

# PLANNING AND CHECKING THE QUALITY OF MILITARY RADIO STATIONS. FACTORS AFFECTING THE QUALITY OF RADIO STATIONS

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**Abstract:** The quality control represents an activity which confirms if application of the standards concerning services, materials, processes and manufacturing can prevent to deliver any defective products to customer. An organization must use all practical means to prevent, detect and correct any error that can appear in different stages of production / operation. These errors can be detected either by testing, verifying and control methods either by identifying the factors that influence the quality of radio stations. To have a real control of quality, these factors must be kept under observation as well as the variables that can affect it as a result of people's action, nature of materials or equipment performance.

**Keywords:** quality, acceptance, testing, reception attempts, control plan.

## 1. INTRODUCTION

A higher quality is conditioned by the contribution of whole organization in realization of it also by fulfilling of the responsibilities' of the department „in charge” with quality that varies from one organization to another, in relation with some factors such as: size of company, profile, territorial dispersion, abilities of employees and staff, etc.

The quality department tasks derive from quality management functions, being specified in the documents that describe the organizational structure. In Fig. 1 are presented the compartments of the most common structure responsible with quality. According with their job, the responsibilities are the following:

- quality management (engineering) – with tasks regarding the Quality Management System (QMS) documents (developing, updating, disseminating, preserving them and other specific activities);
- quality internal audits – the aim of this activity is planning and coordinating of the internal audits, processing and management of

information regarding QMS and evaluation of it's effectiveness.

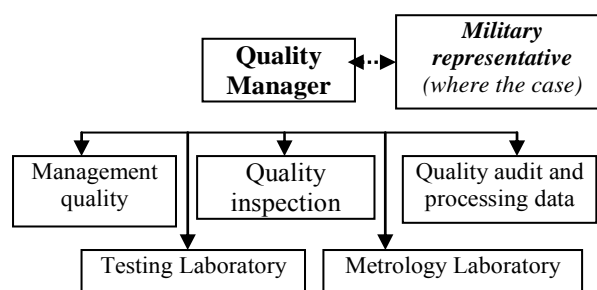


Fig. 1 The Quality Department organizational chart

## 2. PLANNING ATTEMPTS

The quality control of military radio stations can be achieved based on the Control Plan, provided by the organization's specialized compartment, using statistic methods or other methods that are stated by technical documentation of the product.

The Statistical Control Plans regarding radio stations are developed, for example, according with the data from Tables 1 (Control Plans with Simple Sampling) and 2

(Control Plans with Double Sampling) and it's used for all test groups except the requirement of reliability tests (good operation, in service life cycle and preservation).

An example regarding the way to determine for a lot = 550 radio stations, sample size n = 80 and AQL = 1.0 the acceptance / rejection value (A = 2 / R = 3) is shown in the matrix from Table 3.

In the statistical control, the lot size must be at least twice larger that the size of the sample.

For planning of the *Periodic Type Attempts* and *Reception Attempts*, in the case that acceptance quantity is 0, it is allowed to be

used the *Control Plans* with 8/5 sample size or 3 sample pieces. For radios stations with small production series and/or costly verification that require complex measurements and large volume of work, it is allowed the use a sample size of 5 or 3 pieces conditioned by the beneficiary approval and included in the technical documentation.

**Planning of the Periodic Type Attempts**

*Periodic Type Attempts* are scheduled using simple or double sampling plans. The general acceptance number for all attempt groups, carried out with the same periodicity, is established by technical documentation.

Table 1 Control Plans with Simple Sampling

Number of acceptance	Amount of acceptance sample n (pcs) for acceptable quality level AQL (%)										
	0,040	0,065	0,10	0,15	0,25	0,40	0,65	1	1,5	2,3	4
0	315	200	125	80	50	32	20	13	8	5	3
1	-	-	-	315	200	125	80	50	32	20	-
2	-	-	-	-	315	200	125	80	50	32	20

Table 2 Control Plan with Double Sampling

Acceptance number in the first sample - AC1 (pcs)	Acceptance number after the first and second sampling - AC2 (pcs)	Number of sampling	Amount of acceptance sample n (pcs) for acceptable quality level AQL (%)						
			0,65	1	1,5	2,5	4	6,5	10
0	-	n <sub>1</sub>	50	32	20	13	8	5	3
-	1	n <sub>2</sub>	50	32	20	13	8	5	3

Table 3 Matrix of Control Plans with Simple Sampling

Nc = II		Simple plans of normal control																					
Lot size (N)	Sample size (n)	Acceptable quality level AQL																					
		0,1		0,15		0,25		0,40		0,65		1,0		1,5		2,5		4,0		6,5		10	
		A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R
2 - 8	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↓	↓
9 - 15	3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
16 - 25	5	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
26 - 50	8	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
51 - 90	13	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
91 - 150	20	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
151 - 280	32	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
281 - 500	50	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
501 - 1.200	80	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
1.201 - 3.200	125	0	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
3.201 - 10.000	200	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
10.001 - 35.000	315	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	0	1	↑	↓
35.0001 - 150.000	500	1	2	2	3	3	4	5	6	7	8	10	11	14	15	21	22	↑	↑	↑	↑	↑	↑

The assessed of results analysis is done similar with the *Lot Attempts*.

