Chapter 18: IONICS Process 4—Install Risk Control Solutions

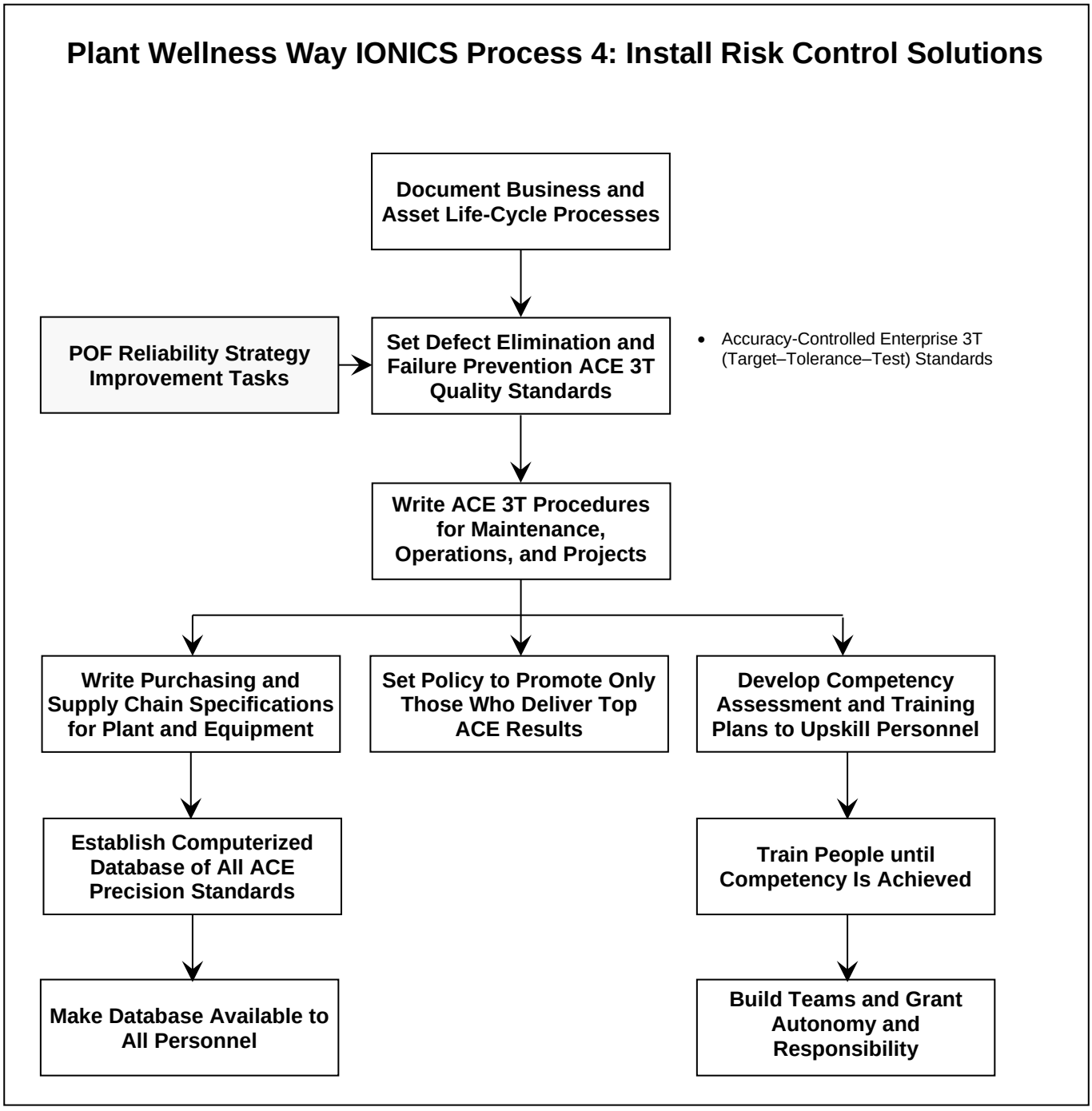


Figure 18.1—IONICS Process 4 Steps

Summary Description of Process 4: Introduce Risk Controls

Once a mix of operating risk controls is chosen and proven on a risk matrix to be useful and effective, those controls need to be introduced into your business. Because the current business processes are producing your current business outcomes, the new risk management controls must be put into the old processes to improve work performance and company results.

Infuse Your Processes with Defect and Failure Elimination Actions

Identify all the business processes to be enhanced with the new defect elimination and reliability creation standards and practices. Typically, these will be all of the processes across the organization's lifetime that affect operational success and equipment reliability.

Set Operating, Maintenance, and Engineering ACE Quality Standards

Set quality standards for the reliability improvement activities identified in the Physics of Failure Reliability Strategy Analysis. Meeting those standards will produce the operating equipment performance and high reliability you want from your plant. This will require you to set "good," "better," and "best" quality standards to produce healthy, long-lived, trouble-free equipment. Some research will be required to determine the appropriate value ranges for job tasks and to decide which tests to use to confirm compliance with the quality standards.

