

# MODERN MARKET OF WELDING EQUIPMENT AND MATERIALS\*

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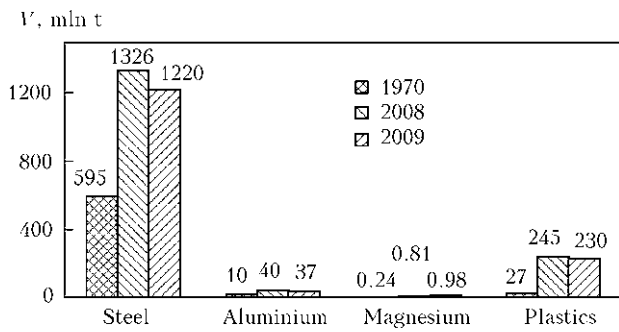
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Systematised economic-statistical information is presented on the state-of-the-art and development of the world, regional and national welding markets, covering a period of 2006–2009. Quantitative and value indices of volumes of production, consumption and export-import of the equipment and consumables for welding and related technologies are given.

**Keywords:** structural materials, welding equipment, statistics, economy, production, world market, regions, countries

**Market of main structural materials.** Main structural materials in modern industrial production are steel, aluminium, titanium, magnesium and their alloys, as well as structural plastics. The volume of production of structural materials continuously grows, despite short-time recessions during periodic economic crises. For instance, during the last 40 years the volume of production of plastics has increased 9 times, that of magnesium – 3.4 times, aluminium – 2.7 times, and steel – 2.2 times. Figure 1 shows growth of the volume of production of main structural materials in 1970, 2008 and 2009. It can be seen from these data that steel is an undisputed leader in the market of structural materials. The volume of its production is more than 4 times higher than the total volume of production of other structural materials.

Different indices of production and consumption of steel are indicators of the state of the world and national economies, and development of separate industries and sectors of industrial production, including the welding industry. In particular, the volume and structure of consumption of steel products in types of products, industries and regions give a sufficiently



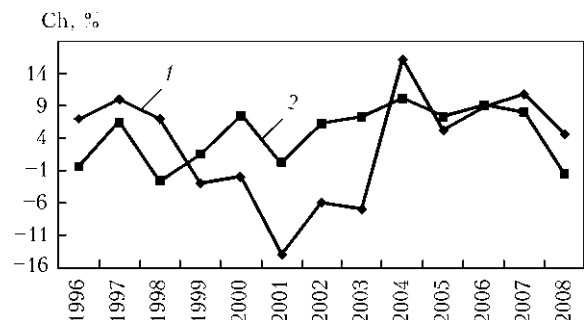
**Figure 1.** Volume *V* of world production of main structural materials according to the data of Information Agency «Worldsteel» (1), statistical book «U.S. Geological Survey» (2, 3) and Company «Plastics Europe Market Research Group» (4)

complete picture of the volumes and structure of the welding market.

The effect of changes in the world steel market on the volume of sales in the welding market can be demonstrated by an example of the «Thermadyne» Company – a leader in manufacture of welding equipment (sixth position in rating of leading world manufacturers of welding equipment in 2008) (Figure 2).

In 2007–2009, the market of structural materials experienced substantial fluctuations. For example, the year 2007 was notable for the highest level of production and consumption of steel in the world. The world economic crisis in 2008–2009 led to reduction of the world-wide production of steel in 2008 by 1.5 %, and in 2009 – by another 8 %. An even more substantial reduction of production of steel took place in the majority of the world regions: in North America this reduction amounted to almost 40 %, and in the EU countries, Japan and CIS it was about 30 %. Only three countries in the world (China, India and Iran) increased their production of steel during this period due to increase in volumes of their domestic markets. Thus, production of steel in China in 2008–2009 grew by 13.5 % and reached a record figure of 567.8 million tons.