#### **Planning of Lot and Reception Attempts**

Planning can be done by using the *Statistical Control Plan* or the *Full Control Plan*.

In case of activities that includes verification of size and other requirements regarding installation and connection of radio station into the circuit, the characteristics that are critical for the functional destination and detection of errors that has as result losing of working capacity is used the *Control Plan with "Zero Defects"*.

The technical documentation for specific product types defines the list of acceptance test with *zero defects*.

If for some groups *The Statistical Control Plans* establish for acceptance values different than 0, the technical documentation sets up the general (total) acceptance number for the sample under the control test as well as the reception.

In case of the full control each product from the group is checked and the number of acceptance is established by the technical documentation. The acceptance number for any size of verified lot has to be 0 for the critical parameters of functional destination, dimension, installing and connection, features as well as the defects which conduct in losing of working capacity of the product. If some features are not important for the functionality of the products, the number of acceptance may be different by 0, if the beneficiary agreed that.

The results of Statistical Control are considered positive if the number of defective products does not exceed the acceptance number established for test groups and the general acceptance number. The result is considered negative if the number of defective products and removed from the lot is superior either to the acceptance number settled for test groups or the general acceptance number.

The results of Full Control are considered positive if the number of defective products does not exceed the number of acceptance and is considered negative if this number exceed.

For the reception of products, the technical documentation established the range values for

each lot size. The type of Control Plan is properly established according with to value of lot size.

#### **Planning of the Periodic Type Attempts**

*Periodic Type Attempts* are scheduled using simple or double sampling plans. The general acceptance number for all attempt groups that are made with the same periodicity are established by technical documentation.

The assessed of results analysis is done similar with the Lot Attempts principle.

#### **Fault Analysis**

Through this activity are developed and introduced in the manufacturing process measures able to eliminate the occurrence of defects. This activity is organized by the manufacturer's Quality Assurance Section with the participation of specialists / structures that are involved in production. The beneficiary's representative can participate in this activity if this one request so.

### **3. THE QUALITY OF RADIO STATIONS**

Using the statistical control for reception of radio stations lots, suppose to develop a Verification Plan which includes data regarding sampling plan, specific rules to be followed for decision of acceptance or rejection of a lot depending on the level of quality.

A Verification Plan can be developed for both methods (attribution / measurement), defining the following: Acceptable Quality Level (AQL); Type of Sampling; the verification level (VL); degree of severity.

a) *The Acceptable Quality Level (AQL)* is stated under the contract closed between supplier and beneficiary. It must be settled according with the type of product and quality features that are controlled.

The defects which may occur at radio station can be classified in different ways. Regarding gravity, the most reliable classification involves two classes: *major defects* and *minor defects*. Also the concept of *critical defects* can be defined and, in this case are three concepts - *minor defects*, *major defects* and *critical defects* [1]:

- Minor defects - defect which is tolerable but it not reduce too much the possibility of using the product for the purpose which has been designated or, according with the specifications presents a little irregularity that affect a little bit using the product or the effective functioning of it.
- Major defects - without being critical, the defect is likely to cause a failure of the product/equipment or to reduce substantially the possibility of using that product for the purpose of which it was designated.
- Critical defect - defect likely to cause the lack of security or risk to injury the users, maintenance personnel or those who depend on that product, or that might hinder the fulfillment of the functions of a final product.

Thus, for the same radio station can be determined two values of AQL: a lower value for major defects and a higher value for minor defects.

In this case, a lot is accepted if it meets both Verification Plans conditions (both AQL values) and is rejected if one or both control plans results are found inadequate.

