

CHAPTER V

QUALITY PROCEDURE

This chapter presents details of selected Quality Indicator including quality procedure and target for the purpose of implementation trial phase and further implementation of the company.

5.1 Deployment of Quality Procedure into the Manufacturing Process

According to the existing Hydraulic Cylinder manufacturing process presented in Chapter 3, the following sub-quality procedure for quality of finished product and reliability of delivery time applied into the company's manufacturing procedure is recommended.

Quality Procedure

QP 1: Contract Review (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline of how to effectively review customer contract in order to obtain all vital information for manufacturing purpose.

2. Scope

This procedure covers from the point of getting order from customers by salesperson until reviewing product specification of Engineering staff.

3. Definition

Not applicable

4. Reference

Contract Review Form

5. Procedure

The following guidelines should be applied whilst reviewing customer contract.

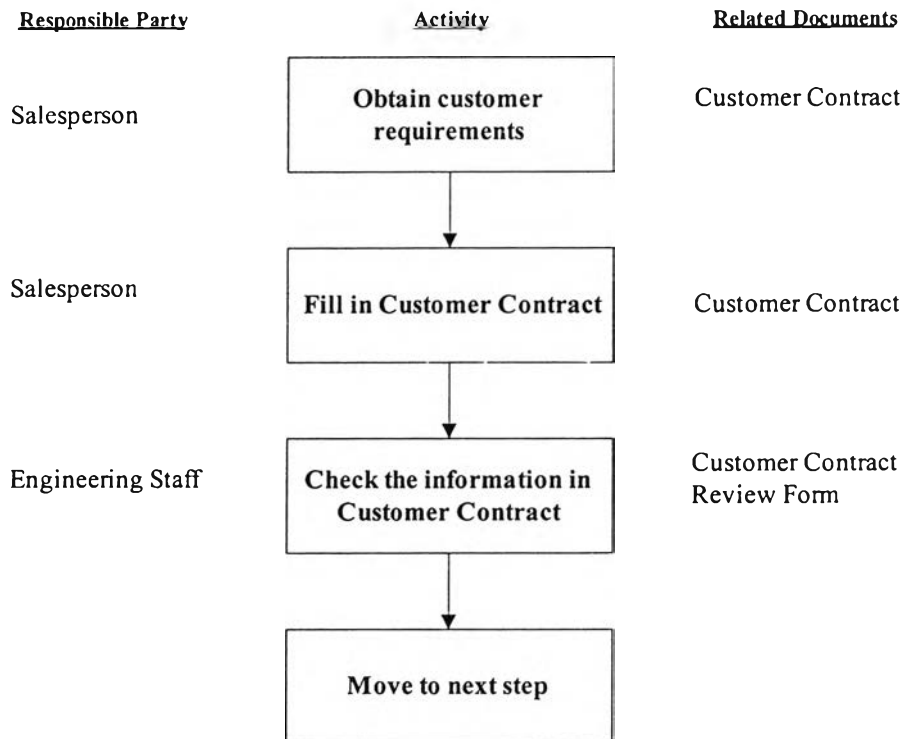
- Complete required technical specification and other related information to the prospective customer so that all aspects of product are clearly defined.
- Ensure that the order or contract contains complete details about the type or model of the product.
- Ensure that the contract clearly indicates mutually agreed packaging, transportation, installation and other related terms.
- Ascertain whether the customer will inspect or test the product either before dispatch or on receipt.
- In case the product meets customer requirements, salesperson should discuss the proposed delivery schedule with the production section before confirming the schedule.
- In case of incomplete information, a Head of Engineering is responsible for obtaining additional information from salesperson.

6. Flow Chart

See next page.

Quality Procedure
QP 1: Contract Review (2/2)

Contract Review Flow Chart



Quality Procedure

QP 2: Design Process (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline for the design process in order to create a design of product of what customer actually needs.

2. Scope

This procedure is applicable for

- design planning
- product design
- design amendment

3. Definition

Not applicable

4. Reference

- Customer Contract Review Form
- Design Planning Form
- Design Review Form
- Design Amendment Form
- Calculation Sheet

5. Procedure

The following guidelines should be followed for the design procedure.

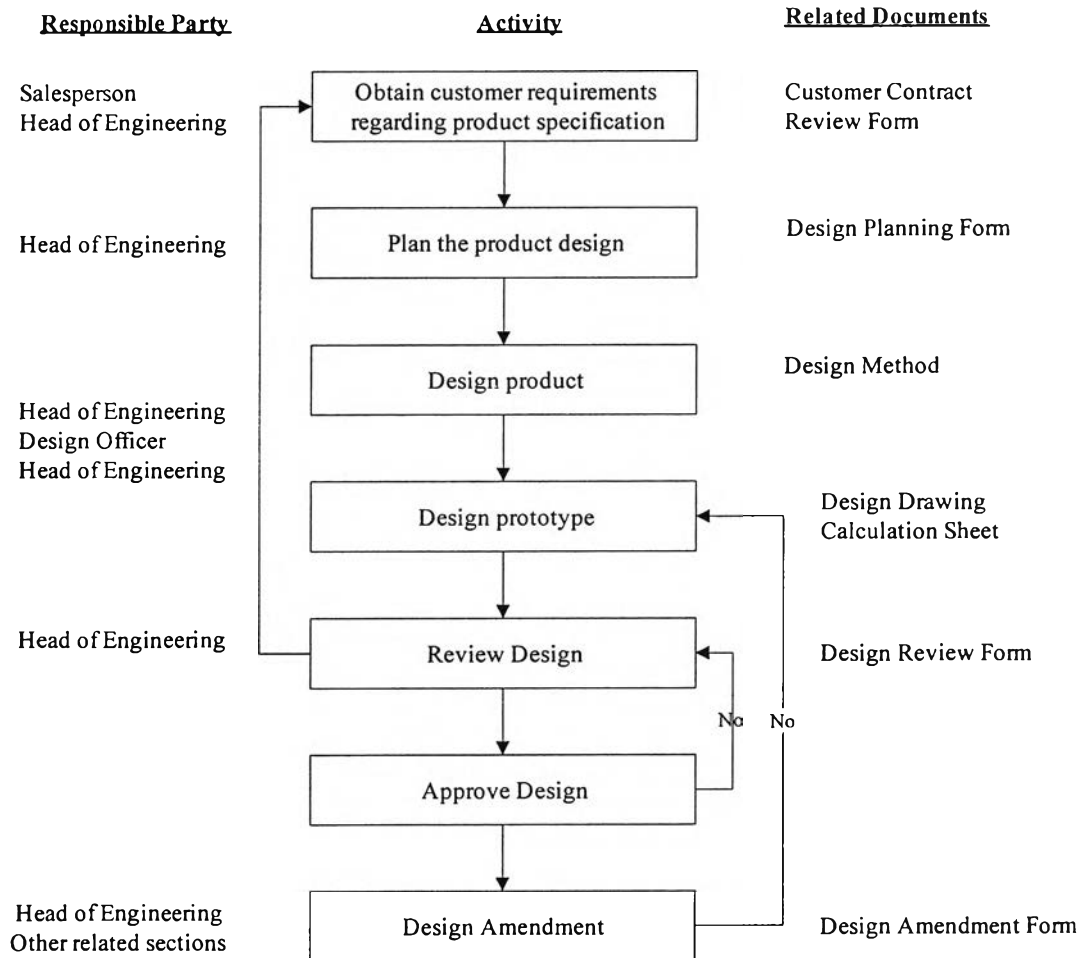
- Customer requirements are defined in sufficient detail so as to serve as a sound basis for design and subsequent activities.
- Following a contract review. Changes in design that do not affect the quality of the product may be needed. Such changes should be discussed with the customer and his/her agreement obtained.
- Design staff has to review the details of product specification indicated in the Contract Review Form and prepare the information of size of seal, strength of parts, strength of socket screw, and strength of welding area. Then, select the seal type and indicate the groove of seal by using information in the calculation sheet.
- Design staff then prepares the design drawing for prototype manufacturing purpose.
- Head of Engineering is responsible for reviewing the design of product whether or not it followed the design plan and fulfil customer requirements.
- Head of Engineering is responsible for design approval.
- In case design amendment is required, other departments can propose for the amendment to the Head of Engineering.

6. Flow Chart

See next page.

Quality Procedure

QP 2: Design Process (2/2)



Quality Procedure

QP 3: Raw Materials Ordering and Inspection (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline for raw material ordering and inspection procedure to assure the quality of raw materials.