In 2009 the world volume of consumption of finished steel products was 1,121 million tons, this being 6.7 % lower than the level of 2008. The world con-



**Figure 2.** Changes *Ch* in world production of steel (1) and volume of sales of Company «Thermadyne» (2) in 1996–2008 [1]

\* Based on data of information-statistical book «SVESTA-2010».

sumption of steel, except for the BRIC countries, reduced in 2009 by 26.8 %, compared to 2008. Consumption of steel in the BRIC countries during that period grew by 18 %, mostly due to growth of its consumption in China. Table 1 gives data on the world production of steel in 2007–2009, and Table 2 — data on the world consumption of finished steel products in 2009, as well as the forecast for 2011.

Over 2/3 of steel products (rolled metal) is processed by using joining technologies, and welding in particular. Therefore, the volume and structure of consumption of finished steel products allow estimating the volume of production of welding equipment and, particularly, of welding consumables. In welding production the deposited metal weight factor per ton of the consumed steel is the main indicator of consumption of welding consumables. According to the ESAB data, in 2006 the countries-average deposited metal weight factor (in kilo per ton of a welded structure) was 2.7 kg [2]. The value of this factor varies depending on the type of welded structures and employed welding methods. Demand for welding equipment is estimated also on the basis of the volume of consumption of steel. According to the international practice, it is assumed that for thousand tons of the steel produced in a country it is necessary to manufacture 2.5 units of welding equipment [3]. Figure 3 shows the structure of the main types of steel products manufactured in the world. Plates and bars constitute 46 % (each) of the total output of the steel products.

The volume of consumption of steel in separate industries allows estimating the structure of consumption of welding equipment in the industries (Figure 4). The construction industry and transport (manufacture of trucks and cars, shipbuilding, railway transport and machine building) are the largest customers for steel products. These industries consume

**Table 1.** Production of steel in main world regions, mln t\*

Region	2007	2008	2009	2009/2008
Europe, including:	364.5	344.1	265.8	-22.8
EU (27)	209.7	198.0	139.1	-29.7
EU (15)	175.2	167.7	117.7	-29.8
CIS	124.2	114.3	97.5	-14.7
North America, including:	132.6	124.5	82.3	-33.9
USA	98.1	91.4	58.1	-36.4
South America	48.2	47.4	37.8	-20.1
Africa	18.8	17.1	15.2	-11.0
Middle East	16.5	16.6	17.2	3.3
Asia, including:	756.5	768.3	795.4	3.5
China	489.3	500.3	567.8	13.5
Japan	120.2	118.7	87.5	-26.3
Australia/New Zealand	8.8	8.4	6.0	-28.6
Total	1345.8	1326.5	1219.7	-8.0

\* Here and in Table 2 — data of the International Iron and Steel Institute.

about 80 % of all metal products manufactured in the world and, therefore, are the main customers of welding equipment.

Half of all steel products manufactured in the world are used in the construction industry. According to the Organization for Economic Cooperation and Development (OECD) data [4], the share of the construction sector in the world gross domestic product was about 13.4 % in 2009, and the market volume was approximately 7.5 trillion USD. The U.S and China markets are biggest in the world. Their shares in the

**Table 2.** Consumption of finished steel products in main world regions in 2009 and 2010, and forecast for 2011

Region	Consumption, mln t			Growth rate, %		
	2009	2010	2011	2009	2010	2011 (forecast)
EU (27)	118.4	134.6	145.2	-35.2	13.7	7.9
Other European countries	23.9	27.2	30.4	-12.5	13.5	11.9
CIS	35.8	39.8	43.0	-28.2	11.0	8.0
North America	80.9	99.9	107.1	-37.4	23.5	7.2
Central and South America	33.6	40.4	43.1	-24.1	20.0	6.7
Africa	26.4	28.7	31.3	9.6	8.6	9.3
Middle East	40.7	44.7	48.4	-8.0	10.0	8.2
Asia and Oceania	761.5	825.7	857.7	8.7	8.4	3.9
Total	1121.2	1240.9	1306.2	-6.7	10.7	5.3
China	542.4	578.7	594.9	24.8	6.7	2.8
BRIC	640.9	692.0	720.7	17.5	8.0	4.1
World, excluding China	578.8	662.2	711.3	-24.5	14.4	7.4
World, excluding BRIC	480.3	548.9	585.6	-26.8	14.3	6.7

