



RCA Name Manufacturing NCR Example  
 Report Number 522012  
 Report Date 5/2/2012  
 RCA Owner John Smith

## Root Cause Analysis Report

### Problem Statement

**Focal Point** Non-Conformance Reported on Brass Tubesheet 1324

#### When

Start Date 5/2/2012                      End Date 5/3/2012  
 Start Time N/A                              End Time N/A  
 Unique Timing During increased production schedule, After 11 straight 12 hour night shifts,

#### Where

Location Morrow Corporation, 4413 Hwy 67 Laporte, TX 77572  
 Location Machine shop, boring mill # 3, cnc drill # 2, radial drill # 2

#### Actual Impact

		Cost
Safety	None	\$0.00
Customer Service	Late production schedule concession.	\$1,000.00
Revenue	Lost on-time production bonus.	\$6,000.00
Cost	Scrapped brass.	\$1,400.00
Cost	Overtime Labor.	\$2,200.00
Cost	Retooling and Setup.	\$500.00
	<b>Actual Impact Total:</b>	<b>\$11,100.00</b>

Frequency 4 times per year

Frequency Notes 4th occurrence this year of NCR and scrapped tubesheet

#### Potential Impact

Safety	Additional risk due to rework.	\$0.00
Customer Service	Potential supplier quality downgrade.	\$5,000.00
Revenue	Potential lost customer.	\$350,000.00
Cost	Potential labor and materials.	\$2,500.00
	<b>Potential Impact Total:</b>	<b>\$357,500.00</b>

# Report Summaries

## **Executive Summary**

On May 2, 2012 quality control issued a non-conformance for project #1234 (brass tubesheet). The non-conformance was issued due to an incorrect bolt pattern (34 hole pattern drilled and 36 hole pattern required) and scratched gasket surfaces.

The causes of the incorrect bolt pattern were a combination of engineering oversight and no quality check performed by the machinist. The scratched gasket surfaces were caused by clamping the tubesheet without protective gasket material between the tubesheet and the clamps.

Solutions:

1. Implement Standard Operation Procedure to verify hole location with drawings and engineering.
2. Relocate gasket material near machinery that requires clamps.
3. Require parts to be secured at the end of every shift. No parts should be left unsecured.
4. Adhere gasket material to bottom of all clamp surfaces.
5. Require material handling training for both raw materials and materials in process.
6. Implement standard operation process of performing quality control checks on engineering designs prior to manufacturing.

## **Cause and Effect Summary**

On May 2, 2012 quality control issued a non-conformance for project #1234 (brass tubesheet). The non-conformance was issued due to an incorrect bolt pattern (34 hole pattern drilled and 36 hole pattern required) and scratched gasket surfaces.

The incorrect bolt pattern was caused by an engineering oversight and no quality check from the drill operator after spot drilling. Engineering provided the CNC drill operator with a design used one month prior for the same customer. Engineering was not aware the the bolt patterns were different. Engineering used the previous program/design to reduce design costs to the customer. The CNC operator only checks spot drilling for hole locations and uniformity. It is not typical for the CNC drill operator to check the hole locations against the blue print during this stage in production, and the operator assumed the program provided from engineering was correct.

The scratched gasket surface was caused by missing gasket material between the radial drill table clamps and the tubesheet. Missing gasket material between the raising blocks and the tubesheet also generated additional scratches to the gasket surface. The 2nd shift radial drill operator has not been formally trained on setup and has not had to setup a pieces/project for work. Historically the 2nd shift operator has completed setup prior to end of shift, but in this case the 2nd shift operator did not have time to setup. The 2nd shift operator has also never worked on brass tubesheets before. The 2nd shift operator is new to the organization and has only been here 5 weeks.