If products are very important it can be stated subdivisions of the same defect class, giving the AQL values and Verification Plans, separate for each subclass.

b) *The Type of Sampling* is different for each method: simple sampling, double sampling and multiple sampling (Fig. 2).

c) *The verification level (VL)*, together with AQL, determine the quantity of samples to be verified and determine in this way, the degree of consistency of information on the quality of the lot from which the sample was taken. The size of the risk inherent in each plan is highlighted by the operational characteristics shown, for example, in Romanian STAS 3160/2-84 - "The Allocation Method" and Romanian standard SR ISO 3951/1998 - "The Measuring Method". For the levels of verification are established two categories namely:

- Usual levels of verification VL 1, VL 2 and VL 3, are used in verification of the products or features, with normal control time, which where no checked previously. They are used for the wide range of products (eg radio stations components, batteries, common modules, etc.).

- Special inspection levels: S1, S2, S3, the relatively high risks can not be tolerated. They are used to check the radio stations.

d) *The degree of severity*: sets condition for acceptance of lots depending on the stability of supplier manufacturing processes (Fig. 3), also by the results of previous checks. May be: low, normal and severe [2].

*Low degree of severity*: the quantity of samples and the defective volumes that establishes the level of acceptance or rejection of the lot is lower than normal control.

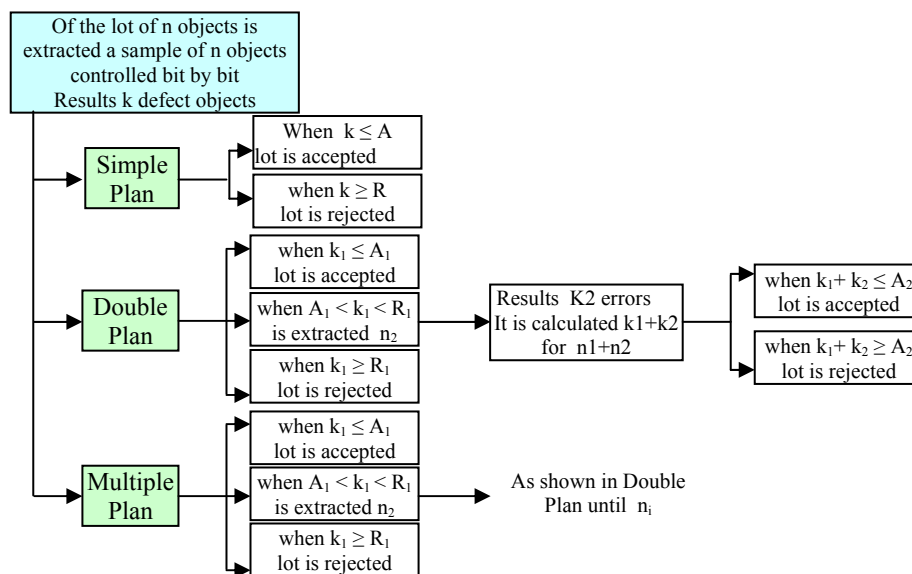


Fig. 2 Control Plans Schedule

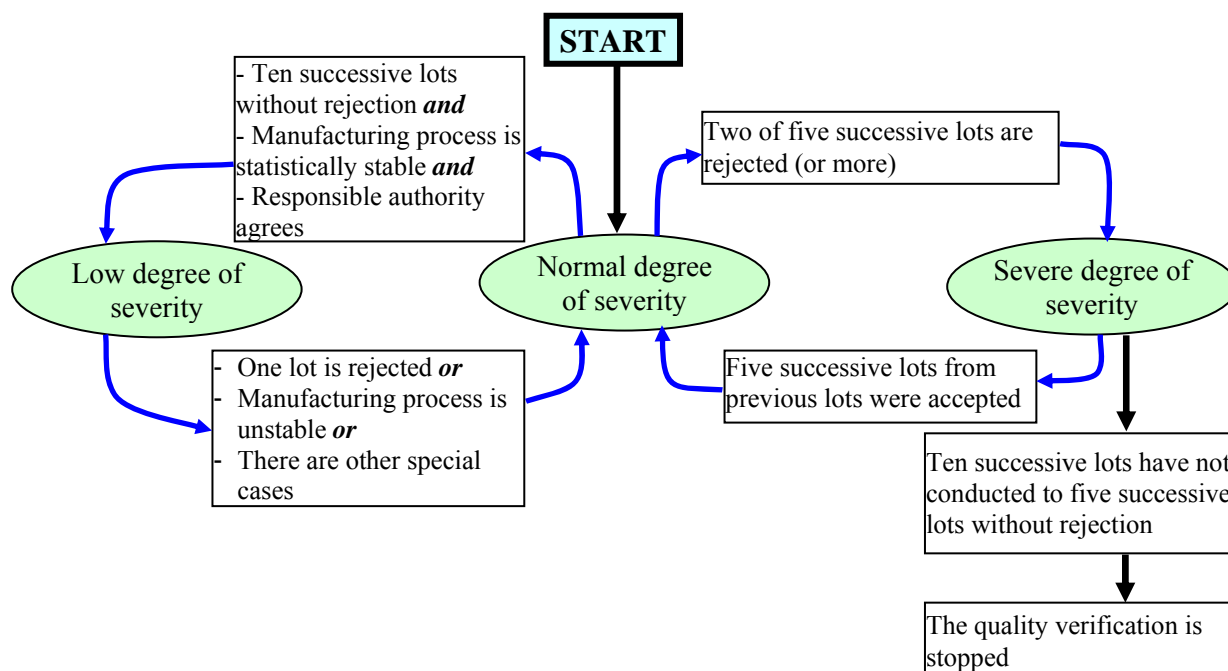


Fig. 3 Rule of increasing the severity degree

*Normal degree of severity:* is applied to a singular control (verification of random lots) or when an item is checked for the first time.

*Severe degree of severity:* level is demanding. At the same  $n$  samples of a product, the volume of defects accepted is lower than the other procedures for which the lot it is accepted or rejected.

Initially, the control begins with the normal degree of severity. The severity degree is established by the obtained results from previous inspections as well as the results obtained during of ongoing inspection.

#### 4. FACTORS AFFECTING THE QUALITY OF RADIO STATIONS

Quality is a practical concept, complex and dynamic. Its dynamic nature has a perturbing or useful effect regarding quality. The factors that affect the quality of radio stations can be characterized by quality spiral [3] as in Fig. 4.

Also this spiral illustrates the stages that are going through in order to raise up the quality from a lower to a higher level.

Steps that are going through from one level to another are:

- Research – in this step are studied all positive results obtained in the previous