Write ACE 3T Procedures

Every job requires procedures that will deliver highly reliable results. The person doing the work needs to understand the excellence and accuracy required of the job. To ensure adoption of the correct operating risk controls and to transfer them to the company's management, staff, and employees,

good, better, and best quality standards need to be made a part of your business processes by writing them into all relevant documents. Doing so will make them standard operating procedures that will be taught to and applied by all users. The day will come when world-class performance is the only way the people in your company will know how to work.

In an Accuracy-Controlled Enterprise, the quality standards that will take your operation to world-class performance are embedded in work tasks as target, tolerance, and test requirements. Because we seek to prevent process variation and control outcomes, a world-class target range is set for all outcomes of a process. Around that target, we identify the worst acceptable range of quality as the tolerance. Finally, you define a test to prove what quality is being achieved.

Write Plant and Equipment Procurement and Service Provider Specifications

The performance standards that you set for your company are the minimum equipment and service specifications that every vendor in your supply chain must meet. They define the performance that your equipment is expected to deliver and the quality standards that will deliver those results. Specific targets must be set with measures to prove that a vendor's performance meets the standard.

Develop a Computerized Knowledge Database for All to Use

The ACE standards, specifications, and procedures should be put into a database that everyone in the company can access. They are valuable best practices and important corporate knowledge to be used all the time. Your people will get the right information to run the operation in the best way to ensure least operating risk.

Make Delivery of Defect Elimination and Failure Prevention Everyone's Duty

Include in management, supervisory, staff, employee, and contractor duty statements and position descriptions the requirement to deliver ACE work quality results. Make it clear that recruits for future vacancies will be drawn from those who deliver high-quality performance. You will become a world-class operation faster and for the least cost when your staff and employees know that the best way to advance in their career is to deliver defect-free work of high reliability that eliminates the possibility of future problems.

Develop Training and Competency Improvement Plans

With performance standards and 3T procedures set, develop training plans to lift the competency of managers, engineers, supervisors, staff, and workers to meet the required ACE performance.

Build Autonomous Cross-Functional Teams

Establish cross-functional teams of people who are responsible for running a process. Subdivide large processes into smaller ones if necessary. Whether you are making a product or providing a service, use series and parallel reliability principles to build teams that have the skills and knowledge to do the required work competently. Remove all direct management supervision of the team and instead provide training to team members to develop the knowledge and skills they need to work as a team. You want to create teams with positive spirit. Let the team members share in the additional operating profits they generate above the best historical average. This will challenge them to seek better solutions while being recognized for the value their efforts bring the organization.

Setting ACE 3T Requirements

The Accuracy-Controlled Enterprise ensures defect and failure prevention by introducing quality controls for POF cause mechanisms so that work is done correctly to eliminate each mechanism or minimize the chance that any will occur. It incorporates the "Carpenter's Creed"—measure twice, cut once—into job tasks. It uses parallel arrangements to error-proof work and lift the certainty of right performance to incredibly high levels. Process steps in an ACE have double-checks in every task. No task step is complete until it is proven to be right.

There are simple rules to use when setting the quality values in a 3T procedure. The "best" target is always the current best practice for the task. The "good" tolerance is always the most demanding original equipment manufacturer (OEM) specification. The "better" value is a stretch goal that is one-third to halfway between good and best. The test is the simplest way to check that the outcome is within tolerance. With a proof test paralleled to a work task, the two activities combined greatly lift the chance of task success. Even if a task is done wrong the first time, there is an almost certain chance that the error will be found during the test and corrected.

The best value is typically found in the books and articles written by subject matter experts. Sometimes recognized international standards identify best values. When using published standards, pick the most demanding performance as the best outcome to achieve. When it is not possible to find the best practice for the target value, make it a magnitude better than the tolerance value.

If there is no OEM value for a task, use your industry's standard as the good value; otherwise, a suitable international standard or code of practice can be applied. You can also choose to use your organization's current standard as the good value. The "good enough" value that you

use must be a fair representation of the currently accepted performance in your operation for the activity. It is the baseline from which your people will grow to become the best in your industry.

Don't set the bar low for best quality—set demanding world-class standards. The ACE 3T procedure-writing method is a psychological device to help people become great at their work. As your people learn to deliver better and then best results, you will progress faster and faster toward world-class reliability. The psychology of ACE 3T is to give your people a challenge to rise up to. They are challenged by the better and best values to outperform their past results. They will become proud of their work and of themselves. They will earn the respect of their peers, supervisors, and managers. They will be valuable, happy, highly productive people.

The practical, simple ACE method for performing masterly work with accurate results means that wasted cost and effort will become new operating profits. The ACE method of failure prevention and defect elimination permanently improves productivity and delivers new production and profits because losses disappear as job after job is done 100% correctly the first time. You can turn a poorly performing operation into a star performer simply by changing the processes and practices used by its people to ACE 3T methods. Everyone can do great work once they know the right things to do and have a sound and reliable method to help them do their job right.

Examples of Accuracy-Controlled Procedures

Accuracy-controlled procedures are simple for users but impose demanding requirements on those writing the procedures. ACE procedure writing starts by drawing a process map of the procedural steps. Each process step is given a three- to four-word description that explains the purpose of the step. For each process step, summarize what happens in that step. Boxes below each process step bullet point the step procedure and/or provide information and explanation. Above the step

description, list all of the step performance indicators so that everyone knows what each step is meant to do. Using a flowchart layout of process steps with their procedures and performance indicators on a single page helps people quickly understand the process design, know what is important to monitor and measure, and find new process improvements.

