A BASIC QUALITY PLAN FOR WELDED TUBE MANUFACTURERS

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FORMALIZED QUALITY PROGRAM

Most tube manufacturers who don't produce product for the automotive, petrochemical, aerospace, or nuclear industry will probably take issue with any blanket statement regarding the universal need for formal quality programs. However, the proliferation of ISO 9000 registrants should be a wake up call. But why would anyone VOLUNTEER to formalize a QA program???

The basic nature of business forces the manufacturer to at least meet his competitors quality if he intends to stay in business, and exceed his competition if he expects to be a leader. One look at government statistics show that the tube industry is operating at less than full capacity and the excess capacity is looking for markets. High quality producers looking for new markets to unload excess product can cut a wide swath though your future if you are not prepared to meet their quality standards. With the rising importance of the Pacific Rim countries, no market is immune to import penetration.

So what does a formal quality program do for you?

First, it is a wonderful sales tool. New or potential customers want to minimize the risk of doing business with new suppliers and a formal QA program is a great advantage. A functioning QA program should reduce the cost to produce tube by reducing the amount of non-conforming or scrap product. With lower costs, you are simply more competitive.

Second, your liability and exposure to risk is reduced because producing fewer defective products means fewer defects are shipped to customers. Fewer defects going to customers means fewer claims and lower costs.

ORGANIZATIONAL PHILOSOPHY

Quality starts at the top. The executive management must take an active, high profile involvement in the QA program if proper emphasis is to be given to quality production. If you want a quality program to "whitewash" sloppy production practice, don't bother. Most industrial users today are sophisticated enough to see through the window dressing. Your commitment must be real if any benefit is to be gained.

Most producers have someone already functioning as a QA leader. This may not need to be a full time job; the QA person may also be an engineer or a clerk. Whoever is should be independent of the manufacturing department if they are to employ objective decision making. Remember, Production controls Production Quality and Quality

Assurance controls Methods. And everyone must be held accountable for the quality of their work!

THE BASIC QUALITY PROGRAM

What follows is admittedly an abbreviated program that many QA managers will find totally inadequate for some products. However, we are talking about the basic needs of a commercial tube producer who sells to service centers, other small manufacturers and the like. It is a first step in establishing a formal quality program and it is designed to be simple and easy to administer. It will not replace API Q1 or NQA-2-1983 for example.

The following outline can be used for a basic quality program and permission to use any or all of it is hereby granted by the author.

A. Quality Policy Manual

1) The quality program shall be described in a Policy Manual (Fig. 1)
2) The exact methods, procedures, specifications, etc., shall be listed in the Procedures Manual (Fig 2)
3) A method of control shall be established to ensure only approved documents are issued to each book.

Topics A through K are the quality program topics to be described in your policy manual. This policy manual is a description of what you do, not how you do it. The Policy Manual is what is usually issued to customers who require documentation of your quality program.

Keep policy statements simple and focused, describing the features of the program but excluding details of methods, procedures, test points, etc. The Procedures Manual will contain the actual details of how you do things. Procedures should be as simple as the process will allow. Keep words and sentences simple. Remember who is responsible for reading, understanding and implementing the procedures. Number each book and keep a log book of where each book is and who it is issued to.

B. Organization

1) The quality and production structure and relationship shall be documented on an organization chart. Responsibility and authority shall be clearly defined for personnel.

Everyone needs to know where their job fits into the manufacturing plan and who has the authority to make decisions. (Fig. 3)

C. Qualification of Personnel

1) Production and Quality personnel shall be trained in the proper methods and techniques to produce and evaluate the product.
2) Qualifications for each job shall be established and training records for each individual maintained. (Fig. 4)

Establishing job qualifications and training procedures will help prevent using untrained and unqualified individuals as temporary fill-ins during vacations, sick outs, etc. It will also insure that everyone uses the same methods to produce and inspect the product.

D. Procurement Control

1) Written specifications shall be established for any purchased product or material which influences the quality of the final product. (Fig. 5)
2) Qualified vendors shall be listed and audited for compliance to the specifications.

Written specifications for steel strip, paints, pipe coatings, rust preventives, thread dope, couplings, etc., should be prepared and included with each purchase order. The purchasing department should buy only from qualified vendors and the vendors should be audited for their products inspected for conformance to the specifications.

E. Material / Product Identification Control

1) A process to control the identification of raw materials shall be established.
2) A process to control the identification of prime product shall be established.
3) A process to identify and segregate non-conforming product shall be established.