2. Scope

This procedure is applicable for

- Supplier selection
- Raw materials ordering
- Raw materials inspection

3. Definition

Not applicable

4. Reference

- Raw Materials Request Form
- Purchase Order
- Raw Materials Return Form
- Raw Materials Inspection Form
- Supplier Evaluation Form

5. Procedure

The following guidelines should be followed for the raw materials ordering and inspection process.

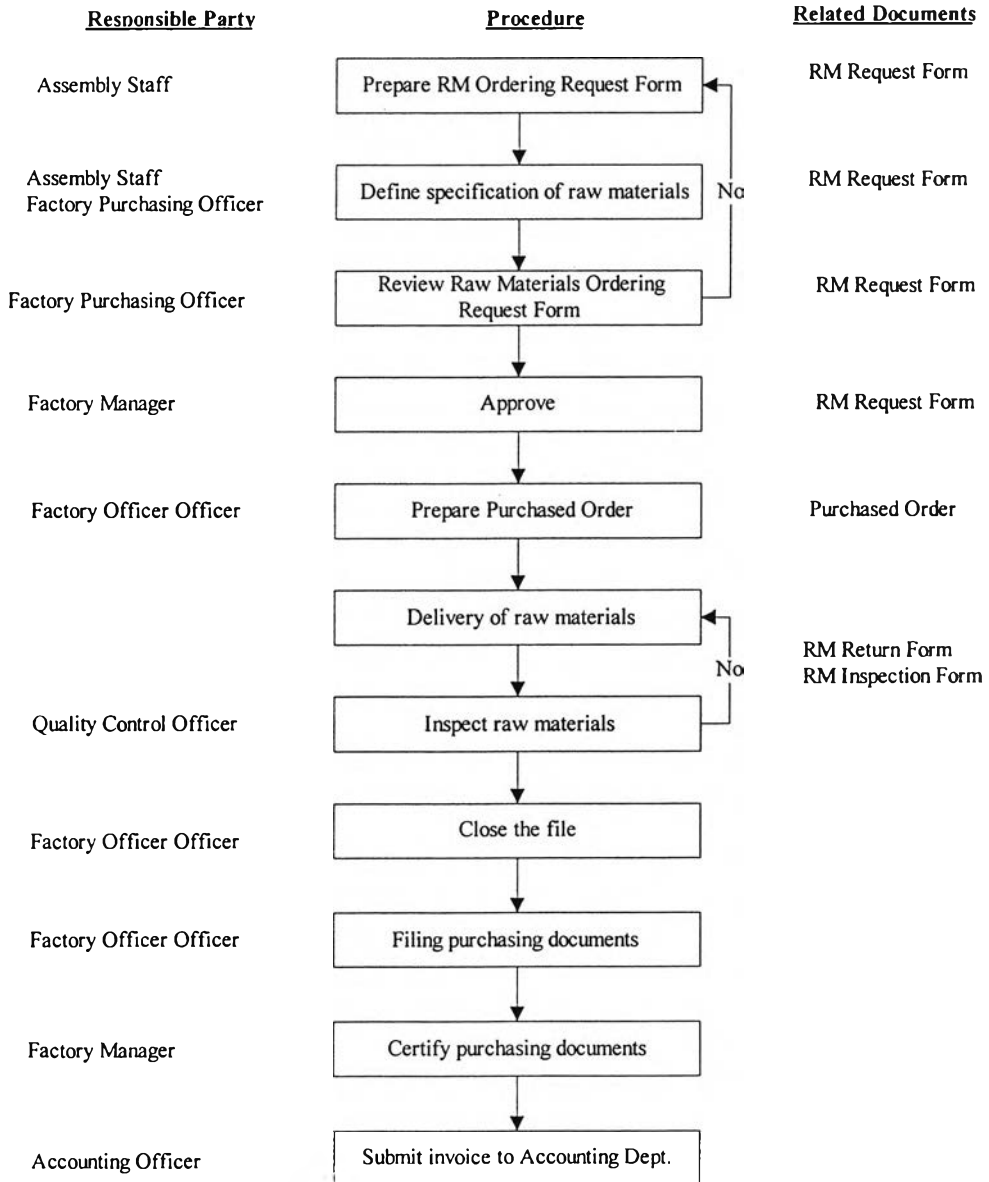
- Assembly officer prepares Raw Materials Ordering Request Form and submit to the Factory Purchasing officer.
- Factory Purchasing Officer collects and checks the Raw Materials Ordering Request Form and prepare the Purchase Order.
- Purchasing Officer has to prepare Supplier Evaluation Form for new supplier or use the evaluation score for existing supplier.
- Factory Inventory Officer conduct quality inspection upon receipt of raw materials by using the following procedure:
 - Check the quantity of raw materials whether or not it is in accordance to the purchase order.
 - Record reception items in the Raw Materials Reception Form
 - Inspect the quality by using the Sampling method
- Purchasing staff close the purchase file when received all raw materials completely.
- Qualified raw materials will be delivered for manufacturing process.

6. Flow Chart

See next page.

Quality Procedure

QP 3: Raw Materials Ordering and Inspection (2/2)



Quality Procedure

QP 4: Hydraulic Cylinders Manufacturing (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline for a manufacturing of simple hydraulic cylinders in order to ensure the quality of hydraulic cylinders

2. Scope

This procedure is applicable for

- Production Plan
- Production Process

3. Definition

Not applicable

4. Reference

- Design Plan
- Postponement for Late Delivery of Merchandise Form

5. Procedure

The following guidelines should be followed for the manufacturing of hydraulic cylinders.

- The Metal Cutting Officer cut the iron by using AMADA machine and HERO machine following the method mentioned in the Raw Materials Disbursement Form. Then, Raw Materials Inspection Officer checks if the cut iron is as the specified pattern and put the "QC Passed" label. Otherwise, put "QC Hold" label and follow the quality control process.
- The acceptable cut iron will be routed to the assembly section for product assembly, which follows the process mentioned in the production plan. Process here includes drilling, lathing, and tapping. The work-in-process will be inspected by the Inspection Officer. The "QC Passed" components will be routed for further assembly. The unqualified components will be put into the quality control process again.
- The qualified components will be used for hydraulic cylinder assembly in different pattern such as round type hydraulic cylinder, square type hydraulic cylinder and square type hydraulic cylinder.
- The Inspection Officer will then inspect hydraulic cylinder and conduct the functional test prior to route for painting, name plate attaching and packaging.

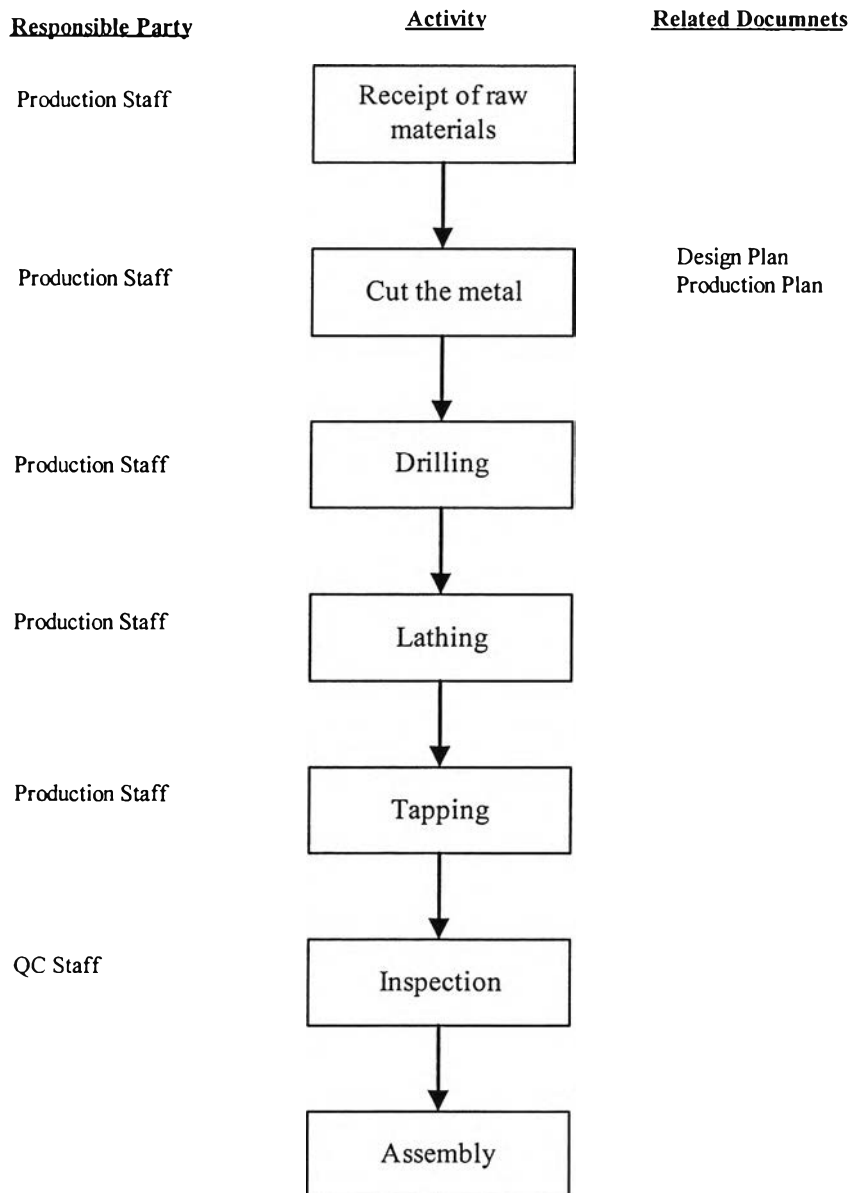
In case the production is not as scheduled or expected to be off-schedule, the assembly section as to fill in the Postponement for Late Delivery of Merchandise Form and submit to the Head of Production at least three days before the schedule date. This information has also to be informed to salesperson.