Table 18.1 can be used as a template for writing an ACE 3T procedure. Tolerance is subdivided into good, better, and best ranges, with the target listed in the "best" column, and a test is specified for each task. You also advise the user what to do if the tolerance is exceeded. Tell people what they must do if they can't meet the quality standard, as they will get distressed when they find a problem they cannot fix. It's human nature to get upset when things go wrong. Simply tell them what they need to do—the "emergency procedure" they will follow when they face trouble. Procedure layouts are flexible, and formats can be altered to suit an organization's existing templates. It is the inclusion of the 3Ts in each task that is the vital ingredient that must always be present in a procedure or a detailed work instruction.

Task Step No.	**Task Step Owner**	**Task Step Name**	**Materials, Tools, and Their Condition**	**Full Description of Task**	**Test for Correctness**	**Tolerance Range**			**Actual Result**	**Action if Out of Tolerance**	**Sign-Off**
		(3–4 words)		(Include all tables, diagrams, and pictures)	(Include diagrams and pictures)	Good	Better	Best			
1	2	3	4	5	6	7	8	9	10	11	12

Table 18.1—Sample ACE 3T Procedure Layout

When writing the procedure for a job, be clear why the job is in the business. When the procedure is read by users, you want them to get the right mind-set of wanting to do excellent work in a timely manner. Identify the process in which the job is used and its importance. Explain the purpose of the job. Indicate all the people who are affected by the work so that the consequences of poor quality and the necessity of doing each task thoroughly and correctly are clear.

In the procedure or work instruction incorporate the 3Ts of defect elimination into each work task. This provides accuracy control and allows users to clearly identify the quality requirements they need to meet. They must prove that they have met those quality standards before going on to the next task. Explain every step in a task in detail, using words and including images wherever possible, and even access to short films showing correct practice. Visual explanations improve understanding, and they should be used liberally in your procedures. Define and explain the information flows, the data to be collected, and the records needed. The procedure can be used as a quality control form to record results and collect evidence of quality assurance.

Two examples of an ACE procedure follow. The first, for a clerical task, sets pass/fail criteria for each activity. In situations in which the output is either right or wrong and no tolerance range exists, you set “accept/reject” standards. A task is not complete until it meets the “accept” criterion. An accept/reject procedure can be turned into an ACE 3T procedure by introducing fair and reasonable target, tolerance, and test quality standards. You intentionally install performance requirements into a job, task, or activity by specifying factors such as timeliness, workplace cleanliness, percentage compliance achieved, condition of the equipment used, calibration of tools, or other factors that influence the quality of work results and productivity.

The second procedure, for bolting up an 80 mm pressure pipe flange, is written in the full ACE 3T format. This procedure sets the standard and quality to be achieved for each task in the job. The workmanship quality and standard of work is not left to the discretion of the person doing the work. An ACE 3T procedure clearly states the minimum acceptable outcome in the “good” column and defines top-class performance in the “best” column. This approach to error-proof work provides a practical and sure way to control task quality regardless of who does the job. Everyone

knows what "good enough" is—anything less is unacceptable. Everyone also knows what top-class work is, and they are encouraged to strive for it.

Clerical Example: Cost Report Spreadsheet Accept/Reject Procedure

Figure 18.2 is a flowchart of the process steps for assembling the information required for a management report. Table 18.2 contains the procedural steps and quality requirements. The procedure opens with a statement to explain the importance of the work. The intention is to get the person compiling the report to commit to doing a good job because so much else depends on the accuracy and the quality of what he or she does.

Compile and Develop the Monthly Cost Report

Importance of developing an accurate and useful report: This procedure explains in detail how to create the department's monthly production costs summary spreadsheet. Your department manager and the cost accountants use it to make their monthly business performance reports. Any errors will flow through to the monthly report presented to the head office. The procedure is our current best practice, and you should follow it exactly. It is the result of many people's efforts over many years. It is the quickest, best way to do the job. You are encouraged to learn the job exactly as it is documented. If, after you master this procedure, you see a way to improve it, please bring your idea forward for discussion. You can test your idea and compare it with the procedure. If your suggestion proves to be better, it will become the new way of doing this job.

The people affected by the job: Department, Senior and Executive Management, and ultimately everyone in the company.

Necessary equipment and tools: Computer, national monthly production computer file, national monthly production hard copy file.

Task summary: Below is a summary of the process for completing the spreadsheet. A fully detailed procedure is beneath the list. If you have a problem that you cannot solve, please see your supervisor.