It is critical that the heat numbers of the coils be maintained throughout the manufacturing process. This not only provides a basis for lot control but allows the manufacturer to locate and segregate any non-conforming material which is discovered after the product has been shipped.

F. Manufacturing Process Control

1) A flow chart of the manufacturing process for each product shall be prepared. Each step of the process shall be identified on the flow chart along with all specified tests and inspections. (Fig. 6).

2) A preventive maintenance program shall be established for all equipment which influences the quality of the product.
3) Where appropriate, setup sheets shall be created to verify that the

equipment has been setup and adjusted to produce a product to specific requirements. (Fig 7).

The flow chart lets everyone see how the product is to be manufactured and where tests must be performed. The setup sheet insures that the same product is produced time and time again without a lot of experimenting to get the mill adjusted. Preventive maintenance is essential to keeping the mill and other key pieces of equipment in condition which will maintain dimensional tolerances and minimize welding problems.

G. Inspection and Testing Control

1) A list of all tests and inspections for the entire manufacturing process shall be created for each product size, grade and type.
2) The check list will include the station name, test type, procedure number, test frequency, and accept/reject criteria. (Fig. 8).
3) Each inspection and test procedure shall be documented and include methodology, equipment used, test location, personnel qualifications, and reject procedure. (Fig. 9).

This is a key document as it will summarize all of the tests to be performed, where the test is performed, by what procedure, at what frequency, and to what specifications and tolerances.

H. Measurement and Testing Equipment Control

1) Every piece of equipment used to measure or test for purposes of final approval of the product shall be part of a documented calibration control system. (Fig. 10).

This simply involves keeping all gages, measuring devices, etc., in proper calibration and checking the calibration periodically against known standards. There are many excellent computer based systems which can greatly simplify the task. The value of this process should be obvious: why bother to measure, test or inspect your product with an instrument which is not capable to telling you the truth?

I. Handling and Storage

1) Written procedures for minimizing damage from handling and storage must be created. (Fig. 11).

It does not make sense to produce a quality product and then ruin it by sloppy handling or unprotected storage. The procedures should include stacking heights, lumber spacing, strapping size and location, maximum lift weights, use of rust inhibitors, etc.

J. Corrective Action

1) The quality program shall define a method to identify and correct recurring problems.

Keeping track of the type and number of various common problems and graphing them on a bar chart is called a Pareto Analysis and it's a great way to focus on correcting your biggest problems first. (Fig. 12). Whether it is a procedural problem or material problem makes no difference: first you must establish the relative importance of the problem and then analyze it. The solution should go to the root of the problem, and not just put a Band-Aid on it. Remember that quality is a process of continuous improvement.

K. Quality Records

1) All quality records must be tied to the product via a unique number.
2) All quality records must be legible, recorded on paper or electronic media and stored in a manner which prevents deterioration and allows ready retrieval.

Product should be identified with a lot number, or heat number of job number. This number can be printed on the product or on a tag affixed to the product bundles. It is highly recommended that the manufacturer permanently mark the product with his unique identification and product number. Any customer claims must reference this number. Should the unthinkable happen and you end up in court, product traceability demonstrating documented production and inspection procedures may be your best witness. Quality records can be used to demonstrate that you took reasonable and prudent steps to prevent defective material from reaching the customer. Without the records, your motives are less clearly discerned.

Forms for recording the results of all specified tests should be created and a supply of them placed at the appropriate stations. The forms should include the date, shift, persons name, the product, size, grade, specification, and job number. Heat or coil numbers should be referenced with the specific test results. All forms should be turned in to the Quality Assurance person at the end of each shift for analysis and filing. All quality data should be filed together for each run. Neat and well organized quality records convey the degree of effort and the importance a company places on product quality.

CONCLUSION

The foregoing is intended to give a blueprint of a simple Quality Program which can be expanded upon and customized by the individual tube producer. It should be considered a starting point, not the end point. Producers who do not now employ a formal quality program would be wise to contact a quality consultant to assist in creating a program to meet the requirements of a recognized industry specification such as ISO 9000.

The benefits of a functioning quality program should be immediately realized by the reduction in scrap, claims, and costs. If you do not see any improvement in these areas after initiating a quality program, the program may be nothing but a paper mill in

need of a more serious commitment. Remember, Quality is Free! It's the Non-Conforming Product which will always cost you more money!