6. Flow Chart

See next page.

Quality Procedure

QP 4: Hydraulic Cylinders Manufacturing (2/2)



Quality Procedure

QP 5: Inspection and Testing (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline of consistent inspection and testing method in order to verify that the requirements for products are being met.

2. Scope

This procedure is applicable for

- Finished product inspection and testing
- Work-in-process inspection and testing

3. Definition

Not applicable

4. Reference

- Product Design
- Final Inspection Form

5. Procedure

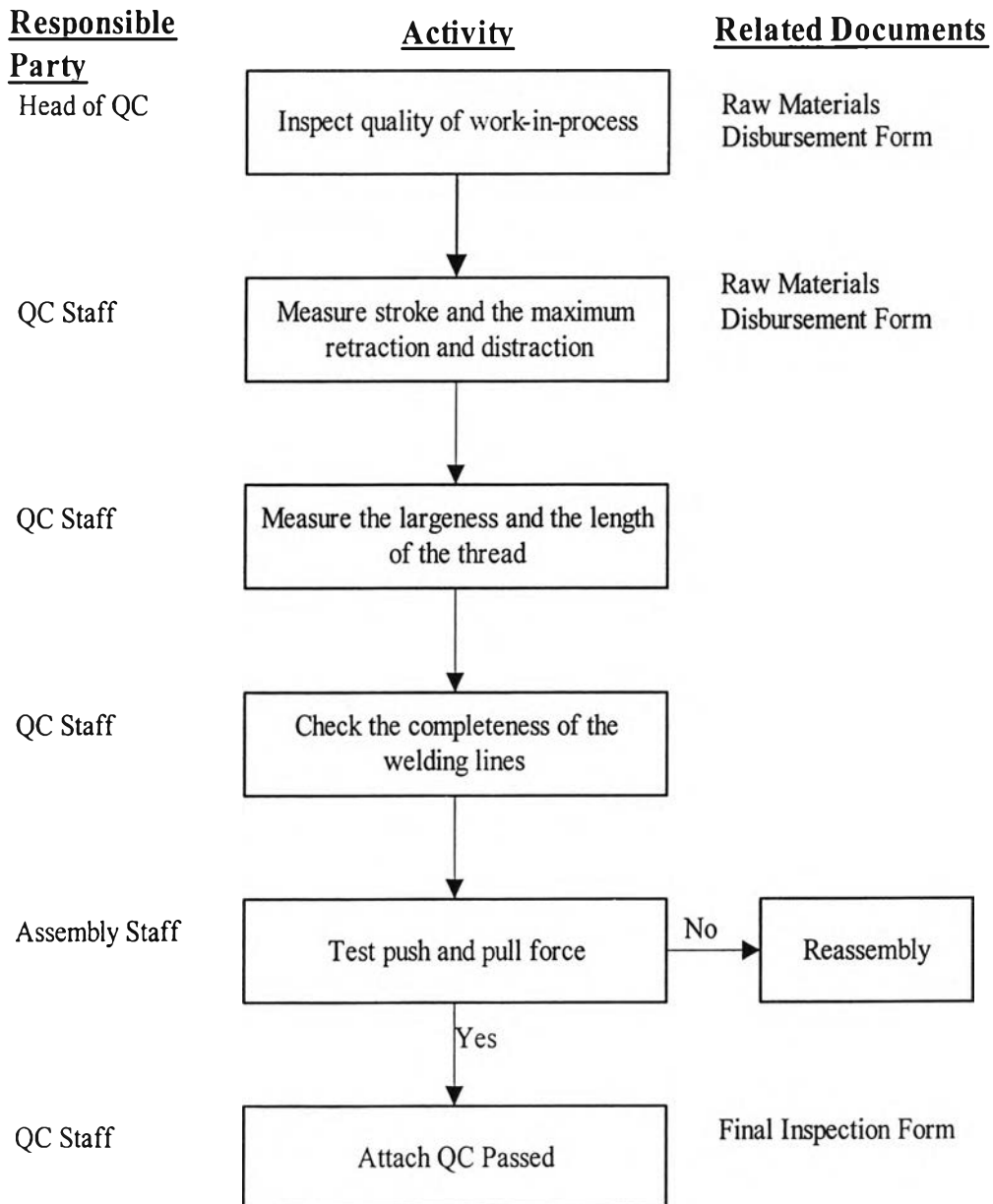
- The simple procedure is to check the size of components and the smoothness of the work-in-process surface at the iron cutting stage prior to the lathing. This has to follow a guideline mentioned in the Raw Materials Disbursement Form.
- Final inspection with testing procedure is as follows.
 - 1) Measure stroke and the maximum retraction and distraction as mentioned in the design of product. Vernier will be used for the length of up to 500 mm. with an allowance of +0,-1.5mm. and metre casket will be used for the length of more than 500 mm. with an allowance of +0, -3mm.
(Use the pressing force of 3000 ± 200 PSI)
 - 2) Measure the largeness and the length of thread. Use Thread Ring Gauge as the tester. Hold for at least one minute to see if the seal or other points leak.
 - 3) Check the completeness of the welding lines.
 - 4) Test Push and Pull Force.
 - 5) Record the information of the test in the Final Inspection of Hydraulic Cylinder Report Form.
 - 6) Summarise the cylinder testing result and find out if the inspection value is within the acceptable deviation value or not.
 - 7) Attach "QC Passed" label to the finished product if the quality is acceptable. These finished products will be routed to painting section.
 - 8) Inspect the quality of paint and sign on the "QC Passed" label.

6. Flow Chart

See next page.

Quality Procedure

QP 5: Inspection and Testing (2/2)



Quality Procedure

QP 6: Name Plate Attaching (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline of name plate attaching to ensure the product information used as reference on name plate is correct.

2. Scope

This procedure is applicable for name plate attaching process.

3. Definition

Not applicable

4. Reference

- Final Inspection Form
- Production Plan

5. Procedure

Name plate attaching procedure is as follows.

