her training sessions. The questions asked in the examination are basic and are mostly related to the company's safety and quality policy, mission and vision statement, awareness about the work on the shop floor, control plan, manufacturing process layout, SOS and JES. The trainer has to be assured that the operator can perform a job on the machine. So keeping this in mind the test paper is framed for the level I test, which includes questions such as:

- What is the importance of safety precautions to be followed on the shop floor?
- How to record observation on the machine?
- What are attribute and variable gauges?
- What is gauge/drop policy?
- How to read the quality documents such as Set up check sheet, Tool life management sheet, PMC, DPR, MPL, SOS and JES?
- How to handle Non conforming parts and what is the meaning of different colors of tag?
- Which gauge is used to measure the run out?
- What is the feed rate for the turning tool (outer face)?
- What is the code number of the fixture used for this operation?
- What is the RPM of the turning tool used for "Outer Face"?
- What material is the component made of?

- What is the reaction plan if a dimension is out of specifications?
- What is the Operation name?
- What is the Operation Number?
- What are the tolerances given to the dimensions?
- How to record in a Re-work register?
- What are the machine panel operating instructions?
- What were the past quality issues and complaints?
- How to do Poka-yoke verification?
- What are the special characteristics of the product?
- What is the frequency of the inspection and recording?

An operator has to get a minimum of 70% marks in the test in order to get level-I license.

If he/she gets less than 70% marks, he/she is trained again until he/she clears the test.

3.5. Issue Operator License i.e. Certification

After successful completion of written examination, the license is issued to the operator for the particular work center. An operator who wants to work on a specific work center has to get level-I operator license for that work center. The same procedure is followed for each operation.



Figure 4. Operator License Board.

For example if an operator gets the license for working on vertical machining center, he/she can operate on vertical machining center. But, if he/she has to work on CNC grinding, he/she will have to go through the licensing process for CNC grinding.

Refer [Appendix 5](#), Operator License Card

He can also have the license for performing different operations such as welding, drilling, debarring, and grinding etc. In this way we ensure that multi-skilled operators are developed.

When operator goes to a station, he/she needs to put his/her License on the machine. After completion of work, he/she puts his/her license back on the board.

3.5.1. Skill Matrix and Records

Skill matrix is a sheet which gives summarized data of the skill level of all the operators. Besides an operator license, which gives only the details of the skill level of an individual operator, there was a need to maintain a database which contains information of all the operators with their respective skill level on each working center. So the focus geared towards creating a multifunctional skill matrix.

Instead of giving training sheet, which gives only a “Yes” or “No” for job skills, rectangular charts are made which highlight the current skill level of each operator.

The skill matrix is filled out as follows:

1. The department for which this work cell is made
2. Name of the trainee
3. Current skill level of the trainee
4. Different machining centers on which an operator can work
5. Last date the skill matrix was updated

Refer Appendix 6, Skill Matrix

The skill matrix can be used to compare the skill level and performance of operators and can also highlight the operators who need extra training and attention.

3.6. Monitoring Operator through Layered Process Audit (Effectiveness of Training Process)

When an operator enters the shop floor, he/she only thinks of doing an excellent and error free job. Every operator wants to know how well he/she is performing, for various reasons, including personal pride, recognition, etc. If people need to measure their performance, they need to have metrics regarding their job. A layered process audit provides those metrics.

Layered process audit is a process used for monitoring the job execution of the operators on a daily basis. It is developed to validate both the consistent compliance with existing manufacturing process steps and the implementation of changes or corrective actions in those existing steps. LPA is short in duration and is conducted accordingly, at a regular and planned interval, so that an operator can get timely feedback.

Divgi Warner's management believes that a multi-disciplinary approach, with management's involvement itself, is the most effective way to plan for LPA. A cross-functional team identifies existing key process steps for the audit. These are selected based on risk to product quality including lessons learned, safety, criticality of a process step and product characteristics.

Three important factors are considered before planning an audit:

- What are we going to audit?
- Why have we selected that audit item?
- Who ensures that the audit is conducted and that the results are reviewed and acted upon?

The audits are done by a supervisor who has the complete knowledge of the shop floor. The multiple levels of plant personnel who are involved in the audit process must do so with a standard and common set of questions. Audit items are typically yes/no checks regarding process steps, requirements, etc.