The following figures are examples of many of the documents referred to in the text. They are included to give you guidance on the form and substance of your own documentation. Actual procedures, specifications, tolerances, etc., for your own products must be established and documented. The information contained in these figures is for demonstration purposes only.

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QUALITY POLICY MANUAL
TABLE OF CONTENTS

QUALITY POLICY MANUAL NUMBER_____

ISSUE DATE_____

ISSUED BY_____

ISSUED TO_____

Figure 1 Example: Quality Policy Manual Table of Contents

QUALITY PROCEDURES MANUAL
TABLE OF CONTENTS

Figure 2 Example: Quality Procedures Manual Table of Contents

QUALITY PROCEDURES MANUAL
TABLE OF CONTENTS-CONTINUED

7. Measurement and Testing Equipment Control

-Calibration Procedure C100 : 0-1" Micrometer (figure 10)
-Calibration Procedure C101 : 1-2" Micrometer
-Calibration Procedure C103 : 2-3" Micrometer
-Calibration Procedure C104 : 25' Tape measure
-Calibration Procedure C105 : 6" Rule
-Calibration Procedure C106 : NDT system

8. Handling and Storage Procedures

-Procedure H100 : Moving and Storing Steel Coils
-Procedure H101 : Moving Tube with a Fork Lift
-Procedure H102 : Moving Tube with a Crane
-Procedure H103 : Bundling of Tubes
-Procedure H104 : Stacking of Bundles (figure 11)
-Procedure H105 : Applying Rust Inhibitor
-Procedure H 106: Loading of Trucks

9. Corrective Action

- In-House Audits: Procedures and Reports
- Management review of Audits

10. Quality Records

- Station Reports
- Final Inspectors Summary Reports(figure 12)
- Pareto Analyses
- Field Non-Conforming Reports

QUALITY PROCEDURES MANUAL NUMBER_____

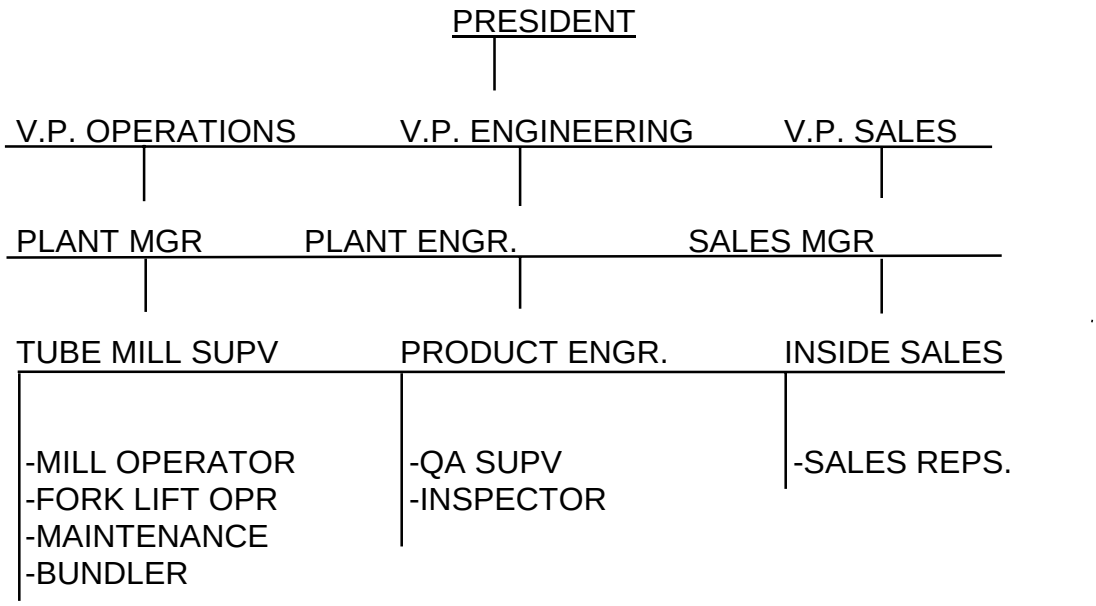
ISSUE DATE_____

ISSUED BY_____

ISSUED TO_____

Figure 2 continued

DENTON BENT TUBE COMPANY
ORGANIZATION CHART



Approved_____Date_____Rev_____

Figure 3 Example: Organization Chart

JOB DESCRIPTION AND QUALIFICATIONS

TUBE MILL OPERATOR

JOB DESCRIPTION

1. The Tube Mill Operator shall have responsibility to oversee the setup, maintenance and operation of the tube mill and welder.