1. Find spreadsheet
2. Bring up spreadsheet
3. Select worksheet
4. Get hard copy folder
5. Return with hard copy
6. Record monthly total
7. Cross-check totals
8. Totals don't agree
9. No spreadsheet error
10. Hard copy checked
11. Update spreadsheet
12. Totals agree

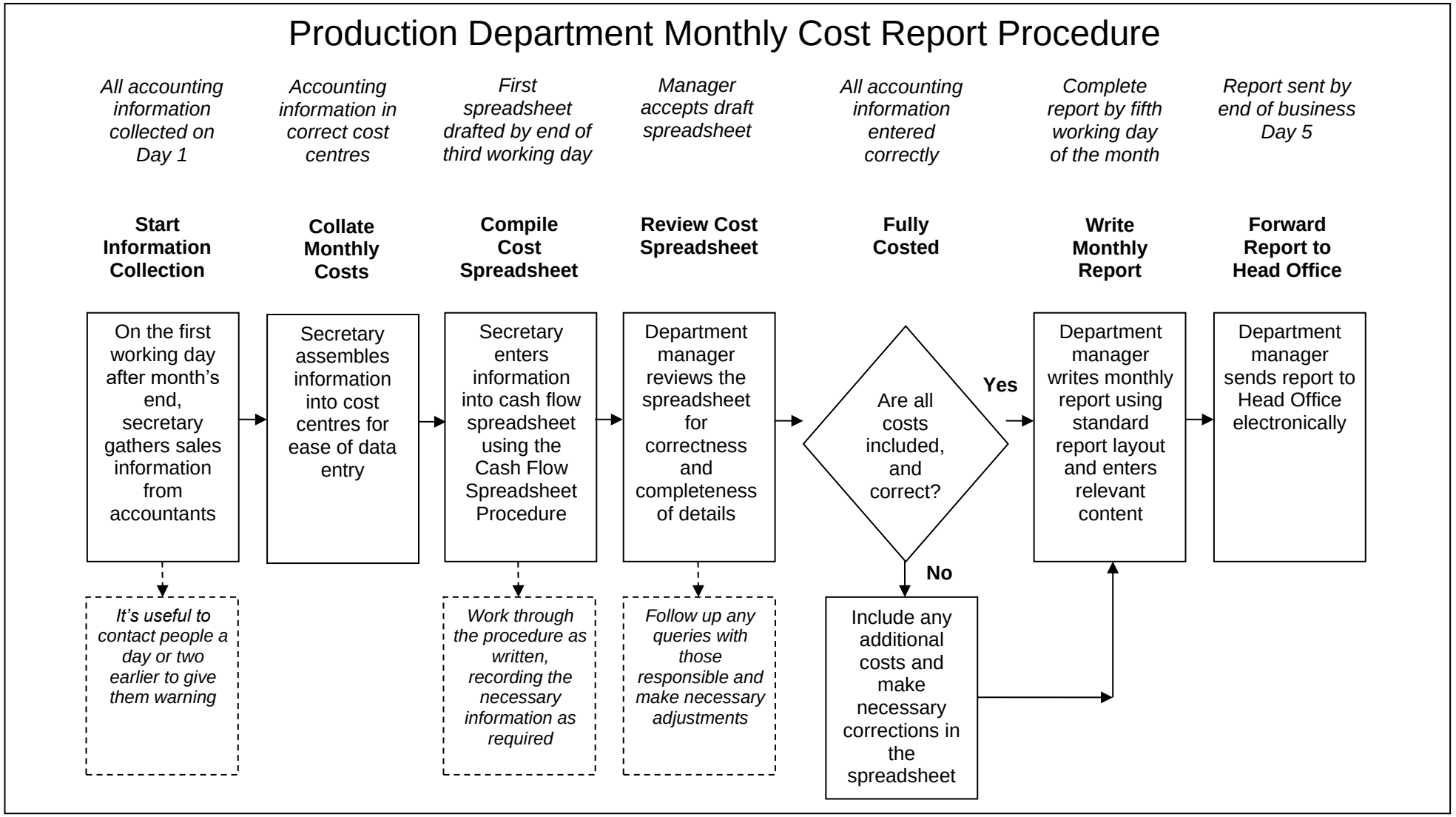


Figure 18.2—Process Map of Cost Report Procedure

Task Step No.	Task Step Owner	Task Step Name	Full Description of Task	Test for Correctness	Actual Result	Initial after Complete
1.	Office clerk	Find spreadsheet	Find the shortcut on the screen called "National Monthly Production." *[You would also insert a screen image showing the item]*	See the icon called "National Monthly Production"		
2.	Office clerk	Bring up spreadsheet	Make spreadsheet ABC active on computer by double-clicking the icon. *[You would also insert a screen image showing the item]*	Note that the name on the spreadsheet is "National Monthly Production"	*(Place spreadsheet name here.)*	
3.	Office clerk	Select worksheet	Bring up the worksheet called ABC-1. *[You would also insert a screen image showing the item]*	See that the name on the SOP and actual worksheet is ABC-1.	*(Place worksheet name here.)*	
4.	Office clerk	Get hard copy folder	Get the "National Monthly Production" folder in the top drawer of the National Sales filing cabinet in the Sales Office.	Read the file name and see that it is called "National Monthly Production."		
5.	Office clerk	Return with hard copy	Return to your desk and open the folder to the Total National Production Report.	See page has the title "Total National Production Report"		
6.	Office clerk	Record monthly total	Total the "Purchase Price" column for the month and put into cell D8. *[You would also insert a screen image showing the item]*	Check that cell D8 has the monthly total.	*(Could also record monthly total here.)*	
7.	Office clerk	Cross-check totals	Check that the total for "Purchase Price" in the hard copy folder and the spreadsheet are the same.	Both totals are the same.	*(Record the total.)*	
8.	Office clerk	Totals don't agree	If the two numbers are not the same, check that the formula in the spreadsheet matches the correct cells. *[You would also insert a screen image showing the item]*	Check that all individual cells are picked up by the formula in the total cell.		
9.	Office clerk	No spreadsheet error	If the spreadsheet is correct, the error lies in the hard copy file. Report the error by telephone to the national production manager.	Call the national production manager.		
10.	National production manager	Hard copy checked	Confirm that the totals of individual sales are recorded correctly and ring back the correct individual production figures.	National Managers advises each figure.		
11.	Office clerk	Update spreadsheet	Correct the figures in the spreadsheet with the correct values and confirm that the totals are now correct.	Double-check the new total against hard copy file total.	*(Record the correct total.)*	
12.	Office clerk	Totals agree	If the totals in both documents agree, the job is complete. Save the spreadsheet, print a copy for the manager to review, close the electronic file, and return the hard copy file to the office filing cabinet.	See that spreadsheet is saved and the file is returned.		