Figure 5. Layered Process audit conducted on the shop floor, People respect what you inspect.

Refer Appendix 7, Layered Process Audit for the common audit questions.

Audit questions are updated as and when required to incorporate the latest improvements and process updates based on previous audit findings, employee suggestions, etc.

Layered Process Audits have several tangible and intangible benefits most of which are associated with process compliance and directly impact the product quality. From LPA we can also come to know about the weaknesses of an operator and then train him in that regard. Other benefits are associated with the softer side of managing an organization and including increased floor time for plant management.

The other benefits of LPA are

- Measure and encourage work process standardization
- Reinforce key or updated process steps, including safety requirements
- Openly publish what is important and what will be checked
- Increase the interaction between manager, superior and line operators
- Allow operators to provide first hand feedback to management
- Demonstrate the importance of key processes to the operator by the plant manager
- Institutionalize training and process knowledge for operators and for the person who takes the audit
- Reduce errors, reduce scrap, increases first time pass rate, and therefore reduce costs
- Improve product quality and customer satisfaction

One more important benefit of the layered process audit is to check whether an operator is prepared for renewing his/her license.

3.7. Renewal of the Operator License by Evaluating Skills

As an operator continues to work on the shop floor and gets continuous feedback on his/her work through LPA, his/her skill level improves with continuous practice. The current license of an operator needs to be updated to match with his/her skill level, which was obtained after clearing level-I test or from the previous upgrade. For renewing his/her license, an operator has to go through a series of tests which are conducted quarterly. These tests vary with the different skill level and the difficulty of the questions in the examination increases as the license level goes higher. This process ensures that an unbiased and lucid methodology is followed for the promotion of the operators to the next level.

The following points are tested during the level-L, level-O, and level-U tests:

L Level

- Can he/she operate on the machine without the help of a supervisor?
- Can he/she give offset to the tool insert in order to achieve the required specification as per the technical drawing?
- Can he/she do the calculation of process capability?
- Is he/she aware about the process failure modes & control plan linkage?
- Is he/she aware of machine operating instructions?
- Can he/she change the tool/insert?

- Minimum Passing Percentage = 80%

U Level

- Can he/she do rework of the job independently?
- Does he/she know about the setting procedure?
- Can do new job setting on machine?
- Does he/she know the Single Minute Exchange of Die (SMED) procedure for setup change?
- Does he/she know the right cutting tools for a particular setup (broach, inserts, drill, taps, rotary, tips, hobs, shaping cutters etc.)?
- Can do an analysis of non-conformance.

Minimum Passing Percentage = 90%

O Level

- Can he/she be a coach to new operator?
- Can he/she solve quality issues?
- Can he/she plan for production?
- Does he/she have a predictive approach toward machine maintenance?

Minimum Passing Percentage = 95%

4. BENEFITS OF TRAINING

1. Increased productivity- Training improves efficiency and productivity of employees. Well trained employees show both quantity and quality performance. There is less wastage of time, money and resources if employees are properly trained.

2. Eliminates possibilities of accidents- Errors are likely to occur if the employees lack knowledge and skills required for doing a particular job. The more trained an employee is, lesser are the chances for accidents to occur and the more proficient the employee becomes.

3. Less supervision- A well trained employee will be well acquainted with the job and will need less of supervision. Thus, there will be less wastage of time and efforts.

4. Improves morale of employees- Training helps the employee to get job security and job satisfaction. The more satisfied the employee is, the greater is his/her morale, the more will be his/her contribution to organizational success and the lesser will be employee absenteeism and turnover.

5. Career Development- Employees acquire skills and efficiency during training. They become more eligible for promotion. They become an asset for the organization.

6. Repeatability & Reproducibility- It assures similar and adequate training is given every time.

5. LEARNING FROM OPERATOR LICENSING PROCESS

We have two manufacturing plants and presently 250 people are working. Operator licensing process is being implemented from the last five years. We are manufacturing precise products for Global customer in China, Korea, Thailand, Europe and USA. So we cannot afford to make any mistakes. That is the reason we have implemented operator licensing process.

Following are important steps to implement Operator Licensing System, otherwise it can go wrong.