2. The Tube Mill Operator will report to the Tube Mill Supervisor.

3. The Tube Mill Operator shall be responsible for producing a product according to the written Quality Procedures which meets the written Quality Specifications for each product.

JOB REQUIREMENTS

1. Tube Mill Operator shall have a minimum of 2 years on line operating experience as a bundler or mill operator helper.

2. Tube Mill Operator shall have completed the following training courses:
    a. Basic First Aid
    b. Use of Precision Measuring Equipment
    c. Basic Operations of a High Frequency Welding System
    d. Set-up and Maintenance of Tube Mills

Approved_____Date_____Rev_____

Figure 4 Example: Job Description and Qualifications

MATERIAL SPECIFICATION

PRODUCT: 2" X .070" TUBE SPEC: ASTM GRADE: ZX2445-A

CHEMISTRY:	**C**	**Mn**	**P**	**S**	**Si**	**Al**
MINIMUM	.021	.90			.15	.02
MAXIMUM	.026	1.10	.025	.010	.25	.04

Note: A copy of certified mill test reports must be sent by fax for each coil. Mill will report all normally measured residuals.

MECHANICAL PROPERTIES (AS ROLLED)

Tensile Strength: 42,000 Psi
Yield Strength: 30,000 Psi
Elongation: 15 percent

MELT PRACTICE: Electric Arc, fully killed fine grain practice
CASTING PRACTICE: Continuous Slab Cast
ROLLING PRACTICE: Cold Rolled

MASTER COIL WIDTH: 36"
PIW: 900
COIL EYE DIAMETER: 24"
MAXIMUM CROWN: .008"
MAXIMUM CAMBER: .030" per 10 feet
STRIP THICKNESS: .070" +.006 -.002
LOAD CONFIGURATION: load coil with eye parallel to axles

COIL IDENTIFICATION

Each coil must bear a tag on the coil Inside Diameter with the following information:

- -vendors name and location
- -purchase order number
- -nominal gage
- -grade
- -heat and coil number
- -coil weight
- -shippers name
- -date of shipment