Table 18.2—Accept/Reject Cost Report Procedure

Industrial Example: Flange Connection Procedure with ACE 3T Tolerance Banding

This is an example of an ACE 3T procedure with tolerance bands for bolting together 80 NB, ANSI B36.5, forged steel, Class 150 flanges. Each task has quality ranges divided into good, better, and best performance. You must also provide instruction on what to do if the tolerance is not achieved. Figure 18.3 is a flowchart of the process steps. Table 18.3 lists the technical details applying to the work. Table 18.4 contains the procedural steps and quality requirements. The procedure opens with a statement explaining the importance of the job.

DISCLAIMER: The example covers the method for creating a 3T procedure and is not the actual procedure for bolting up flanges. Each organization must research, develop, and approve safe practices and procedures for bolting flanges. The use of turn-of-nut on pressure flanges may not comply with the applicable pressure piping design codes.

Pressure Pipe Flange Connection Procedure

Importance of correctly mating flanges: This procedure explains how to correctly bolt up pipe flanges on 80 mm (3 inch) diameter pipe. Pipe flanges must be bolted up so that they do not leak. Dangerous chemicals leaking from pipe flanges are a safety and environmental hazard that can lead to the death of workers and the destruction of production plant and equipment. Even a water leak from a flange can cause a slip hazard and make an unsightly mess. The procedure is our current best practice, and you should follow it exactly. It is the result of many people's efforts over many years. It is the quickest, best way to do the job. You are encouraged to learn the job exactly as it is documented. If, after you master this procedure, you believe that you can improve it, please

bring your idea forward for discussion. You can test your idea and compare it with the procedure. If your suggestion proves to be better, it will become the new way of doing this job.

The people affected by the job: All Operators, maintainers, and workplace staff and employees passing by the flange in future.

Necessary equipment and tools: Gasket, ring spanners (do not use adjustable shifters and pipe wrenches as they damage corners of bolt heads and nuts making their removal dangerous and unsafe), suitably load-rated studs and nuts, pencil.

Task summary: Below is a summary of the process for installing gaskets and making flanges. A fully detailed procedure is beneath the list. If you have a problem that you cannot solve, please see your supervisor.

1. Get work pack, tools, new fasteners, and new gasket
2. Get safe handover isolated and pipe drained
3. Place personal danger tags and test if drained
4. Break and spread flange safely
5. Clean up flange faces
6. Check and correct unrestrained pipe alignment
7. Check and correct bolt hole alignment
8. Mount gasket and insert fasteners
9. Pull up fasteners snug tight in sequence
10. Mark nut position and turn angle past snug
11. Turn nuts to position in sequence
12. Test flange for leakage at operating pressure

13. Safely clean up, hand back, complete job record and sign off on work order

The process map in Figure 18.3 showing the flange bolting procedure. It is not normally included in the workplace document. It is included here to show that the work is a series process and that bad quality outcomes at any stage will produce defects that cause leaks in the future.