- 1. Top Management Commitment-** Top Management should be committed for competency development of employee as key strategy of business.
- 2. Dedicated Trainer-** Production supervisor has some other priorities; he/she would not be able to conduct the training on that particular day. So, the consistency is lost. That is the reason why a dedicated person is required to be employed. So as to have 100 % focused on this work.
- 3. Standardize Operation-** First Activity is to Standardize Operation by using cross functional Team including Manufacturing, Engineering, Maintenance, Manufacturing Engineering, and Quality. Standardize operation includes:
 - a. Standardized Operating Sheet (SOS) and Job Elements Sheet(JES):-** Methods or steps to complete operation
 - b. Work Station Standardization:-** Each work station must have enough place to accommodate everything and everything is to be in its place
 - c. Standardization of inventory on each station:-** Define inventory level on each station on the basis of cycle time
This will help to impart similar training to all.
- 4. Evaluation of operator-** Based on our experience we have set questions on each operation methodology, Controlling parameters, speed, feed and important task to complete operation are required to evaluate operator competence, so that mistakes can be avoided.
- 5. Review of Training Process-** Review of Training System must be done through the Layered Process Audits (LPA) to sustain it.
- 6. Train the trainer-** Spend the resources to upgrade the faculty.

6. CHALLENGES FACED

We have faced many challenges while implementing the Operators Training System and many more lie ahead in order to improve and sustain it. Volatile customer requirement and an unpredictable dropout rate of the operating employee's continually increased the work load on this process to train new employees. This was resolved by allocating a dedicated and focused faculty member for assuring effectiveness and

efficiency of this system. Need was also felt to simplify training module so as to easily grasp by all level people, resulting in required output from them. More focus needed on process and product approach in training module. Diversity and complexity of the various manufacturing technologies used cannot be deployed through one person. Commitment of an interdisciplinary team is needed to support and execute the objectives of the Training and Licensing System. To date we have issued about 1000 licenses to operators.

7. FUTURE DIRECTION

We are encouraged to extended Scope of this process to other business and supporting processes as a part of education, training and skills up gradations and rolling it further to customer and supplier base. Since the cross functional teams are been working on various projects, the similar approach to be practiced for workgroups competency mapping and development.

8. CONCLUSIONS

Operator training and licensing is an ideal system for training and developing operators with high skill level and an effective preparation to handle any kind of contingencies. The most important thing about the framework is its flexibility. With some modification, it can be applied to any manufacturing industry.

Objectives achieved through this system have been summarized as:

- “Zero” unsafe incidence
- Customer PPM reduced by 64%
- Increase in actual run rate and product quality which in turn increased OEE (Overall Equipment Efficiency) from 41% to 82.9%
- Reduced operation lead time helping in 100% On-Time Delivery to customers
- This process of training increases operator involvement and enables him to give valuable suggestions for continuous improvement

This paper can also provide a guideline or benchmark for the industries which are keen on developing an effective operator training system.