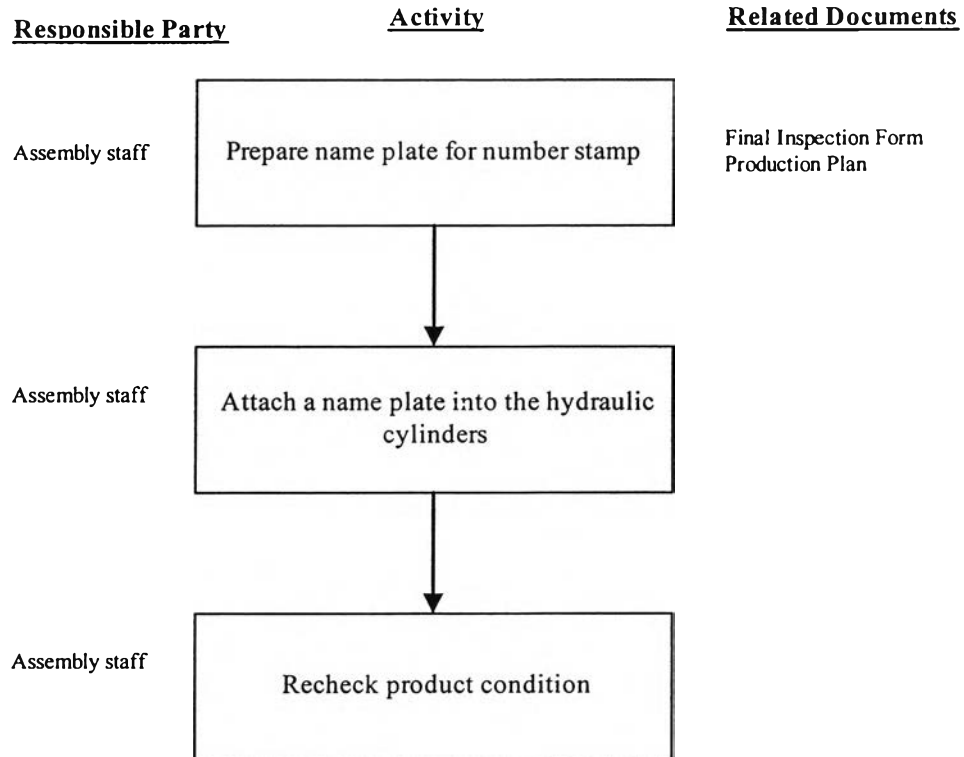
- Prepare the name plate for number stamp.
- Stamp number on the first row which refers to the job of factory, followed by product type, month, year, and ordering of product manufactured in each month.
- Stamp job No. followed by salesperson's initial on the second row.
- Stamp the initial of cylinder type, followed by inspector's initial and manufactured date in dd/mm/yy format on the third row.
- Attach the name plate to the cylinder by drilling hole on both sides of name plate. Then, insert rivets into both holes and use hammer to fix name plate to the cylinder.
- Recheck condition of product and prepare for delivery product to customer.

6. Flow Chart

See next page.

Quality Procedure

QP 6: Name Plate Attaching (2/2)



Quality Procedure

QP 7: Packaging (1/2)

1. Purpose

The purpose of this procedure is to provide a guideline for hydraulic cylinders packaging to ensure that customer requirements is being fulfilled.

2. Scope

This procedure is applicable for packaging process.

3. Definition

Not applicable

4. Reference

- Customer Contract Review

5. Procedure

Hydraulic cylinder packaging is the final step in the manufacturing procedure. The packaging procedure is as follows.

1. Put the plastic tube at the end of hydraulic cylinder thread to prevent damaging from bumping.
2. Measure the hydraulic cylinder dimension.
3. Cut the wrapping plastic according to the size of hydraulic cylinder.
4. Put the hydraulic cylinder onto the wrapping plastic. Wrap the hydraulic cylinder.
5. Attach "Final" label to specify completeness of packaging. Details of hydraulic cylinder will be included in this label.
6. Hydraulic cylinder is now ready for customer delivery

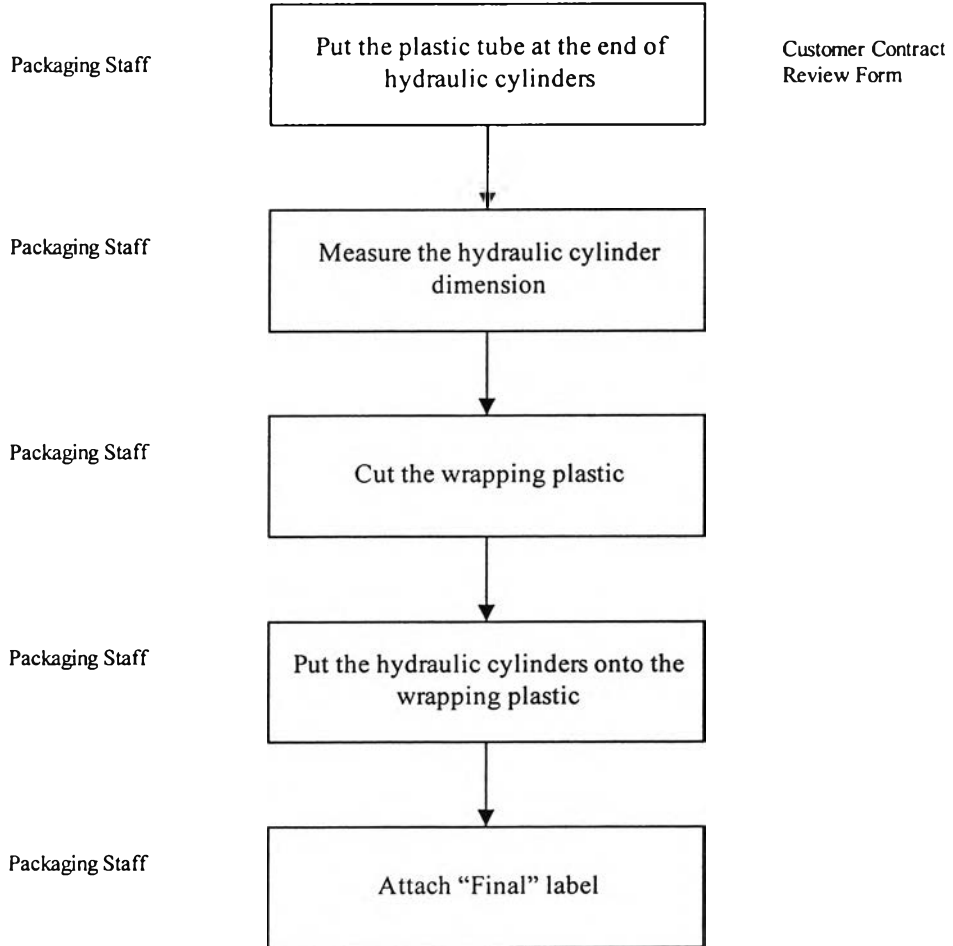
6. Flow Chart

See next page.

Quality Procedure
QP 7: Packaging (2/2)

Responsible Party

Related Documents



Quality Procedure

Quality of finished product/Reliability of Delivery Time(1/5)

1. Purpose

The purpose of this procedure is to provide a guideline with consistent system for the process of customer contract review, product design, raw materials ordering and inspection, quality inspection and testing, name plate attaching and packaging, in order to ensure that customer requirements are being fulfilled.

2. Scope

This procedure is applicable for:

- Customer Contract review process
- Product design process
- Manufacturing of work-in-process and finished products
- Product inspection and testing procedure
- Name plate attaching process
- Product packaging process

3. Definition

Not applicable

4. Reference

QP 1: Customer Contract Review

QP 2: Design Process

QP 3: Raw Materials Ordering and Inspection

QP 4: Hydraulic Cylinders Manufacturing Process

QP 5: Inspection and Testing

QP 6: Name Plate Attaching

QP 7: Packaging

5. Procedure

The following guidelines should be applied whilst reviewing customer contract.

- Complete required technical specification and other related information to the prospective customer so that all aspects of product are clearly defined.
- Ensure that the order or contract contains complete details about the type or model of the product.
- Ensure that the contract clearly indicates mutually agreed packaging, transportation, installation and other related terms.
- Ascertain whether the customer will inspect or test the product either before dispatch or on receipt.
- In case the product meets customer requirements, salesperson should discuss the proposed delivery schedule with the production section before confirming the schedule.

Quality Procedure

Quality of finished product/Reliability of Delivery Time (2/5)

The product design guideline is as follows.

- Customer requirements are defined in sufficient detail so as to serve as a sound basis for design and subsequent activities.
- Following a contract review. Changes in design that do not affect the quality of the product may be needed. Such changes should be discussed with the customer and his/her agreement obtained.
- Design staff has to prepare the calculation sheet within one working day after the assignment date for made-to-stock product type and two working days for made-to-order product type.
- Design staff has to prepare a drawing of design and complete it within the same day of preparing the calculation sheet for the made-to-stock product type, and three working days for made-to-order product type.
- Head of Engineering has to review and approve the product design within the same day of receiving a design for made-to-stock product, and within two working days for made-to-order product.
- For design amendment, Head of Engineering has to process and make a decision whether or not to approve the amendment of design within two working days for made-to-stock product and three working days for made-to-order product.

The raw materials ordering and inspection guideline is as follows.