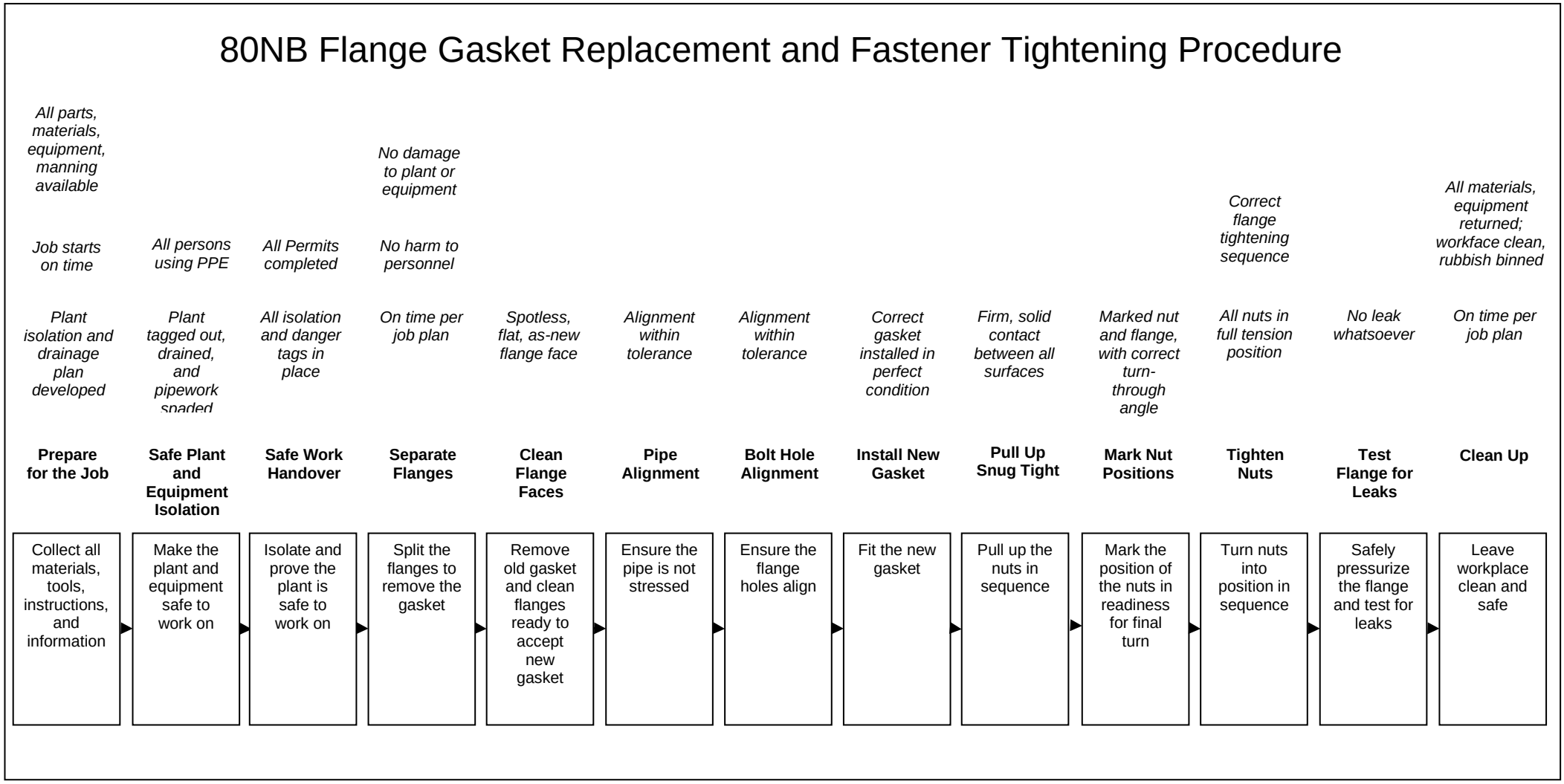


Figure 18.3—Process Map of Flange Connection Procedure

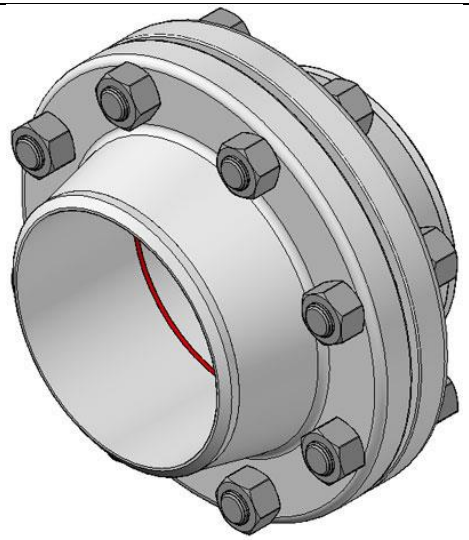
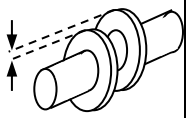
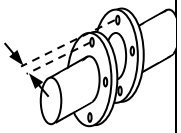
<table>
<tr><th>Bolt Size</th><th>Bolt Grade</th><th>Bolt Torque</th><th>Tolerance on Torque</th><td rowspan="3">  </td><th>Engineering Standards</th></tr>
<tr><td>5/8”</td><td>A193 B7 stud and nut</td><td>201 Nm (60% Yield)</td><td>±15% with torque wrench</td><td><u>Flange Squareness</u>:
Good: Within 1 mm for every 200 mm diameter
Better: Within 0.75 mm for every 200 mm diameter
Best: Within 0.5 mm for every 200 mm diameter</td></tr>
<tr><td></td><td></td><td>½ turn from snug tight</td><td>½ to 5/8 turn</td><td><u>Stress-Free Flange Bolt Hole Alignment</u>:
Good: Centres within 2 mm
Better: Centres Within 1.5 mm
Best: Centres within 1 mm</td></tr>
<tr><td colspan="4">Gasket: Non-asbestos fibre, 1.5 mm thick, ring, grade as noted on work order</td><td><u>Bolt Lubricant</u>: Molybdenum disulphide</td></tr>
</table>