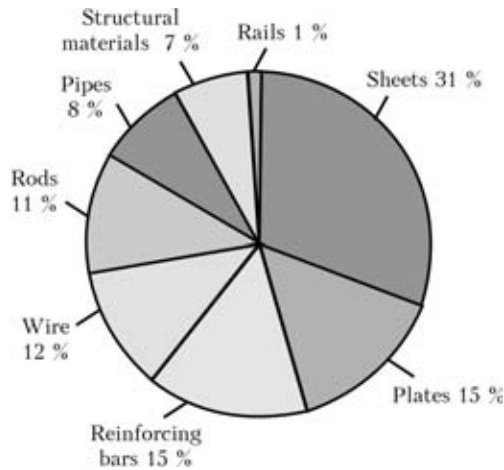


Figure 3. Structure of manufacture of main types of steel products in 2009 (according to the OECD data)

world construction market are 17 and 14 %, respectively. In the USA approximately 33 % of the domestic consumption of steel is in the construction industry. In Europe this figure is 40 %, and in the countries of South-East Asia it is 60 %. Decline in the construction sector market took place during the crisis. For example, in the countries of Europe in 2008 this decline was 7–8 %.

The world transport sector consumes about 16 % of steel produced in the world. It is a capital-intensive industry (the share of steel in weight of a car is approximately 70 %). Starting from 2001, the automobile markets of Japan, North America and Western Europe have continually reduced. In the same years China, India and Brazil featured a 25, 15 and 5 % increase in car sales, respectively. The world manufacture of cars shifted to the growing markets of Asia.

The machine building sector suffered from the economic crisis to a greater degree – the volume of production in regions decreased by 25–55 %, especially in the EU countries, USA and Japan. The fall in production in developing countries (due to the growth of consumption in China) was much lower. At present,

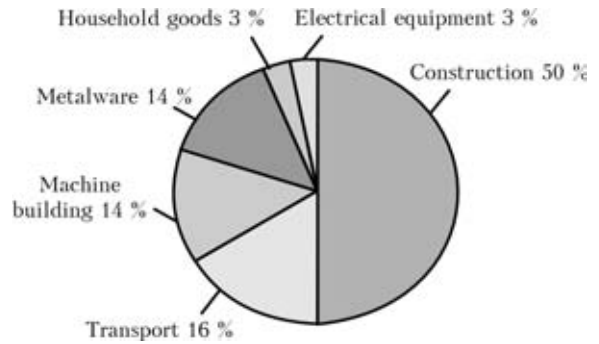


Figure 4. Structure of world consumption of steel in different industries in 2009 (according to the OECD data)

China takes the key position in the world market of this sector. Its share grew from 12 to 17 % during a period from 2005 to 2008.

The volume of consumption of steel products in 2009 reduced to the greatest degree in Europe (see Table 2). Table 3 shows the branch structure and changes in consumption of finished steel products in 2008–2010 in main industrial sectors of the EU countries, as well as the forecast for 2011.

By the end of 2010 almost all metalworking industries had restored their pre-crisis volumes of production and consumption of steel.

In 2008–2009 the volume of production in non-ferrous metallurgy also reduced. Production of primary aluminium, which was the second structural material in application in 2009, fell by 6.2 %. The world production of plastics also reduced by 6 %, compared to 2008, and made up 230 million tons. Table 4 gives data on the world production of primary aluminium in 2007–2009.

