Verkovich, E.N. Golovenkin, V.A. Golubkov i dr.; Pod obshch. red. K.N. Yavlenskogo, B.P. Timofeeva, E.E. Chaadaevoj. - L.: Mashinostroenie Leningr. Otd-nie, 1989. - 729 s.: il.

2. Dubinin, A.V. Povyshenie resursa gazodinamicheskoj opory malogabaritnogo dinamicheski nastraivaemogo giroskopa dlya kosmicheskih apparatov.: dis. ...kand. tekhn. nauk : 05.11.03 / Dubinin Aleksandr Viktorovich. - Moskva, 2015. - 121 s.

3. Podshipniki s gazovoj smazkoj / Pod red. S.A. Harlamova. M.: Mir. 1966. 423 s.

4. Giroskopicheskie sistemy: Elementy giroskopicheskih priborov: Uchebnik dlya VUZov po spec. «Giroskopicheskie pribory i ustrojstva»; Pod red. D.S. Pel'pora. – M.: Vysshaya shkola, 1988.

PRODUCTION AND APPLICATION OF HIGH-PRECISION RESISTORS

Boltrushevich A.E., Gogolev A.D.
Tomsk Polytechnic University, Tomsk
Scientific supervisor M.V. Kuimova, Ph.D in Methods of TFL,
Associate Professor of TPU

Measurement of current and its subsequent control are important issues in electronics. More and more electrical appliances are to be controlled and we should increase their efficiency.

External voltage may distort the results of measurement of electrical devices. To minimize the influence of external voltage there are ultra precision resistors. These resistors are physically optimized to minimize the error of external factors (operating time, temperature, frequency and voltage). The error of resistor resistance depends on the material, design of the component and its production process.

Long-term stability of parameters is very important for a variety of sensors. This stability is possible when we use materials that are not subject to corrosion and have thermal and structure resistance [1].

To determine the possibility of the work of resistors at different temperatures, we use the formula:

$$\mathbf{U = R^* I + U_{th} + U_{ind} + Ui_{ext}},$$

U_{th} – thermo electromotive force
U_{ind} – induced voltage
U_{iext} – voltage drop at terminals

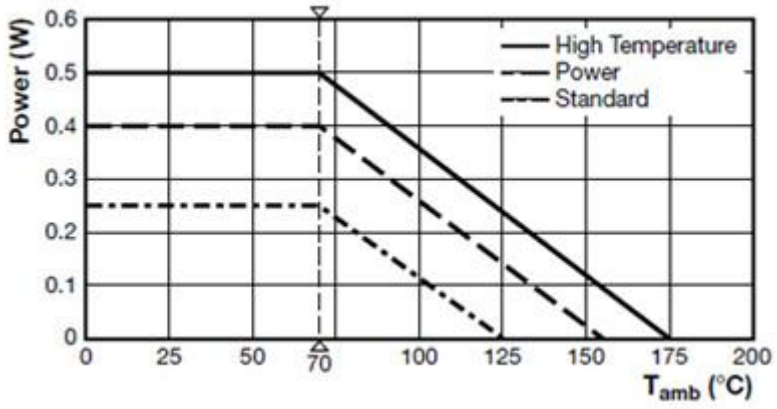

Image 1. Thermal properties of resistors.

With increasing temperature, these resistors may lose power and resistance. For a standard resistor, the loss of power occurs at a temperature of 70 °C or higher. The precision of resistor structure is an additional requirement for the manufacture of low resistors [3].

Welding is necessary to connect the parts of a resistor. There are various types of welding. Each of them has its own advantages and disadvantages. Resistors require low deformation of the material, low thermal effect and connection of dissimilar metals. Laser welding meets these requirements [2].