production activities, all results of similar producers and market requirements.

- Comparative studies, establishing of tipo dimensions and specific details. In this case is specified the new look of the product and it's features.

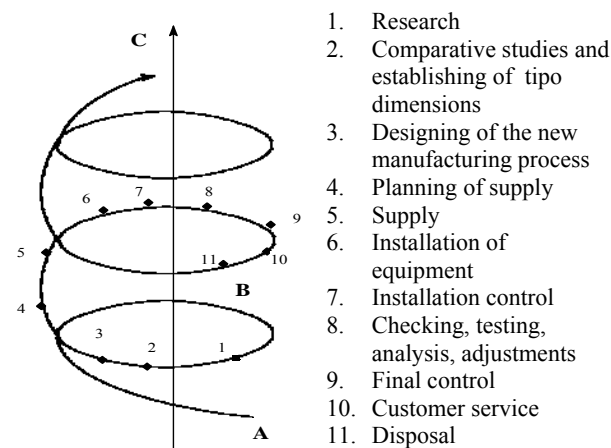


Fig. 4 Quality Spiral

- Designing of the new manufacturing process - the aim is to obtain products with higher level of quality by establishing the technical rules for manufacturing.

- Planning of supply - in this phase is planned the purchase order for equipment / raw material based on suppliers and is established the assembly order.

- Supply - in this stage are purchased the machines from suppliers, with particular attention on condition and quality of machines, equipment and facilities to prevent their degradation.
- Installation of equipment.
- Installation control.
- Checking, testing, analysis, adjustments - tools are tested in this stage and is made the first attempt to obtain the new product (prototype). The prototype is analyzed and according of the results adjustments are made on the tools/machinery.
- Final control - in this stage is controlled the adjusted technological flow of production and is made a statistical analysis in order to identify its normal state.
- Customer service - in this stage are organized all activities regarding carriage, storage and handling in order to obtain an optimal cost of these.
- Disposal - in this stage the high quality product is available for delivery.

## 5. CONCLUSIONS

- Using the control methods presented above allows the customer to perform a correct reception of products and provides complete information regarding the characteristics of lot.
- Organizing of inspection/control should be based on prevention principle and the early

quality, which provide significant savings by reducing of non-conformities and / or their early detection. Also, by using the methods of testing and verification presented above, can be provided complete conclusions regarding the entire manufacturing process.

- Having in view the results obtained during the manufacturing process and using the verification and control methods, the manufacturer can intervene, in real time, on the production flow for reducing of defects in early stage. In this way, the final product fulfills the requirements from technical specifications with significant savings and high quality.

- The control regard all production processes and it have to be planned. The control methods are chosen and adapted by taking in consideration the particularities of each controlled process.

- By identifying the factors that affect quality of radio stations it can be intervened in the flow of design and production in order to obtain high quality products.

## REFERENCES

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