**World and regional welding markets.** The world market of products and services provided by welding and related technologies continues growing steadily, despite short-time recessions in a period of world crises. As estimated by German experts, in 2003 the value of the world market was about 33, in 2006 – 40, and in 2008 – 60 billion USD [5]. According to estimates

Table 3. Structure of consumption of finished steel products in separate industries in the EU countries (27), change rate in 2008–2010, and forecast for 2011 (European Confederation of Iron and Steel Industries)

Industrial sector	Share of consumption of steel products, %	Change, %			
		2008	2009	2010	2011 (forecast)
Construction	27	-0.8	-6.7	-0.5	2.8
Steel structures	11	-1.8	-13.9	0.4	2.9
Machine building	14	-1.0	-21.8	0.8	4.7
Motor car construction	16	-5.9	-28.9	1.2	4.5
Household goods	4	-4.6	-12.8	1.2	0.6
Ship building	1	6.2	-22.7	-10.2	2.0
Manufacture of pipes	12	-1.1	-26.0	3.6	5.8
Metalware	12	-2.3	-22.6	2.6	5.3
Others	3	2.3	-16.6	1.7	4.4
Total	100	-2.0	-18.2	0.9	4.0

**Table 4.** Production of primary aluminium (thou t) in main world regions (according to the data of the International Aluminium Institute)

Region	2007	2008	2009	2009/2008, %
China	12588	13105	12964	-1.1
North America	5642	5783	4759	-17.7
Central and Eastern Europe	4460	4.658	4117	-11.6
EU	4305	4618	3722	-19.4
Asia	3717	3923	4400	+12.1
South America	2558	2660	2508	-5.7
Australia/New Zealand	2315	2297	2211	-3.7
Africa	1815	1715	1681	-2.0
Total	37400	38759	36362	-6.2

**Table 5.** Volume of the world market of welding equipment and consumables, mln USD (according to the BCC Research data)

Indicator	2006	2007	2008	2013 (forecast)	Annual increment in 2008–2013, %
Welding equipment and consumables	9842	10219	10677	13615	5.0
Gases for welding	1911	1968	2017	2618	5.4
Protection means	367	383	406	487	3.7
Welding robots and accessories	86	96	108	148	6.5
Total	12206	12666	13208	16868	5.0

of a number of expert companies and commodity producers, the value of the welding market in 2009 was 12–13 billion USD [6]. Table 5 gives data on the volume of the welding market, including indices of the market of welding consumables and equipment, gases for welding, protection means and welding robots.

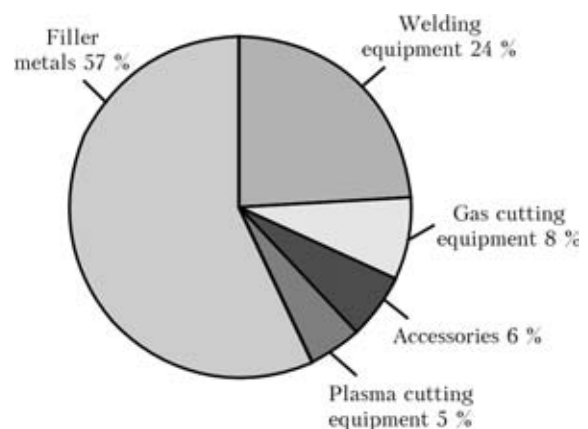
According to estimation of Company «Thermadyne», the welding market, including the market of filler metals, welding equipment, equipment for gas and plasma cutting and accessories, was 15 billion USD in 2008. In 2009 the volume of sales fell to 12 billion USD. The value of the market does not include gases for welding, gas bottles and protection means [7, 8].