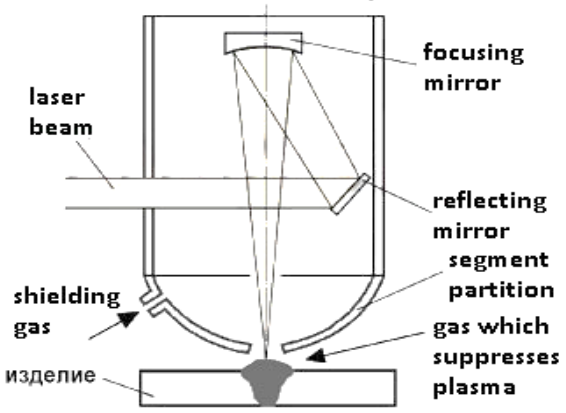

Image 2. Laser welding.

Moreover, laser welding has the following advantages:

1. small area of the thermal effect of the laser beam on the material. It leads to minor thermal deformation;
2. small diameter of the light beam;
3. flexible manipulation of the light beam by means of optical fiber transmission;
4. possibility to join dissimilar materials.

All these advantages are suitable for the manufacture of precision resistors [4].

Table 1. Comparison of different types of welding.

Options	Laser welding	Soldering	Contact welding	Argon arc welding	Plasma welding	Electron-beam welding
Accuracy	high	rough	rough	medium	high	high
Deformation	small	medium	big	big	medium	small
Heat effect	very small	medium	big	big	medium	small
Weld quality	good	medium	medium	medium	medium	good
Filler Metals	no	need	no	need	need	no
Additional conditions	no	pre-heating	electrode	electrode	vacuum	vacuum
Efficiency	high	medium	high	low	high	high
Speed	high	low	medium	low	high	high

Table 2. Advantages of laser welding.

Competition of processes	**Advantages of laser welding**
Gas welding	faster gas welding procedure, with low distortion, no need for filler metal, one-pass double-sided welding
Flux core welding	faster than normal welding, low distortion, no need to stream or filler
Contact welding	non-contact, it is necessary to remove any foreign particles, it can be used in inaccessible places, more rapid welding
Electron beam	should not be performed in vacuum, shorter cycles, welds magnetic materials, it does not require radiation shielding

Thus, laser welding has several advantages which are important in the production of resistors. Welding is an essential process in the production of high-precision resistors.

References

1. Precision resistors: http://www.npk-photonica.ru/content/products/precision-low-ohm-resistors-isabellenhutte (accessed 08 May, 2016).
2. Laser welding: http://electricalschool.info/main/electrotehnolog/1382-lazernaja-svarka.html (accessed 08 May, 2016).
3. Advantages of different kinds of welding: http://electrowelder.ru/index.php/news/18-modern-technologies/227-laser-welding.html (accessed 08 May, 2016).
4. Resistors: http://www.platan.ru/news/news112.shtml (accessed 08 May, 2016).

THE SITUATION IN THE RUSSIAN FEDERATION IN THE QUALITY FIELD

Braun A.A.
Scientific Supervisor: Redko L.A., PhD, associate professor

Unfortunately, the Russian Federation has no any officially published documents state quality direction for whole country, promote national quality approach or consider a quality problem. There are some reasons of that situation.

In the administrative-command system of the Soviet Union the supply and demand had been the subjects of state planning, there was no competition between manufacturers. Consumers could not choose between one or another manufacturer, because they actually had no choice and had to buy what they were suggested. The artificial market simulation not only interfered, but had the opposite meaning then the philosophy of quality [1].

Quality of consumer's goods was accordance to standards in conditions of planning-distribution system. It is still the main idea of Russian managers and producers. It keeps them thinking that parameters of quality are stated by government or manufacturers. Orientation on costumers, continuous improvement, process approach, involvement of employees, social responsibility are integral principles of business abroad [1]. These principles are artificially stated in Russian companies. On the one hand, Russian company's managers understand necessity of changes in business's philosophy, on the other hand, there is plenty of barriers: lack of knowledge, incomprehension and resistance of workers, colleagues and partners.

Situation slowly changes last years. The Russian Federation meets clear progress in the field of quality. There are more and more publications connected with quality in the press. Also, a certain amount of local