- Select qualified subcontractors or suppliers prior to place raw materials ordering. The information from the supplier evaluation data will enable Factory Purchasing Officer to select qualified suppliers.
- If new supplier is required, the price quotation should be getting from at least another supplier for comparison.
- Factory Purchasing Officer has to monitor raw materials quality and the supplier's quality assurance system.
- Factory Purchasing Officer should review supplier's performance after completion of orders.
- Factory Purchasing Officer has to get the price quotation from existing supplier and prepare Purchase Order for raw materials that similar to the company's previous order within one working day upon receipt of Raw Materials Ordering Request Form from assembly staff.
- Factory Purchasing Officer has to obtain a price quotation from new suppliers within three working days upon receipt of Raw Materials Ordering Request Form from assembly staff in case of new item of raw materials.
- Factory Purchasing Officer has to complete the Supplier Evaluation Form for new supplier for the new item of raw materials, within the same day of getting the price quotation from new supplier.

Quality Procedure

Quality of finished product/Reliability of Delivery Time (3/5)

- Factory Purchasing Officer has to submit the Raw Materials Ordering Request Form along with a price quotation of selected supplier to the Factory Manager for approval within the same day of supplier evaluation.
- Factory Manager has to approve/disapprove the raw materials ordering within one working day upon receipt of all required documents.
- Factory Purchasing Officer has to prepare Purchase Order for raw materials ordering within one working day upon getting approval from Factory Manager.
- Upon receipt of raw materials, the quality control staff has to conduct quality inspection and finish it within one working day.

Guideline of Hydraulic Cylinder Manufacturing procedure is as follows.

- The Metal Cutting Officer cut the iron by using AMADA machine and HERO machine following the method mentioned in the Raw Materials Disbursement Form. Then, Raw Materials Inspection Officer checks if the cut iron is as the specified pattern and put the “QC Passed” label. Otherwise, put “QC Hold” label and follow the quality control process.
- The acceptable cut iron will be routed to the assembly section for product assembly, which follows the process mentioned in the production plan. Process here includes drilling, lathing, and tapping. The work-in-process will be inspected by the Inspection Officer. The “QC Passed” components will be routed for further assembly. The unqualified components will be put into the quality control process again.
- The qualified components will be used for hydraulic cylinder assembly in different pattern such as round type hydraulic cylinder, square type hydraulic cylinder and square type hydraulic cylinder.

The Inspection Officer will then inspect hydraulic cylinder and conduct the functional test prior to route for painting, name plate attaching and packaging.

In case the production is not as scheduled or expected to be off-schedule, the assembly section as to fill in the Postponement for Late Delivery of Merchandise Form and submit to the Head of Production at least three days before the schedule date. This information has also to be informed to salesperson.

- Head of Production has to prepare the production master plan within two working days upon receipt design drawing from Head of Engineering.

Quality Procedure

Quality of finished product/Reliability of Delivery Time (4/5)

- Assembly staff has to follow the production plan. In case of late assembly is expected, assembly staff has to report to the Head of Engineering at least two days in advance. Assembly staff performance will be noted and rewarded at the end of the year if staff can finish work faster than plan.
- Quality Control staff has to complete the WIP inspection process within one working day upon completion of WIP manufacturing.
- Quality Control staff has to complete the final inspection and functional test of finished products within the same day upon the completion of finished products manufacturing.
- Quality Control staff has to finish painting inspection within the same day of painting.

Guideline of Quality Inspection is as follows.

- Measure stroke and the maximum retraction and distraction as mentioned in the design of product. Vernier will be used for the length of up to 500 mm. with an allowance of +0,-1.5mm. and metre casket will be used for the length of more than 500 mm. with an allowance of +0, -3mm.
(Use the pressing force of 3000 ± 200 PSI)
- Measure the largeness and the length of thread. Use Thread Ring Gauge as the tester. Hold for at least one minute to see if the seal or other points leak.
- Check the completeness of the welding lines.
- Test Push and Pull Force.
- Record the information of the test in the Final Inspection of Hydraulic Cylinder Report Form.
- Summarise the cylinder testing result and find out if the inspection value is within the acceptable deviation value or not.
- Attach "QC Passed" label to the finished product if the quality is acceptable. These finished products will be routed to painting section.
- Inspect the quality of paint and sign on the "QC Passed" label.

Guideline of Name Plate Attaching is as follows.

- Prepare the name plate for number stamp.
- Stamp number on the first row which refers to the job of factory, followed by product type, month, year, and ordering of product manufactured in each month.
- Stamp job No. followed by salesperson's initial on the second row.
- Stamp the initial of cylinder type, followed by inspector's initial and manufactured date in dd/mm/yy format on the third row.
- Attach the name plate to the cylinder by drilling hole on both sides of name plate. Then, insert rivets into both holes and use hammer to fix name plate to the cylinder.
- Recheck condition of product and prepare for delivery product to customer.

Quality Procedure

Quality of finished product/Reliability of Delivery Time (5/5)

- Production staff has to finish the name plate attaching upon receipt finished product from production section by noon of each working day and pass it to the packaging section.
- Guideline for Hydraulic Cylinder Packaging is as follows.
- Put the plastic tube at the end of hydraulic cylinder thread to prevent damaging from bumping.
- Measure the hydraulic cylinder dimension.
- Cut the wrapping plastic according to the size of hydraulic cylinder.
- Put the hydraulic cylinder onto the wrapping plastic. Wrap the hydraulic cylinder.
- Attach "Final" label to specify completeness of packaging. Details of hydraulic cylinder will be included in this label.
- Hydraulic cylinder is now ready for customer delivery.
- Packaging staff has to finish packaging with in the same day of receipt finished product.

5.2 New Quality Procedure Deployment with Quality of Finished Product Emphasis

Referring to the existing hydraulic cylinder's manufacturing process explained on page 28. The KQI deployment into the existing manufacturing procedure will be emphasis more on the quality of finished products. The recommended Quality Procedure can be added to the existing procedure as follows.

1. Contract Review

Salesperson is responsible for preparing the Customer Contract Form.

The details of product specification should be mentioned in the Contract Review Form. This form will be submitted to Head of Engineering along with the Design Review Form. If the form is incomplete, a Head of Engineering is responsible for obtaining additional information from salesperson and process further. Once all required information is obtained, these forms will be submitted to Design Section for product design process.

KQI Deployment

With KQI, the following guidelines should be applied whilst reviewing customer contract.

- Complete required technical specification and other related information to the prospective customer so that all aspects of product are clearly defined.
- Ensure that the order or contract contains complete details about the type or model of the product.
- Ensure that the contract clearly indicates mutually agreed packaging, transportation, installation and other related terms.
- Ascertain whether the customer will inspect or test the product either before dispatch or on receipt.
- In case the product meets customer requirements, salesperson should discuss the proposed delivery schedule with the production section before confirming the schedule.

Example of KQI implementation is as follows. Presently, the angle of hydraulic cylinders which is the key element used in a calculation of parts production, is not included in the form. This resulted in product defect. With KQI, the hydraulic cylinders' angle should be specified in the Contract Review Form.

Moreover, the uses of hydraulic cylinders should be included in the form to enable the Head of Design and Engineering to select an appropriate parts such as U-ring and Wiper.

(See Appendix A for example of Contract Review Form)

2. Design Process

Head of Engineering will then assign Design Section to design a hydraulic cylinder per customer requirement. Once the design of product is complete, it will be passed to Head of Engineering for approval.

KQI Deployment

With KQI deployment, the following guidelines process should be strictly followed in order to create a design of product as what customer actually needs.

- Customer requirements are defined in sufficient detail so as to serve as a sound basis for design and subsequent activities.
- Following a contract review. Changes in design that do not affect the quality of the product may be needed. Such changes should be discussed with the customer and his/her agreement obtained.

With KQI implementation, the design process should follow the following steps.

2.1) Design Planning

Check the details of product specification indicated in the Contract Review Form and prepare the following information for product design purpose.

- Size of a seal

Required information is size of barrel, piston rod size, the maximum working pressure, maximum temperature, and maximum speed.

(See Appendix B for the calculation of seal size)

Then, indicate the groove of seal in the design. Parts number of all the seals used in this design has to be noted in the Design Form.

- Strength of Parts

Find the strength of each parts by using information of barrel size, piston rod size, push force, pull force and maximum working pressure. The figure of strengths will be then used in designing the product with the safety factor of more than two times.

(See Appendix B for the calculation of strength)

- Strength of Socket Screw

Find the strength of Socket screw according to Eastech Sign of Power Type 2. The Pull Force will be used in designing of product.

(See Appendix B for the calculation of parts' strength)

- Strength of Welding Area

Find the strength of welding area according to Eastech Sign of Power Type 2. The Pull Force will be used in product design.

(See Appendix B for the calculation of welding area's strength)

Then, select the seal type and indicate the groove of seal.