SPECIFICATION NUMBER: ABC-234.6 REV 1
APPROVED BY:_____**DATE ISSUED:** _____

Figure 5 Example: Material Purchasing Specification

MANUFACTURING FLOW CHART
TUBE MILL OPERATIONS

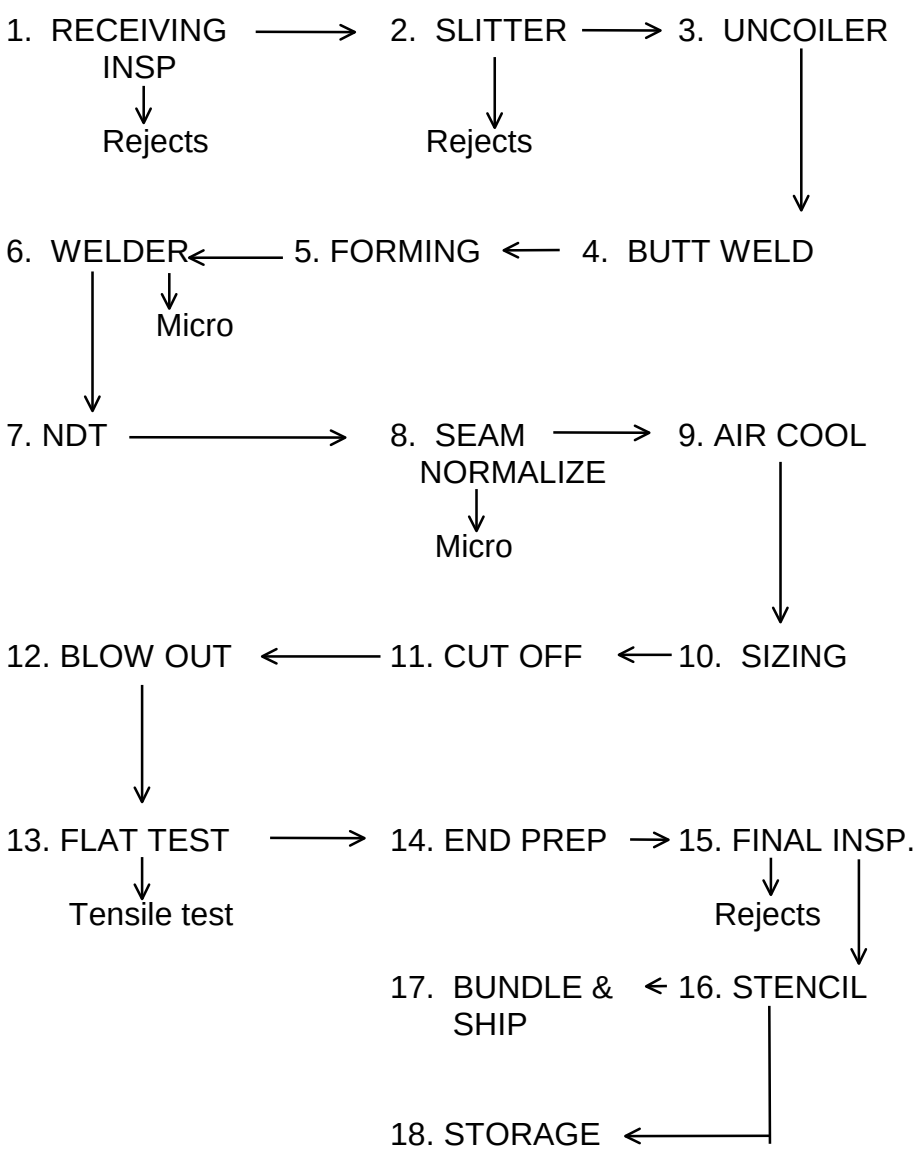


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Figure 6 Example: Manufacturing Flow Chart

TUBE MILL SET UP SHEET **TUBE SIZE: 2” X .070**

DATE_____SHIFT_____OPR_____

PARAMETER	AIM	TOL+/-	START	MID SHFT
Skelp Width	6.365	.050”	_____	_____
Wall Thickness	.077	.005”	_____	_____
Dia. @ #5 Fin Pass	2.100	.005	_____	_____
Dia. @ #6 Fin Pass	2.060	.005	_____	_____
Dia. @ #7 Fin Pass	2.040	.005	_____	_____
Weld Vert. Front	2.033	.002	_____	_____
Weld Vert. Back	2.033	.002	_____	_____
Weld Horizontal	2.033	.002	_____	_____
Dia. after Weld	2.020	.002	_____	_____
Turkshead	2.020	.002	_____	_____
Seam Norm. Temp.	1750F	50 F	_____	_____
Dia. @ #1 Size Pass	2.010	.002	_____	_____
Dia. @ #2 Size Pass	2.005	.002	_____	_____
Dia. @ #3 Size Pass	2.000	.002	_____	_____
Vee Length	2”	.250	_____	_____
Vee Width @ 2”	0.175	.040	_____	_____
Impeder Size	1 x 9”		_____	_____
Impeder Position	1/8” past weld roll center line			
Line Speed	200 fpm	5	_____	_____
Power	90 kW	5	_____	_____
Cut Length	21’	.032	_____	_____

Figure 7 Example: Tube Mill Setup Sheet

INSPECTION AND TEST CHECK LIST

PRODUCT: 2" TUBE WALL: .070" GRADE: ZX2445-A

STATION	TEST	PROCE-DURE	FREQU-ENCY	ACCEPT/REJECT
Rec'g	Gage	100	Each Coil	.070" +/- .005"
	Heat #	102	Each Coil	Must have legible number
	Coil ID	103	Each Coil	26" +/- 1"
Slitter	Slit Width	101	Each Mult	6.365" +/- .050"
Uncoiler	Heat #102		ach mult	Must have Heat and Mult #
Welder	See Set-up Sheet		2 X Shift	Must be within tolerances
	Weld Micro	104	2 X Shift	Must meet Weld Specs
NDT	Weld Insp.	105	Cont.	No rejectable defects
Seam Norm	Micro	106	2 X Shift	Full Penetration & coverage No grain growth
Sizing	Finished diameter	107	2 X Shift	2.000" +/- .002"
Cutoff	Length	108	2 X Shift	21' +/- .032"
Flat Tester	Flat Test	109	4 X Coil	No cracks before 1" height
End Prep	End Cond.	110	Each tube	Bevel @ 30 Deg +/- 5
Final Insp.	Diameter	107	Each Tube	2.000" +/- .002
	Length	108	6 X coil	21' +/- .032, Check entire coil if reject is found.
	Surface	111	Each Tube	No defects over .007" deep
Stencil	OD Mark	112	Each Tube	Must bear Heat#, OD, Wall, & Grade

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Figure 8 Example: Inspection and Test Check List

INSPECTION PROCEDURE #100
STRIP GAGE MEASUREMENT

I. METHODOLOGY

1. Remove all loose rust, dirt, etc., from the surface where test is to be conducted.

2. Place fixed anvil of the micrometer against the bottom of the strip and run the moving anvil snug against the top surface.