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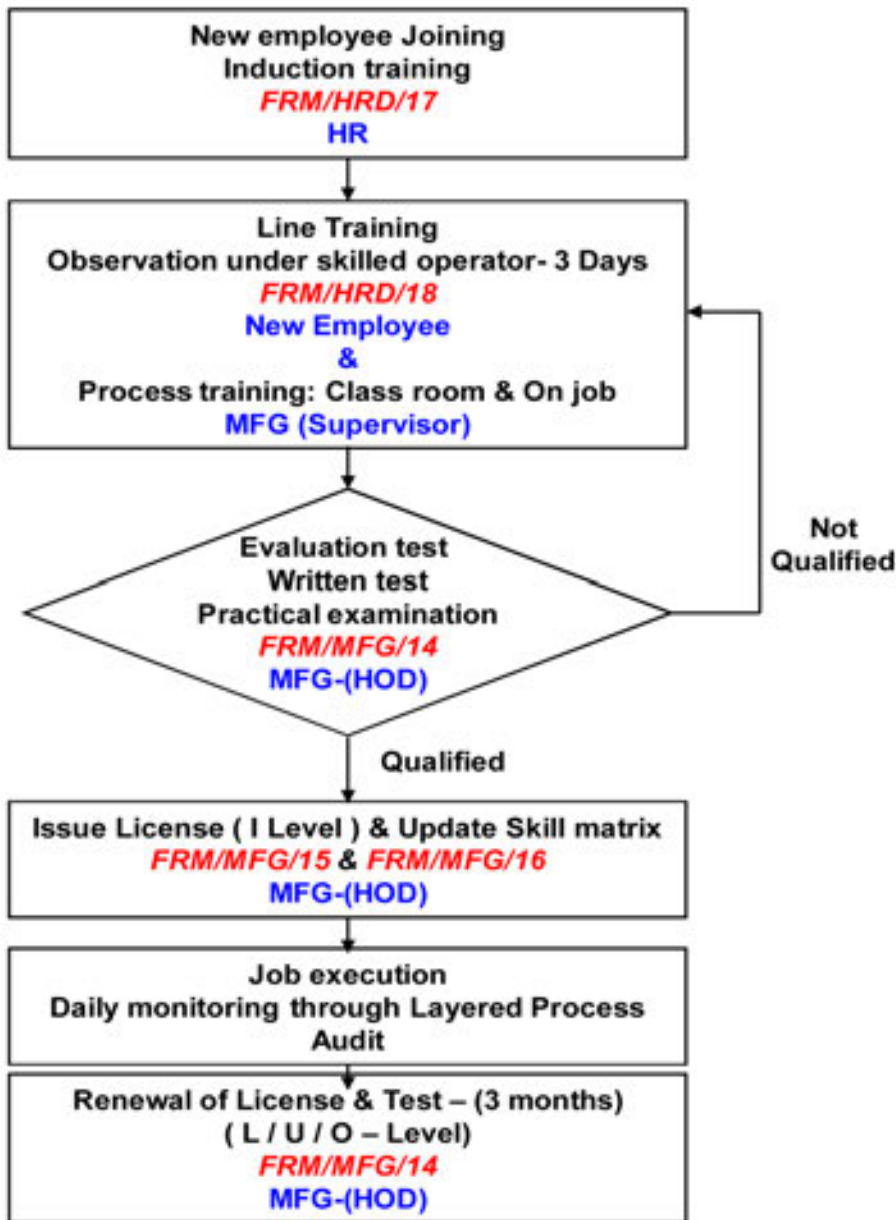
ABBREVIATIONS

SOS - Standard Operation Sheet
JES - Job Element Sheet
MPL - Manufacturing Process Layout
PFMEA - Potential Failure Mode Effect Analysis
DPM - Daily Preventive Maintenance
LPA - Layered Process Audit
SMED - Single Minute Exchange of Dies
CAPA - Control and Preventive actions
KPI - Key Process Indicator
QSB - Quality System Basics
STA - Supplier Technical Assistance
SCM - Supply Chain Management
PPC - Production Planning and control
DWPL - Divgi Warner Privet Limited
PPM - Part Per Million Rejection
RPM - Revolution Per Minute
CNC - Computerized Numeric Controlled Machine

APPENDIX

APPENDIX 1: OPERATOR LICENSING PROCESS FLOW DIAGRAM

 Divgi - Warner	Process: Operator Licensing Procedure		
	Process Owner	Head-MFG	Control Number: - OP/MFG/003
	Short Description	Operator license execution	
	Original Release	00/ July. 28, 2008	
	Latest Revision	00/ July.28, 2008	Page of : 1 of 1



Manager-MFG	Head- Operations	Any hard copy of this document, except with QMR, is an uncontrolled copy and is only for reference purpose.
Prepared and checked By	Approved By	

APPENDIX 2: MANUFACTURING PROCESS LAYOUT (MPL)