## Solutions

<b>ID</b>	<b>Label</b>	<b>Description</b>		
1	<b>Solution</b>	Implement Standard Operation Procedure to verify hole location with drawings and engineering.		
	<b>Cause</b>	Only checked drill tip spots for uniformity		
	<b>Note</b>	Require quality control check after spot drilling with engineering, design, and customer request. There will be a slight increase in costs associated with production.		
	<b>Assigned</b>	Brian Hooghess	<b>Criteria</b>	Pass
	<b>Due</b>	5/11/2012	<b>Status</b>	Approved
	<b>Term</b>	Short	<b>Cost</b>	\$0.00
2	<b>Solution</b>	Relocate gasket material near machinery that requires clamps.		
	<b>Cause</b>	Gasket material not located near radial drills		
	<b>Note</b>	Ensure all materials required to complete the job are available to the machinists.		
	<b>Assigned</b>	Mel Eggbert	<b>Criteria</b>	Pass
	<b>Due</b>	5/11/2012	<b>Status</b>	Selected
	<b>Term</b>	Short	<b>Cost</b>	\$0.00
3	<b>Solution</b>	Require parts to be secured at the end of every shift. No parts should be left unsecured.		
	<b>Cause</b>	Previous shift employee did not complete setup		
	<b>Note</b>	Modify training to include this requirement. Conduct management of change exercise to ensure experienced machinists implement this modification. Costs are associated with training and job aids.		
	<b>Assigned</b>	Mel Eggbert	<b>Criteria</b>	Fail
	<b>Due</b>	5/31/2012	<b>Status</b>	Approved
	<b>Term</b>	Medium	<b>Cost</b>	\$1,200.00
4	<b>Solution</b>	Adhere gasket material to bottom of all clamp surfaces.		
	<b>Cause</b>	Clamps scratched top gasket surface		
	<b>Note</b>	Implement clamps as part of tool check-out requirement, and have the tool warehouse maintain clamps with approved gasket material.		
	<b>Assigned</b>	Theodore Nugent	<b>Criteria</b>	Pass
	<b>Due</b>	5/18/2012	<b>Status</b>	Approved
	<b>Term</b>	Medium	<b>Cost</b>	\$500.00

5	<b>Solution</b>	Require material handling training for both raw materials and materials in process.		
	<b>Cause</b>	2nd shift employee not familiar with tubesheet setup		
	<b>Note</b>	Implement material handling into new employee training.		
	<b>Assigned</b>	Mel Eggbert	<b>Criteria</b>	Fail
	<b>Due</b>	6/22/2012	<b>Status</b>	Identified
	<b>Term</b>	Medium	<b>Cost</b>	\$600.00

6	<b>Solution</b>	Implement standard operation process of performing quality control checks on engineering designs prior to manufacturing.		
	<b>Cause</b>	Tubesheet does not meet design specifications		
	<b>Note</b>	Mandate QC check of blueprints and drawings before manufacturing. Reference blueprints/drawings with customer before production approval.		
	<b>Assigned</b>	Brian Hooghess	<b>Criteria</b>	Pass
	<b>Due</b>	5/18/2012	<b>Status</b>	Approved
	<b>Term</b>	Medium	<b>Cost</b>	\$0.00

## Team

ID	Label	Description	Label	Description
1	<b>First Name</b>	Brian	<b>Last Name</b>	Hooghess
	<b>Phone (1)</b>	713-255-4451	<b>Phone (2)</b>	
	<b>Role</b>	Design Engineer	<b>Group</b>	Engineering
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2	<b>First Name</b>	Cory	<b>Last Name</b>	Buzzano
	<b>Phone (1)</b>	713-255-4561	<b>Phone (2)</b>	
	<b>Role</b>	Class C Machinist	<b>Group</b>	Manufacturing
	Email	cbuzzano@morrowprod.com		
3	<b>First Name</b>	Theodore	<b>Last Name</b>	Nugent
	<b>Phone (1)</b>	713-255-4454	<b>Phone (2)</b>	
	<b>Role</b>	Foreman	<b>Group</b>	Operations
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4	<b>First Name</b>	Mel	<b>Last Name</b>	Eggbert
	<b>Phone (1)</b>	713-255-4446	<b>Phone (2)</b>	
	<b>Role</b>	Supervisor	<b>Group</b>	Operations
	Email	meggbert@morrowprod.com		
5	<b>First Name</b>	Troy	<b>Last Name</b>	Cakeman
	<b>Phone (1)</b>	713-255-4558	<b>Phone (2)</b>	
	<b>Role</b>	Class A Machinist	<b>Group</b>	Manufacturing
	Email	tcakeman@morrowprod.com		