2.2) Product Design Drawing

The information from the previous step will be used in preparing a drawing of design. The following document has to be prepared.

- Drawing
- Calculation Sheet
- Bills of Materials

(See Appendix B for example of calculation sheet)

2.3) Prototype Manufacturing

The prototype of the hydraulic cylinder will be manufactured. The initial approval sheet has to be prepared at this stage.

2.4) Design Review

Head of Engineering is responsible for reviewing the design of product whether or not it follows the design plan and fulfil customer requirements. However, representative from related section such as salesperson, technician, manufacturing, and customer if any, has to agree with the design of product.

The product prototype has to be reviewed in the following aspects.

- review against the given information from customer and salesperson
- compare to other similar products that had been approved

2.5) Design Approval

Head of Engineering is then responsible for design approval to ensure that customer needs can be fulfilled.

Prototype testing or a test conducted by using computer has to be conducted prior to the approval of product design to ensure the product functional.

2.6) Design Amendment

The product design amendment can be processed. Other department head can propose to amend the design provided reasons of amendment. The design amendment proposal form will be submitted to the Head of Engineering for further process from step 2.5.

Each one copy of approved design form will be submitted to Head of Production, Factory Inventory Officer and Factory Purchasing Officer.

3. Raw Materials Availability

Once the specification of all parts is defined, checking for the availability and quality of raw materials will be the next stage to guarantee the quality of products. Head of Assembly is responsible for checking specification and availability of raw materials, parts and components. If parts and components are not sufficient for manufacturing product, Assembly staff has to fill in the Bills of Materials Form with the product specification details and pass to Factory Purchasing Officer.

4. Raw Materials Ordering and Inspection

Factory Purchasing Officer is therefore responsible for placing order of raw materials.

KOI Deployment

With KQI, the raw materials ordering process should follow the following guidelines.

- Select qualified subcontractors or suppliers prior to place raw materials ordering. The information from the supplier evaluation data will enable Factory Purchasing Officer to select qualified suppliers.
- If new supplier is required, the price quotation should be getting from at least another supplier for comparison.

- Factory Purchasing Officer has to monitor raw materials quality and the supplier's quality assurance system.
- Factory Purchasing Officer should review supplier's performance after completion of orders.

With KQI, the raw materials ordering and inspection procedure should be as follows.

- 4.1) Assembly officer prepares Raw Materials Ordering Request Form which includes details of specification and features of each raw materials and submits to the Factory Purchasing officer.
- 4.2) Factory Purchasing officer collects and checks the Raw Materials Ordering Request Form, and prepare the Purchased Order Form. Purchased Order will be prepared by using the supplier as criteria. One Purchased Order Form for each supplier.

Factory Purchasing officer has to follow the following guideline for the selection of supplier.

- If the specification of raw materials is the same as indicated in the Raw materials lists that the company used to order from existing suppliers, officer has to compare the price of at least one supplier.
 - If the demanded raw materials had not been ordered from any supplier, the purchasing officer has to ask for the price quotation from existing suppliers or new supplier if any.
 - Purchasing officer will then prepare the Supplier Evaluation Form (See Appendix C for an example of the form.) for new supplier or use the evaluation score for existing supplier.
 - Purchasing officer then evaluates quality of supplier and select the most appropriate supplier for further approval from Factory Manager.
- 4.3) Raw Materials Request Form along with price quotation received from suppliers will be then submitted to the Factory Manager for approval.
 - 4.4) Once the Factory Manager approved for raw materials purchasing, the Factory Purchasing officer will prepare a Purchased Order. Details of place and time of delivery has to be specified in the form.
 - 4.5) Once raw materials is delivered to the factory, Factory Inventory officer will conduct quality inspection of raw materials by using metre casket, micrometre, ply measuring comb, vernier and checking gauge and follow the following forms.
 - Raw Materials Defects Report Form
 - Raw Materials Reception Form
 - Raw Materials Inspection Form
 (See Appendix D for example of the form)

In case of late delivery, Factory Purchasing Officer has to contact supplier and ask for the expected delivery date. Number of late delivery date and reasons of late delivery has to be recorded in the Supplier Evaluation Form. Moreover, Purchasing officer has to inform Factory Manager and Head of Manufacturing for further action.

Raw materials inspection procedure is as follows.

- Check the quantity of raw materials if it is in accordance with the purchase order.
 - Record reception items in the Raw Materials Reception Form.
 - Inspect the quality by using the sampling method. The “QC Passed” label will be attached to the raw materials that quality is accepted.
 - Note and inform the QC officer for any problem regarding the quality of raw materials and related problems on the “QC Hold” label.
 - QC officer will then inform Factory Purchasing Officer for further action.
 - The “QC Passed” raw materials will be delivered for manufacturing or delivered to the stock room.
- 4.6) If raw materials is delivered completely, Factory Purchasing staff will close the purchased order file, filing related documents and pass to the Factory Manger for final approval. Then, the invoice will be sent directly to the Accounting Department.
- 4.7) Then, raw materials will be delivered for manufacturing.

5. Hydraulic Cylinder Manufacturing

Head of Production is responsible for setting a production plan for the whole process by liaise with the Head of Engineering.

KOI Deployment

Head of Production uses the Design Plan from the design process as the master plan to formulate the production plan. Machinery utilisation in production will be included in the production plan along with the daily working schedule for technicians to follow.

(See Appendix E for example of hydraulic cylinder production plan)

- The simple manufacturing process is summarised below.
- 5.1) The Metal Cutting Officer cut the iron by using AMADA machine and HERO machine following the method mentioned in the Raw Materials Disbursement Form. Then, Raw Materials Inspection Officer checks if the cut iron is as the specified pattern and put the “QC Passed” label. Otherwise, put “QC Hold” label and follow the quality control process.
- 5.2) The acceptable cut iron will be routed to the assembly section for product assembly, which follows the process mentioned in the production plan. Process here includes drilling, lathing, and tapping. The work-in-process will be inspected by the Inspection Officer. The “QC Passed” components will be routed for further assembly. The unqualified components will be put into the quality control process again.
- 5.3) The qualified components will be used for hydraulic cylinder assembly in different pattern such as round type hydraulic cylinder, square type hydraulic cylinder and square type hydraulic cylinder.

The Inspection Officer will then inspect hydraulic cylinder and conduct the functional test prior to route for painting, name plate attaching and packaging.

In case the production is not as scheduled or expected to be off-schedule, the assembly section as to fill in the Postponement for Late Delivery of Merchandise

Form and submit to the Head of Production at least three days before the schedule date. This information has also to be informed to salesperson.
(See Appendix F for example of Postponement for Late Delivery of Merchandise Form)

6. Quality Inspection

Quality inspection has to be conducted throughout the manufacturing process to ensure that finished product is at the standard level and fulfil customer requirements.

KOI Deployment

Quality Control Officer has to perform quality inspection of the work in process during the manufacturing time. Usually, the tools are metre casket, micrometer ply measuring comb, Vernier and gauge.

The simple procedure is to check the size of components and the smoothness of the work-in-process surface at the iron cutting stage prior to the lathing. This has to follow a guideline mentioned in the Raw Materials Disbursement Form.

The inspection item with the inspection tool is summarised in the table below.

Table 5.1: Rod Bushing's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Outer diameter	Vernier	Deviation specified in a design of product
2. Inner diameter	Plug gauge for inner hole measuring	
3. Length	Vernier	
4. O-Ring Grove	Vernier	
5. Width of U-Ring, Wiper	Gauge	
6. Size of U-Ring and Wiper's grove	Inner grove measuring gauge	

Table 5.2: Piston Rod's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter	Thread ring gauge	Deviation specified in a design of product
2. Length	Vernier (up to 500mm) and metre casket (> 500mm)	
3. O-Ring grove	Vernier	
4. Piston rod's surface	Sight	

Table 5.3: Barrel's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Inner diameter	Bore gauge	Deviation specified in a design of product
2. Thread diameter	Thread ring gauge, Thread plug gauge	
3. Thread length	Vernier	
4. Sharpness of inner chamfer	Hand	
5. Barrel length	Vernier (up to 500mm) and metre casket (> 500mm)	

Table 5.4: Cover End Rod's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Inner diameter	Vernier	Deviation specified in a design of product
2. Hole diameter	Vernier	
3. Thread diameter	Thread plug gauge	
4. Thread Length	Vernier	
5. Cover End Rod's length	Vernier	