3. Read instrument and record results on appropriate form.

II. EQUIPMENT

1. 0-1” calibrated micrometer.

2. Wire Brush

III. TEST LOCATION

1. 2” from edge of strip, within 25’ of lead end of coil.

IV. PERSONNEL QUALIFICATIONS

1. Satisfactory completion of “Use of Precision Measuring Equipment” course.

V. REJECT PROCEDURE

1. Retest after verifying calibration of micrometer.

2. If results are still out of tolerance, tag product with Hold/Claim tag, File QA Reject Report, notify Supervisor.

APPROVED_____**DATE**_____**REV**_____

Figure 9 Example: Inspection and Test Procedure

CALIBRATION PROCEDURE # C100
0-1” MICROMETER

I. METHODOLOGY

1. Gently wipe both anvils clean.

2. Insert a 1” NIST traceable calibration bar between the anvils and gently close the micrometer on the bar.

3. Observe and record the results on the calibration log sheet for the numbered instrument being calibrated.

II ACCEPTANCE TOLERANCE

1. Must read between .999” and 1.001”

III. PERSONNEL QUALIFICATIONS

1. Satisfactory completion of “Use of Precision Measuring Equipment” course.

IV. REJECT PROCEDURE

1. If instrument fails to read within tolerance, retest per the specified procedure.

2. If instrument still fails to read within tolerance, tag it with red “RECALIBRATION REQUIRED” TAG.

3. Send instrument to gage lab.

4. Note on calibration log that instrument was sent to gage lab.

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Figure 10 Example: Gage Calibration Procedure

MATERIAL HANDLING PROCEDURE # H 104
STACKING OF BUNDLED TUBES

I. CRANE

1. When moving bundles with an overhead crane, verify that slings and hooks are in safe condition.

2. Use a spreader bar when lifting tube bundles over 10' long.

3. Note the weight of the bundle and do not overload the crane.

II. FORK LIFT

1. When using a forklift to move bundles, spread the forks so that each fork is approximately 1/3 in from each end.

2. Center the forklift in the middle of the bundle before lifting.

3. Do not rub or bump the end of the tubes on other bundles or buildings.

III. STACKING OF BUNDLES

1. Place 2x4 stripping 2' from each end and in center of bundle on floor.

2. Place first bundle layer on 2x4's.

3. Place second layer of 2x4's onto first layer of bundles so that they are directly over the first layer of 2x4's.

4. Place second layer of bundles on top of the first and continue to maximum stacking height of 10'.

Figure 11 Example: Material Handling Procedure

QUALITY ASSURANCE FINAL INSPECTORS
SUMMARY REPORT

DATE May 20, 1996 **SHIFT** 2 **SUPV** Rusty Piper

PRODUCT: 2" x .070" tube **GRADE:** ZX2445-A **CUT LENGTH:** 21'

FINAL INSPECTION REPORT

CODE	DESC	PCS	DISPOSITION
9	Flat test	33	Downgrade to commercial
5	NDT	21	Hand probe, cut and downgrade
8	Length	13	Downgrade to commercial
7	Size	8	Scrap

TOTAL PIECES FOR SHIFT: 1247

PRIME YIELD: 94%

CORRECTIVE ACTION PLAN

ANALYSIS OF PROBLEM: Flat test failures and NDT rejects continue to be the primary cause of problems. QA has evaluated the nature of the failures and in discussion with steel supplier, the chemistry of the strip will be modified to lower the P and S. Additionally, an extra .010" will be added to the mult width to allow for more squeeze out in the weld.

FOLLOW UP: QA will prepare a report on the effects of the changes after the new chemistry coils have been run. Evaluation and recommendations for further work will be forwarded to Plant Mgr.

DUE DATE: June 20, 1996

APPROVED:_____DATE_____REV_____

Figure 12 Example: Final Inspectors Report with Corrective Action Plan