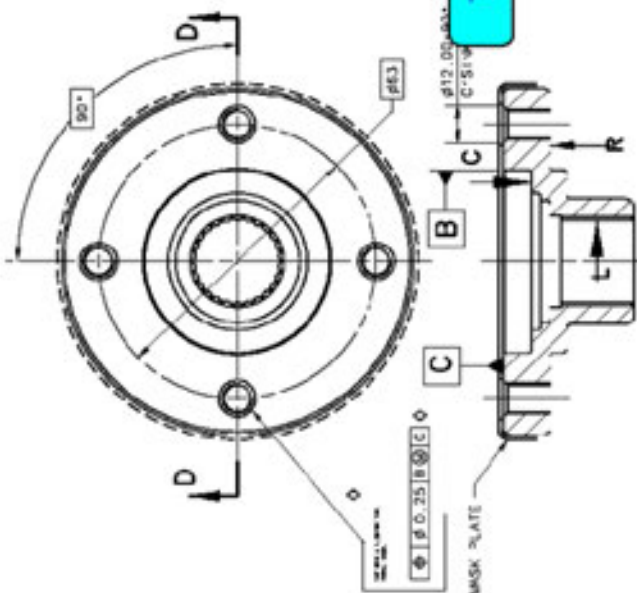
MANUFACTURING PROCESS LAYOUT

PHL DP. No. 60	No XI DP. No. 80	Sheet 1 of 1
OP. OFSC. BROACH INT. SPLINES	OP. OFSC. BACK SIDE DEBURRING	
VAC / WINNER		
OWN. DESCRIPTION DRILLING & TAPPING		
S. No. SLIP PROCEDURE		
01 REST, LOCATE & CLAMP THE JOB AS SHOWN IN FIG.		
02 COVER THE JOB WITH MASK PLATE AS SHOWN IN FIG		
03 START PROGRAM NO.0024		
04 HANDLE ALL THE PARTS IN TRAYS & ALL PARTS MUST BE FREE FROM BURRS, SHARP CORNERS, DENTS & RUST.		
05 USE SOLUBLE OIL COOLANT CHANGE IT EVERY MONTH & ADD 0.1% BACTROL (BAC-333) IN FRESH COOLANT.		
06 AFTER COMPLETION OF OPERATION DIPP THE JOB IN VCI-418 01...		
07 TAKE THE FRESH PREVENTIVE OIL AT THE START OF SHIFT FOR JOB DIPPING.		
08 FEED THE COMPONENT IN RESPECTIVE TRAY ONLY.		

S. No.	FIXTURES	QOH. No.	QTY.
01	DRILLING / TAPPING FIXTURE	F-10414	01
02	HANDLING TRAY	F-10784-A	AS REQD.
S. No.	CUTTING TOOL S	QTY.	B.P.N.
01	Ø6.76 CARBIDE S.S. DRILL	STD.	1000-2500
02	CHAMFER TOOL-DONNER 3 FLUTE TIN COATED	STD.	300-500
03	M10 x 1.25 SH TAP (M/C. TAP)	STD.	400-800

S. No.	PARAMETERS	REPRESENTATION	GAUGES/IMP. METHOD	GAUGE QOH. No.	TRIG. OF IMP.	REACTION IN AN
01	DRILL HOLE	Ø6.75 ±0.1	PLAIN PLUG GAUGE	DM/PG/2281/	1/	CHANGE DRILL/CHECK POSITION AFTER RESHARP. COOLANT FLOPPATE
02	CHAMFER	Ø12.00 ±0.15	FLUSH PIN GAUGE/ VERNIER	DM/PPG/208	2-100	OUTTER CHANGE FREQUENCY
03	P.C.D.	Ø90	RECEIVING GAUGE	STD.	1/	CHANGE DRILL/CHECK PALLE P.C.D. AFTER CHANGE
04	POSITION	Ø10.25 ±0.05	RECEIVING GAUGE	G-10874	1/	CHANGE DRILL/CHECK POSITION AFTER RESHARPING
05	TAP HOLE	M10x1.25-8H THRU	THD. PLUG GAUGE	DM/TFG/200	100	OUTTER CHANGE FREQUENCY
06	APPEARANCE	FLANGE SHOULD BE FREE FROM ANY TYPE OF MARKS/ BURRS & SHARPS. SHOULD BE FREE FROM CUTTER MARKS	VISUAL	---	---	100K

SPECIAL CHARACTERISTICS LIST		REF. AND REV. NO. L	MAT. UNS	CIT/450	MARKS/160-710	18H
S. No.	PARAMETER	SPECI.	DATE	14.06.06	GAGE FORC. DRG. No.	45-00-031-974
01	POSITION	Ø10.25 ±0.05	STIP	3ATC	CUSTOMER DRG. No.	---
02	TAP HOLE	M10x1.25-8H THRU	OB	PCS	Ø 10.06	CUSTOMER DRG. No.
			APPD.	MSA	16.10.06	PART NAME
			I.L.D.			FLANGE - COMPANION
						DRG. No. 44-00-031-024-C



Tool life

Cutting parameters

Gauges as per Quality control plan

Special Character

Inspection frequency

NOTY :- BOPAK SIMP CORNERS.