Table 5.5: Front and Rear Cover's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Inner and outer diameter	Vernier	Deviation specified in a design of product
2. O-Ring groove	Vernier	
3. Body length	Vernier	
4. Drilled hole diameter	Vernier	
5. Port's thread	Thread plug gauge	

Table 5.6: Piston's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter and length	Vernier, Thread plug gauge	Deviation specified in a design of product
2. Piston's length	Vernier	
3. Inner diameter	Vernier	

Table 5.7: Port Oil's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter	Thread plug gauge	Deviation specified in a design of product
2. Port Oil's length	Vernier	

Table 5.8: Rod Clevis's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter	Vernier, Thread plug gauge	Deviation specified in a design of product
2. Inner hole diameter	Vernier	
3. Rod Clevis's length	Vernier	
4. Groove diameter	Vernier	

Table 5.9: Rod Eye's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter and length	Vernier, Thread plug gauge	Deviation specified in a design of product
2. Inner hole diameter	Vernier	
3. Rod Eye's diameter	Vernier	
4. Rod Eye's length, outer length	Vernier	

Table 5.10: Front Flang's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter and outer diameter	Vernier	Deviation specified in a design of product
2. Hole diameter	Vernier	
3. Thread diameter	Thread plug gauge	
4. Front Flang's width	Vernier	

Table 5.11: Turnion Mounting's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Inner hole diameter	Vernier	Deviation specified in a design of product
2. Turnion Mounting's thickness	Vernier	

Table 5.12: Eye Mounting's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Eye mounting's length	Vernier	Deviation specified in a design of product
2. Inner hole diameter	Vernier	
3. Eye Mounting's thickness	Vernier	

Table 5.13: Clevis Mounting's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Clevis mounting's length	Vernier	Deviation specified in a design of product
2. Inner hole diameter	Vernier	
3. Clevis Mounting's thickness	Vernier	
4. Width in between	Vernier	

Table 5.14: Bush's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Inner hole diameter	Vernier	Deviation specified in a design of product
2. Outer diameter	Vernier	
3. Bush's length	Vernier	

Table 5.15: Stay Flang's Inspection Tools

Inspection Item	Inspection Tool	Inspection Criteria
1. Thread diameter	Thread plug gauge	Deviation specified in a design of product
2. Thickness	Vernier	
3. Outer diameter	Vernier	

Once the components is fully inspected. The "QC Passed" label will be attached. Then, it will be delivered for the assembly of product. The inspection of the finished product will include the testing of product to ensure the quality of product and the attribute of product.

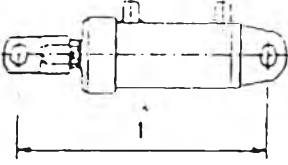
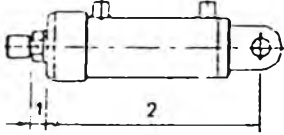
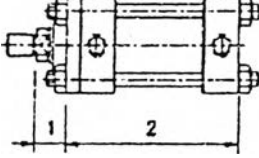
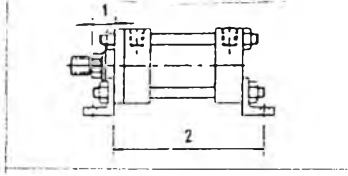
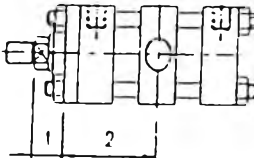
The inspection tool is similar to that of component inspection, which are metre casket, hydraulic compressor, Vernier and pressure gauge.

Final inspection with testing procedure is as follows.

- 1) Measure stroke and the maximum retraction and distraction as mentioned in the design of product. Vernier will be used for the length of up to 500 mm. with an allowance of +0,-1.5mm. and metre casket will be used for the length of more than 500 mm. with an allowance of +0, -3mm.
(Use the pressing force of 3000 ± 200 PSI)

Details of measurement is as follows.

Table 5.16: Final Inspection

No.	Type of Measurement	Method of Measuring
1.	Cylinder with Mounting in the front and the back 	Thread the axle into the inner hole of the mounting both in the front and back. Then measure the length from the center of the axle on each side as shown in the illustration picture (1). Stroke = the distance between center of the threaded axle before filling pressure into the cylinder to make the cylinder axle move to the extreme position less the most retraction position.
2.	Cylinder without Mounting in the front 	Use the Vernier to measure the bottom of thread to the Cover End Rod (No.1) and use the vernier or the metre casket measure distance from the front cover to the center of the axle at the point of mounting. Add these 2 values to get the maximum distraction value. Then, find Stroke by following a method mentioned in No.1.
3.	Cylinder without Mounting in the front and the back 	Use Vernier to measure distance (1), from bottom of Piston Rod's thread to the Cover End Rod. Use Vernier or Metre Casket to measure distance (2) from the Cover End Rod to the back of Rear Cover. Add these 2 values to find the most retracting value. Then, find Stroke by following a method mentioned in No.1.
4.	Cylinder with Foot Mounting in the Front and the back 	Use Vernier to measure distance (1), from Bottom of Piston Rod's thread to the Cover End Rod. Use Vernier or Metre Casket to measure distance (2) from the Cover End Rod to a centre of back Foot Mounting. Add these 2 values to find the most retracting value. Then, find Stroke by following a method mentioned in No.1
5	Cylinder with Turnni on Mounting 	Use Vernier to measure distance (1), from bottom of Piston Rod's thread to the Cover End Rod. Use Vernier or Metre Casket to measure distance (2) from the Cover End R Add these 2 values to find the most retracting value. Then, find Stroke by following a method mentioned in No.1

- 2) Measure the largeness and the length of thread. Use Thread Ring Gauge as the tester. Hold for at least one minute to see if the seal or other points leak.
 - 3) Check the completeness of the welding lines.
 - 4) Test Push and Pull Force.
 - 5) Record the information of the test in the Final Inspection of Hydraulic Cylinder Report Form.
 - 6) Summarise the cylinder testing result and find out if the inspection value is within the acceptable deviation value or not.
 - 7) Attach "QC Passed" label to the finished product if the quality is acceptable. These finished products will be routed to painting section.
 - 8) Inspect the quality of paint and sign on the "QC Passed" label.
- (See Appendix G for Final Inspection Form)

7. Name Plate Attaching

Name plate attaching procedure is as follows.

- 7.1) Prepare the name plate for number stamp.
- 7.2) Stamp number on the first row which refers to the job of factory, followed by product type, month, year, and ordering of product manufactured in each month.
- 7.3) Stamp job No. followed by salesperson's initial on the second row.
- 7.4) Stamp the initial of cylinder type, followed by inspector's initial and manufactured date in dd/mm/yy format on the third row.
- 7.5) Attach the name plate to the cylinder by drilling hole on both sides of name plate. Then, insert rivets into both holes and use hammer to fix name plate to the cylinder.
- 7.6) Recheck condition of product and prepare for delivery product to customer.

8. Hydraulic Cylinder Packaging

Hydraulic cylinder packaging is the final step in the manufacturing procedure. The packaging procedure is as follows.

- 8.1) Put the plastic tube at the end of hydraulic cylinder thread to prevent damaging from bumping.
- 8.2) Measure the hydraulic cylinder dimension.
- 8.3) Cut the wrapping plastic according to the size of hydraulic cylinder.
- 8.4) Put the hydraulic cylinder onto the wrapping plastic. Wrap the hydraulic cylinder.
- 8.5) Attach "Final" label to specify completeness of packaging. Details of hydraulic cylinder will be included in this label.
- 8.6) Hydraulic cylinder is now ready for customer delivery.

5.3 New Quality Procedure Deployment with Reliability of Delivery Time Emphasis

Referring to the existing hydraulic cylinder's manufacturing process explained on page 28. The KQI deployment into the process with regards to reliability of delivery time is presented below.

1.Contract Review

Apart from the KQI deployment on quality aspects, the contract review process should add the following deadline.

- Salesperson has to submit the Contract Review Form to the Head of Engineering on the same day of receipt of customer ordering.
- Engineering staff has to review the information given in the Contract Review Form on the same day of receipt the form. In case of additional of information is required from salesperson, Engineering staff has to list all questions and send it to salesperson within the same day.
- Salesperson has to obtain more information or clarify the information and submit to the Head of Engineering within two working days for made-to-stock product type and four working days for made-to-order product type.

2. Design Process

Apart from the KQI deployment on quality aspects, the design process should add the following guideline in order to speed up the process.