Table 18.3—ACE 3T Industrial Procedure Engineering Information

Task Step No.	Task Step Owner	Task Step Name (3–4 words)	Task Description	Materials, Tools, and Their Condition	Test for Correctness (Include diagrams and pictures)	Tolerance Range Good	Better	Best	Reading/ Result	Action if Out of Tolerance	Sign -Off
1	Technician	Prepare for the job	Gather new studs and nuts, washers, gasket, thread paste, tools, job work order, danger tags, handover permit, special instructions, PPE	5/8" ring spanner or socket, podgy spike bar, screwdriver, scraper	All materials and tools are on the job before starting the job	Request and collect issued items from store	Planner arranged all items ready for issue from Store	Planner has all items at job and job is ready to do		Only start work once all requirements are gathered	
2	Technician	Inform operator	Contact operations personnel responsible for plant isolations and handover		Handover preparation and documents correctly done	Contact operator when ready to start job	Operator has plant off-line awaiting work	Operator has plant isolated, tagged, and drained		Job can only start when Operations safely handover plant and piping	
3	Technician and plant operator	Make workplace safe	Place personal danger tags at isolation points and accept plant handover after proving isolations and drainage	Danger tags	Isolation procedure is correctly done and proven safe	Operator and repair man walk circuit and identify and tag isolations and open drains	Operator has isolated plant & tagged isolations out-of-service & drained piping	Operator has isolation point drawing and walks circuit to show previous tagged isolations and open drains		Only start work when piping is fully drained and proven to be empty and possible gas build-up vented	
4	Technician	Separate flanges	Release tension on exiting fasteners gradually in tightening sequence. Remove one fastener at a time but leave the last fastener loosely in place if pipe springs unexpectedly, spring flanges with podgy bar	5/8" ring spanner or socket, anti-seize liquid	All fasteners removed without damage to flanges or harm to personnel or other property	Back-off all nut's half a turn in sequence and then a full turn, removing all fasteners but last one. Spring flanges with podgy	Back-off all nut's half a turn in sequence and then a full turn, catch any drops of product from flange in suitable container, remove all fasteners but last one. Spring flanges with podgy	Cover fasteners with anti-seize, back-off nuts half a turn in sequence and then a full turn, catch any drops of product from flange in suitable container, remove every second fastener and finally all fasteners but last one. Spring flanges with podgy		If flange does not spread easily review the situation and consider use of hydraulic spreader or wedges without damaging flange faces	
5		Clean flange faces	Remove old gasket and clean flange faces, remove any burrs, check face is flat with straight metal ruler and 0.05 mm shim in gaps, no draw marks, pits, or scratches allowed across flange face	25 mm wide metal scraper, 80 grit emery cloth	Flange face are totally clean and safely usable	Loose material removed, burr-free, flat face, no draw marks or pits deeper than 0.25mm	Grooves clean, face sanded, flat face, no draw marks, or pits	Bright, smooth, flat face, no groove damage or pitting, as good as new		Replace or machine flange with identical rating and grade if pits are deep, or are in close clusters, or not flat *(pictures would be necessary)*	
6		Pipe alignment	Check unrestrained pipe alignment	5/8" ring spanner x 2, or socket and ring spanner	Measure misalignment with vernier callipers on flanges with studs	Flanges are unbolted and are in-line to within 2 mm	Flanges unbolted and are in-line to within 1.5 mm	Flanges unbolted and are in-line to within 1 mm		Cut pipe and remount flange to bring unrestrained flanges to within 1 mm alignment and 0.5 mm squareness to applicable procedure for the pipe material and grade	

Task Step No.	Task Step Owner	Task Step Name (3–4 words)	Task Description	Materials, Tools, and Their Condition	Test for Correctness (Include diagrams and pictures)	Tolerance Range Good	Better	Best	Reading/ Result	Action if Out of Tolerance	Sign -Off
					removed 						
7	Tradesman	Bolt hole alignment	5/8” ring spanner x 2	Check bolt hole alignment	Measure with vernier callipers on flanges with studs removed 	Flanges unbolted and holes in line to within 2 mm	Flanges unbolted and holes in line to within 1 mm	Flanges unbolted and holes in line to within 0.5 mm		Cut pipe and realign flange to bring hole alignment of unrestrained flanges to within 0.5 mm	
8		Install new gasket and fasteners	Mount gasket and insert fasteners. Pre-cut studs to length and de-burr so that two full threads protrude out of each nut when fully tightened. Lightly lubricate the studs and the face of the nuts in contact with the flange.	Approved new gasket, new studs and nuts, bolt lubricant, podgy bar	Only new gasket and new fastener components used	Gasket slid between flanges and centred without damage and new studs/nuts fitted by hand	Gasket slid between flanges without and centred damage and studs/nuts lightly, pre-lubricate and fitted by hand within 2 minutes	Gasket slid between flanges and centred without damage and studs/nuts lightly, pre-lubricate and fitted by hand within 1 minute			
9		Bring flanges together	Pull up fasteners snug tight in cross tightening sequence. Sung means flanges are in firm contact under about 20% of final bolt torque. It is obtained by the full effort of a well-built man pulling on a ring spanner until it can no longer be moved by hand. It can also be achieved by use of an impact wrench. When the spinning nut turns to blows, count three blows, and the bolt will be snug tight.[a]	5/8” ring spanner or socket, feeler gauges	Flanges come together square with stress-free alignment	Wind nuts onto studs by hand so studs extend equal distance either side of flange. Tighten nuts finger tight and check that flanges are parallel to an accuracy of 0.4 mm with the feeler gauges. Pull all nuts on both flanges up sung tight in correct sequence.	Wind nuts onto studs by hand so studs extend equal distance either side of flange. Tighten nuts finger tight and check that flanges are parallel to an accuracy of 0.2 mm with the feeler gauges. Pull all nuts on both flanges up sung tight in correct sequence within 5 minutes	Wind nuts onto studs by hand so studs extend equal distance either side of flange. Tighten nuts finger tight and check that flanges are parallel to an accuracy of 0.1 mm with the feeler gauges. Number the studs in the sequence of tightening. Pull all nuts on both flanges up sung tight in correct sequence within 4 minutes		If flanges are not parallel, directly 180° degrees opposite widest part of indicated gap, loosen nuts one or more turns. Return to segment with gap and tighten until both flanges are in contact with gasket. This is necessary to prevent flange levering over the fulcrum formed by the outer edge of the two raised faces at points in contact with gasket. The restriction will cause exceptionally high flange to gasket clamp loading	