(1) TOLERANCE	(2) DEVIATION	(3) KEY CHARACTERISTICS
Ø	○	●
KEY CHARACTERISTICS		
M/C NO	1	11
TIME PER P110		
DATE	16.10.06	
NEW RELEASE		
MODIFICATIONS		

APPENDIX 3: STANDARD OPERATING SHEET (SOS)

GROUP / TEAM J-97 Assembly
OPERATION NAME / # 30

REVISION LEVEL -ASH J97-01
REVISION DATE -15-09-09

REVISION LEVEL -ASH J97-01
REVISION DATE -15-09-09

WORKSTATION 30

STANDARD OPERATION SHEET

Input shaft assembly

JOB ELEMENTS

NO	DESCRIPTION	PREVIOUS	NEXT	QUANTITY	UNIT	TIME
1	Place bush 1 & NRB 2 on Press (A-36) locator			11.0		
2	Take input shaft 3 & place sun gear 4 thrust plate 5 thrust washer 6 with flat side down on input shaft			18.4		
3	Place input shaft thrust plate, thrust washer on press (A-36) locator.			4.0		
4	Place bearing 7 with groove side down on locator			4.5		
5	Press the cycle start button.			2.0		25.2
6	Take out the lip shaft, sun gear & bearing assembly from Press A-36 & place snap ring 8 on input shaft			18.3		4.7
7	Check the depth of bush, depth of NRB I.D of bush.			26.4		

WORK FLOW DIAGRAM

1: 10-001-10-010 Input Ring
 2: 10-001-10-011 Snap Ring
 3: 10-001-10-012 Thrust Ring
 4: 10-001-10-013 Thrust Washer
 5: 10-001-10-014 Thrust Plate
 6: 10-001-10-015 Input Shaft
 7: 10-001-10-016 Bearing
 8: 10-001-10-017 Snap Ring

INPUT SHAFT ASSEMBLY

1: 10-001-10-015 Input Shaft
 2: 10-001-10-016 Bearing
 3: 10-001-10-017 Snap Ring

Scale Ring to L.P. Input Ring
 Groove side of Ring should be inside Sun Gear

21-813
 21-790
 28, 30
 28, 30

TAKE TIME	SEC'S	SUB TOTALS	5
ACTUAL TAKE TIME		84	
ANOWORK + WALK TIME		89	
WAIT WITH CYCLE TIME			
TOTAL CYCLE TIME		89	
PARTS PER CYCLE		1	

J.E.S. LOCATION: Workstation

SAFETY REQUIREMENTS
 Safety Shoes
 Cotton Gloves


CONTROL BLOCK **REV. DATE:** 6/22/08

Shift **Signatures**

1st	Team Leader	Group Leader
2nd	Master Crafts	Andrus Kiefer
3rd	J.N. Johnson	

Freq.	Time	INCIDENTAL WORK
2	60	Adapter CKD
2	30	Carrier - Material Handling

APPENDIX 5: OPERATOR LICENSE



Divgi Warner Pvt. Ltd.

Operator License


Name : Shelake N.M.

Dept. : J-97 Assy line

DOJ : 04-09-2009

Operator sign :

Issued By : [Signature]



SL #	Operation	Learner		Skilled	
		I	L	U	O
1	Carrier Assy	✓	✓	✓	✓
2	Fork & Cam Assy	✓	✓	✓	✓
3	Generator Pump Assy	✓	✓	✓	✓
4	Case Assy	✓	✓	✓	✓
5	Cover Assy	✓	✓	✓	✓
6	Adapter Assy	✓	✓	✓	✓
7	Conveyer Assy Line	✓	✓	✓	✓
8	Motor sub Assy	✓	✓	✓	✓
9	Gear Y Shaft Assy	✓	✓	✓	✓
10	Speedo body & Seal Assy	✓	✓	✓	✓
11	Lockup Assy	✓	✓	✓	✓
12	Yoke & Dust Deflector Assy	✓	✓	✓	✓
13	Functional Test Stand	✓	✓	✓	✓