## Evidence

ID	Label	Description
1	<b>Evidence</b> <b>Cause(s)</b>	Design blue print (Print 1298.2B) Tubesheet does not meet design specifications Design specifications Calls for 36 bolt pattern Design specifications req'd from customer Ream tube holes to desired specifications Debur tube holes Provide area for welding tubes to tubesheet Exterior bolt pattern does not meet design spec
	<b>Location</b>	Engineering
	<b>Link</b>	<a href="g://engineering/blueprints/tubesheet.pdf">g://engineering/blueprints/tubesheet.pdf</a>
	<b>Contributor</b>	Mel Eggbert
	<b>Type</b>	Document
	<b>Quality</b>	★★★★☆
2	<b>Evidence</b> <b>Cause(s)</b>	Quality Control Inspection Report CNC drilled 34 bolt pattern Tubsheet gasket surface scratched Clamps scratched top gasket surface Raising blocks scratched bottom gasket surface QC not performed on final drill design
	<b>Location</b>	
	<b>Link</b>	<a href="g://engineering/inspection/QC_223344.docx">g://engineering/inspection/QC_223344.docx</a>
	<b>Contributor</b>	Theodore Nugent
	<b>Type</b>	Direct Observation
	<b>Quality</b>	★★★★★
3	<b>Evidence</b> <b>Cause(s)</b>	Statement from Engineering Reduce design costs to customer Used previous design Use of radial drill required Knock-off sharp edges left from drill Normal practice to prevent incorrect hole size Customer ordered similar tube sheet 1 month prior

Pattern engineering provided was 34 bolt pattern  
 Gasket surface easily scratched  
 Brass is soft metal  
 CNC uses program from engineering  
 QC not performed on final drill design  
 Unaware spec was different from previous job

**Location** Verbal statement during investigation.

**Link** N/A

**Contributor** Mel Eggbert

**Type** Direct Statement

**Quality** ★★★★★

4	<p><b>Evidence</b> CNC drill operator statement</p> <p><b>Cause(s)</b> Only checked drill tip spots for uniformity          Prevent drill walking for incorrect tube hole location          Did not check bolt pattern for accuracy          Didn't know this design was for 36 bolt pattern          Pattern engineering provided was 34 bolt pattern          CNC operator did not catch on initial spot drilling          CNC uses program from engineering          QC not performed on final drill design          Assumed CNC program was correct</p> <p><b>Location</b> Verbal statement during investigation.</p> <p><b>Link</b> N/A</p> <p><b>Contributor</b> Cory Buzzano</p> <p><b>Type</b> Direct Statement</p> <p><b>Quality</b> ★★★★★</p>
5	<p><b>Evidence</b> 2nd shift radial drill operator statement/observation</p> <p><b>Cause(s)</b> Table clamps used to secure part to table          Normal practice to prevent incorrect hole size          Cut serrations into tube holes          serrations hold tubes in place          tubes need to be rolled into tube sheet          Secured tube sheet with radial drill table clamps          No gasket material between clamp and tubesheet          No gasket on aluminum raising blocks          Employee did not know gasket material needed</p>

2nd shift employee not familiar with tubesheet setup  
 Parts usually already setup on radial drills for 2nd shift  
 Never worked with brass material before  
 Knock-off sharp edges left from drill  
 Employee has only been employed for 5 weeks

**Location** Verbal statement during investigation.

**Link** N/A

**Contributor** Troy Cakeman

**Type** Direct Statement

**Quality** 

6 **Evidence** SOP gasket material located at tool shed

**Cause(s)** Gasket material not located near radial drills

**Location** N/A

**Link** N/A

**Contributor** Brian Hooghess

**Type** Direct Observation

**Quality** 

7 **Evidence** 1st Shift Employee statement

**Cause(s)** Previous shift employee did not complete setup  
 Shift ended  
 No formal training on material handling when machining  
 Table clamps used to secure part to table  
 Raising blocks used to raise tubesheet off table  
 Brass tubesheets are not common for this shop

**Location** Verbal statement during investigation.

**Link** N/A

**Contributor** Troy Cakeman

**Type** Direct Statement

**Quality** 

8 **Evidence** 2nd shift foreman statement/observation



**Cause(s)** No formal training on material handling when machining  
Table clamps used to secure part to table  
Knock-off sharp edges left from drill  
Raising blocks used to raise tubesheet off table  
Brass tubesheets are not common for this shop  
Employee has only been employed for 5 weeks

**Location** Verbal statement during investigation.

**Link** N/A

**Contributor** Theodore Nugent

**Type** Direct Statement

**Quality** ★★★★★

Chart Type Legend

- Transitory
- Non-transitory
- Omission - Transitory
- Omission - Non-transitory
- Focal Point
- Solution Implemented