- Design staff has to prepare the calculation sheet within one working day after the assignment date for made-to-stock product type and two working days for made-to-order product type.
- Design staff has to prepare a drawing of design and complete it within the same day of preparing the calculation sheet for the made-to-stock product type, and three working days for made-to-order product type.
- Head of Engineering has to review and approve the product design within the same day of receiving a design for made-to-stock product, and within two working days for made-to-order product.
- For design amendment, Head of Engineering has to process and make a decision whether or not to approve the amendment of design within two working days for made-to-stock product and three working days for made-to-order product.

3. Raw Materials Availability

Apart from the KQI deployment on quality aspects, the assembly staff has to check and fill in the Bill of Materials Form and Raw Materials Ordering Request Form and submit to the Factory Purchasing Officer within one working day upon receipt of the approved design for both type of product.

4. Raw Materials Ordering and Inspection

Apart from the KQI deployment on quality aspects, the raw materials ordering and inspection process should add the following guideline in order to speed up the process.

- Factory Purchasing Officer has to get the price quotation from existing supplier and prepare Purchase Order for raw materials that similar to the company's previous order within one working day upon receipt of Raw Materials Ordering Request Form from assembly staff.
- Factory Purchasing Officer has to obtain a price quotation from new suppliers within three working days upon receipt of Raw Materials Ordering Request Form from assembly staff in case of new item of raw materials.
- Factory Purchasing Officer has to complete the Supplier Evaluation Form for new supplier for the new item of raw materials, within the same day of getting the price quotation from new supplier.
- Factory Purchasing Officer has to submit the Raw Materials Ordering Request Form along with a price quotation of selected supplier to the Factory Manager for approval within the same day of supplier evaluation.

- Factory Manager has to approve/disapprove the raw materials ordering within one working day upon receipt of all required documents.
- Factory Purchasing Officer has to prepare Purchase Order for raw materials ordering within one working day upon getting approval from Factory Manager.
- Upon receipt of raw materials, the quality control staff has to conduct quality inspection and finish it within one working day.

5. Hydraulic Cylinder Manufacturing

Apart from the KQI deployment on quality aspects, the hydraulic cylinder manufacturing process should add the following guideline in order to speed up the process.

- Head of Production has to prepare the production master plan within two working days upon receipt design drawing from Head of Engineering.
- Assembly staff has to follow the production plan. In case of late assembly is expected, assembly staff has to report to the Head of Engineering at least two days in advance. Assembly staff performance will be noted and rewarded at the end of the year if staff can finish work faster than plan.
- Quality Control staff has to complete the WIP inspection process within one working day upon completion of WIP manufacturing.
- Quality Control staff has to complete the final inspection and functional test of finished products within the same day upon the completion of finished products manufacturing.
- Quality Control staff has to finish painting inspection within the same day of painting.

6. Name Plate Attaching

Apart from KQI deployment on the quality of product, production staff has to finish the name plate attaching upon receipt finished product from production section by noon of each working day and pass it to the packaging section.

7. Hydraulic Cylinder Packaging

Apart from KQI deployment on the quality of product, the packaging staff has to finish packaging with in the same day of receipt finished product.

With KQI deployment in terms of delivery time, a lead time in manufacturing process is set with standardisation. This enables the company to have a better plan in manufacturing starting from receiving order from customers until the end of the process. At present (before the development of Quality Procedure), timing of each activity is not set with the deadline. Staff in each area does not a direction of how fast and efficient should the work be processed. Therefore, this recommended procedure will enable the company to operate and manufacture in more efficient way. In addition, the planning, monitoring and controlling of manufacturing process can be ease with this new procedure.

Changes in terms of lead time in cylinder manufacturing process is a useful criteria for comparing the improvement of days used in the whole manufacturing process. However, there is no guideline on the deadline for each activity or the actual number of days used in manufacturing at this moment. Due to a lack of data reason, lead time of new procedure will be compared with an average number of days used in

each activity. This data again is not available. Therefore, the only source of data is from the ABC's factory manager, in which the accuracy of data can not be proved. The author sees this as a major constraint in comparing the result of new quality procedure implementation.

The author recommends the company to use the result during the two-month trial phase as a comparing base, in which the next cycle result of implementation can be compared. The company will only see the actual improvement after cycles of implementation which can not be included in this research due to a limited of time.

Changes in manufacturing lead time of the new quality procedure in each activity with KQI deployment can be summarised in the table below.

Table 5.17: Changes in Manufacturing Lead Time

Activity	Existing Procedure	New Quality Procedure		
	No. of Days	Deadline		No. of Days
		Made-to-Stock	Made-to-Order	
Contract Review 1. Salesperson submit Contract Review Form to Head of Engineering 3. Engineering staff review Customer Contract Review Form 4. Engineering staff inquire for additional information from salesperson 5. Salesperson obtain more information from customer	2 days	On the same day of receipt of customer ordering		Total Maximum Of 1 Working day
	7-20 days	On the same day of receiving a complete Contract Review Form		
	N/A	On the same day of receiving Contract Review Form		
	3-7 days	Within two working days	Within four working days	1-4 days
	Design Process 1.Design staff prepare a calculation sheet 2.Design staff prepare a drawing of design 3. Head of Engineering review and approve the product design 4. For design amendment. Head of Engineering review and approve the amendment of design	1-3 days	Within two working days	
2-5 days		Within the same day of calculation sheet preparation	Within three working days after preparation of calculation sheet	
2-4 days		On the same day of receiving design of product	Within two working days	1-2 days
N/A		Within two working days	Within three working days	1-3 days

Table 5.17: Changes in Manufacturing Lead Time (continued)

Activity	Existing Procedure	New Quality Procedure		
		Deadline		No. of Days
		Made-to-Stock	Made-to-Order	
Raw Materials Ordering and Inspection				
1. Factory Purchasing Officer gets a price quotation and prepare purchase order for raw materials similar to previous order	N/A	Within one working day upon receipt of Materials Ordering Request Form		1 day
2. Factory Purchasing Officer gets a price quotation for new items of raw materials	N/A	Within three working days upon receipt of RM Ordering Request Form		1-3 days
3. Factory Purchasing Officer prepares the Supplier Evaluation Form of new supplier	N/A	Within the same day of getting price quotation from new supplier		1 day
4. Factory Purchasing Officer submit RM Ordering Request Form and price quotation to Factory Manager for approval	N/A	Within the same day of preparing the Supplier Evaluation Form		
5. Factory manager approve/disapprove the RM ordering	1-3 days	Within one working day upon receipt of all required documents		1 day
6. Factory Purchasing Officer prepare a purchase order	1-3 days	Within the same day of getting approval from Factory Manager		
7. Quality control officer conducts quality inspection	1-3 days	Within one working day of receipt of raw materials		1 day
Hydraulic Cylinder Manufacturing				
1. Head of Production prepares the production master plan	1-3 days	Within two working days upon receipt design drawing from Head of Engineering		1- 2 days
2. In case of late assembly, the assembly staff has to report to the Head of Engineering	N/A	At least two days in advance		N/A
3. Quality Control Officer conduct the WIP inspection	2 days	Within one working day upon completion of WIP manufacturing		1 day
4. Quality Control Officer conduct the finished product inspection	2 days	Within the same day upon completion of finished products manufacturing		N/A
5. Quality Control Officer conduct the painting inspection	1 day	Within the same day of painting		N/A
Name Plate Attaching				
1. Production staff attach the name plate	1 day	With in noon of each working day of all products receipt from production section by noon		½ day
Hydraulic Cylinder Packaging				
1. Packaging staff is responsible for product packaging	2 days	Within the same day of receipt finished products		N/A

The given information reveals that the total number of days used in manufacturing process excluding the manufacturing period ranges from 29+days (information is not available for some activities) to 61 days. The main cause is because no guideline has been set for each activity, despite the capacity of resources is available.

The above table shows that the total number of days used in manufacturing process excluding the manufacturing period, after applying the new quality procedure ranges from 12 ½ days 18 ½ days for made-to-stock product type and from 12 ½ days to 29 days for made-to-order product type.

It shows that the total number of days used in the manufacturing procedure excluding the production time can be improved if the recommended procedure is strictly followed. The improvement in the earlier stage might be less than the later. The backlog order has to rectify. The transitional period is difficult to set accurately at this time. Also, the actual result in terms of improvement depends on many factors such as capability of staff, company's reward system, operational monitoring and controlling system, staff's motivation and morale.

The author then asked for kind cooperation from the top management of the company for a kind cooperation in other supportive areas mentioned above.

The recommended changes in each activity of the manufacturing procedure will be implemented during the two months trial period. The result of implementation will be presented in the next chapter.