SL #	Operation	Learner		Skilled	
		I	L	U	O
14	Leak test	✓	✓		
15	Packaging & Dispatch	✓	✓	✓	
16	General work & Inspection	✓	✓	✓	

I - Informed (Know the basic operations) FRMMPG/011 Rev. 00 w.e.f. 28/07/2008
 L - Learned (Trained but still needs help guidance)
 U - Understand (Employee compliant in all operation without outside help)
 O - Operate (Can be a coach & solve quality issues, handle line independently)

ENSURE FOLLOWING POINT

- Company Uniform, Safety Shoes, Safety Goggle, Operator license.
- Feed back from previous Shift (Log book).
- Poka yoke verification & It's Record in Register.
- Daily PM & It's Record.
- Ensure Current Process SOS, JES, MPL & control plan in work place.
- First Piece approval & check sheet as per frequency.

SAFETY & ENVIRONMENT POLICY

Safe Work Practices.
Energy Saving.
Waste Reduction & Control.

QUALITY POLICY

Customer Satisfaction.
Quality Product.
Continual Improvement.

APPENDIX 6: SKILL MATRIX

Dept : F. C. CELL		SKILL MATRIX							Date : 09/07/2012
Sr No		Vertical Machining Center	Micrometric Grinding	CMT Drilling	Hydro- Pneumatic Press	Packing	General work & Inspections		
1	VINOD SHIRSATH (TRAINER) 14/12/2009							6/1/2011	
1	D.S.MANVAR (Trainer) 4/1/2009							6/1/2011	
2	BELARI L. 7/1/2011							6/1/2011	
3	SHIYA 5/25/2012							6/1/2011	
4	JONDHALE 1/28/2012							6/1/2011	
5	VIJAY BHAGAT 6/24/2012							6/1/2011	

1


2

4

3

5

APPENDIX 7: LAYERED PROCESS AUDIT

 LAYERED PROCESS AUDIT					
Auditor:				Rev - 01, Date - 07/08/2012	
Machine Name :				Date:	
Part Name :				Shift :	
Process :		Cover Transfer Machining		Operator name :	
Sr No	What?	Why?	Compliance		Comments
			Yes	No	
Safety					
1	Safety Shoes	Prevent foot injury			
2	Ensure Machine door is close during machining	Prevent coolant & chips splashing outside the machine			
3	Company uniform, Shirt tucked in.	Prevent injury to hands during clamping of tools , parts & fixtures on in machine & to maintain discipline			
4	Is shoopfloor free from oil spillage.	To avoid slippage & accident			
5	Awareness of safety & Quality policy & Vision, Mission.	To understand company objective.			
Customer Complaints & Quality					
Bearing bore, lip seal bore oversize.					
6	1) Ensure use of coolant gun for spindle area & arm cleaning. 2) If correction required , it should be done by Supervisor only.	Prevent "production of Non conformance."			
7	Is operator Aware of Special characteristics.	Prevent "production of Non conformance." & to see process			
14	Ensure Missing Operation- Speedo Bore for TIME/MM Cover. Ensure operation completeness & sequence.	Prevent "production of Non conformance & mix-up"			
15	To avoid Lip Seal Bore bend during material handling ensure single trays to be used	Prevent "Non conformance mix up"			
16	Work system as per SOS/UES & no. of steps in sos	To improve standardized work system.			
17	Verify the setup approval & actual reading in set up approval.	To improve Quality & standardized work			
18	Verify the working of flushing system & coolant gun	To reduce chances of burr jam.			
5-S & Environment					
19	Gauges & Tools are in place.	To maintain 5S & Save time			
20	No Leakages of oil & air through tank & joints.	Avoid wastages			
Others					
20	MPL & Control plan has same revision level.	Prevent " Production of Non conformance"			
22	Station WIP as per MIN.& MAX. level	For WIP & 5S control			
Gauges					
23	Calibration of gauges	Prevent " Production of Non conformance"			
Operator Licensing					
24	Is certified operator operating the machine.	To produce OK jobs			
25	Check for completion of Daily Preventive Maintenance.				
Auditor Sign			Auditee		
			In-charge		

The Engineering Meetings Board has approved this paper for publication. It has successfully completed SAE's peer review process under the supervision of the session organizer. This process requires a minimum of three (3) reviews by industry experts.

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