Task Step No.	Task Step Owner	Task Step Name (3–4 words)	Task Description	Materials, Tools, and Their Condition	Test for Correctness (Include diagrams and pictures)	Tolerance Range Good	Better	Best	Reading/ Result	Action if Out of Tolerance	Sign -Off
										at this point, with possible damage to gasket, plus diverting necessary clamp loading bolt torque energy to correcting alignment on the opposite segment.	
10		Match mark fasteners	Match-mark nut position **on one flange only** with a pencil when all nuts on both flanges are snug.	Pencil	Scribed marks in correct position and easily observable	Match-mark the nut and flange	Clearly match mark the nut and flange within 1 minute	Clearly match-mark the nut and flange within 45 seconds			
11		Tighten fasteners	Turn each nut **on one flange only** an extra 1/3 turn to final position in cross tightening sequence. Re-tension continuously until all nuts are equally tight. No rotation of stud is permitted while tightening the nut.	5/8" ring spanner or socket, impact wrench	Fasteners correctly tensioned to required nut position in right tightening sequence	Tighten nuts 1/4 turn in cross-sequence and finally tighten nuts to 1/3 turn in cross-sequence.	Tighten nuts 1/4 turn in cross-sequence and finally tighten nuts to 1/3 turn in cross-sequence in 5 minutes.	Tighten nuts 1/4 turn in cross-sequence and finally tighten nuts to 1/3 turn in cross-sequence in 4 minutes.		If a stud starts to rotate as the nut is tightened it indicates that the nuts were not snug to start with. Immediately stop and undo all studs and repeat nut snug tensioning procedure.	
12		Test for leaks	Test flange for leakage at operating pressure, release pressure and retighten nuts on same flange as originally tightened		No leak whatsoever at full operating pressure	No leak whatsoever at full operating pressure	No leak whatsoever at full operating pressure	No leak whatsoever at full operating pressure			
13		Clean and hand back	Safely clean up, hand back, complete job record, and sign off and record work order history		All equipment, tools and waste removed; area left spotlessly clean	Recommission procedure is written, reviewed, and correctly done and plant proven safe for continued use	Recommission procedure is written, reviewed, and correctly done and plant proven safe for continued use	Recommission procedure is written, reviewed, and correctly done and plant proven safe for continued use			
DISCLAIMER: *The example covers the method to use to create a 3T procedure and is not the actual procedure to use when bolting-up flanges. Each organisation must research, develop and approve their safe practices and procedures for bolting flanges. The use of turn-of-nut on pressure flanges may not comply with the applicable pressure piping design codes*.											

Table 18.4—An ACE 3T Industrial Procedure

FOOTNOTE:

a. Alan T. Sheppard, High Strength Bolting, The DuRoss Group, Inc.

Competency Assessment and Training Plan

Once standards of quality are set in a job, you can measure compliance of the delivered outcome. The purpose of having quality standards is to guide an organization and its people to achieve them deliberately and consistently. That includes helping those doing the work learn how to produce more successful results. If your people are not consistently within tolerance of a quality standard, they are putting defects into what they do. It's an unacceptable situation that must be addressed whenever it arises.

A fair approach when people are not meeting their standards is to ask them what can be done to get them to reliably meet all task quality requirements. Let them propose a successful solution. If they can implement the solution themselves, help them do so quickly. If they require further training to produce higher-quality results, then add courses to their training plan. If capital expenditure is needed to guarantee the specified quality, then add the costs into the capital budget and get the equipment into use as fast as possible. If, after all that can be done for them has been, they still cannot consistently deliver the required quality, it is necessary to put them into a different job that they can do competently and appoint a proficient replacement.

Set Up Cross-Functional Knowledge Teams

An organization brings people together to produce outputs that are desired by its customers and stakeholders. The organizational structure connects people together in their efforts. For an industrial operation, the quality of the output is dependent on peoples' knowledge and skills, the effectiveness of business processes, and the reliability of operational assets. There is a lot to get right when world-class reliability is your aim. It's easier and faster to share the load among the people who are best able to do the work right. That's what teams are for.

The aim is to have teams of subject matter experts working seamlessly together who proactively seek to optimize their productivity. They work in partnership with all the other teams in the business so that the organization and all its people are continually becoming better and better at achieving its purpose.