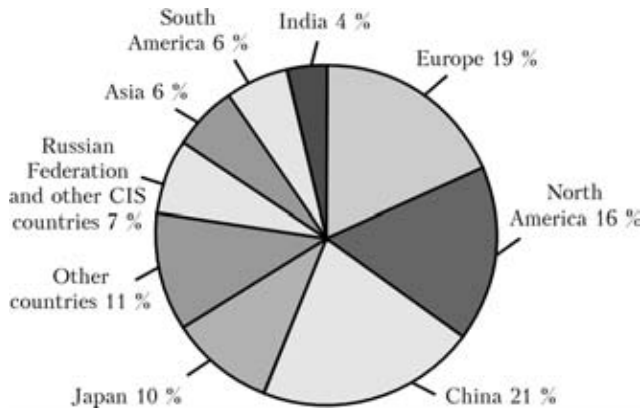
Structure of the world welding market is shown in Figure 5. The market of welding and surfacing consumables in 2009 made up more than half of the world welding market. In 2007–2009 the share of this segment of the market varied from 50 to 57 %. The share of the market of welding equipment in 2009, compared to 2008, reduced by 2 % and constituted 24 %. The sales of gas (-5 %) and plasma (-1 %) cutting equipment decreased. In general, structure of the world welding market was rather stable in a period of 2007–2009, and there were no substantial fluctuations in the sphere of consumption of certain types of products in the welding market.

Main regional segments of the welding market are Asia (40 %), Europe (30 %) and America (30 %). According to estimates of the ESAB specialists, the value of the world welding market, excluding welding robots and automation means, was 13 billion USD in

2009 [9]. Regional distribution of the world welding market, according to the ESAB data, is shown in Figure 6.

The regional structure of the welding market experienced substantial changes in 2007–2009. The welding market, like the steel market, shifted to the Asian regions. In 2009, in value terms the American, European and Japanese welding markets reduced by 30–40 %. The positive trend was noted only in China, India and Middle East (Iran). Compared to 2007, in 2009 the share of the Asian countries in the world welding market grew by 11 %, mostly due to China and India. The growth of sales (by 2 %) was noted also in markets of the South America countries. During that period the share of the EU countries in the world

**Figure 5.** Structure of the world welding market in 2009 (according to the «Thermadyne» data)

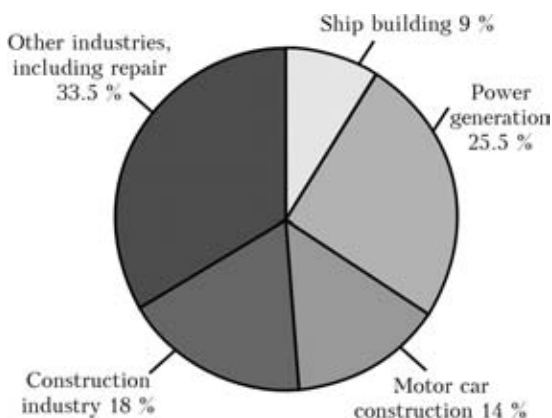


**Figure 6.** Regional distribution of world welding market in 2009

welding market reduced by 6 %, and the share of the North America countries reduced by 3 % [10]. This trend is supported by the data on changes in sales in the regional markets of ESAB – the major transnational company (second position in rating of the world leading manufacturers of welding equipment and consumables in 2009) (Table 6) [9].

The industries that are the main customers of welding equipment and consumables are construction, transport, power generation (including oil and gas producing industry, electrical power generation, petrochemistry, manufacture of pipes and construction of pipelines), as well as the sphere of repair and renewal operations. Figure 7 shows mean world indicators of distribution of the world welding market in main consuming industries [8].

In contrast to the majority of metalworking industries (motor car construction, ship building, aerospace engineering, industrial and civil construction engineering, heavy machine building) that reduced their manufacture and, hence, consumption of the welding equipment and consumables during the crisis period of 2008–2009, only the power generation sector (wind, nuclear, hydro and solar power generation) continued increasing its consumption of welding equipment and consumables. In 2008, the share of power generation in structure of consumption of welding equipment and consumables in the world welding market was 11 %. According to estimates of the «Frost & Sullivan» ex-



**Figure 7.** Distribution in main consuming industries in 2009 (according to the «Thermadyne» data)

**Table 6.** Regional structure of ESAB sales

Region	Share, %	
	2009 (volume of sales – 1031.4 million pounds)	2002 (volume of sales – 581.9 million pounds)
Europe:		
developed countries	25	55
developing countries	13	–
America:		
North	23	33
South	16	9
Russian Federation	6	–
India	5	–
China	3	–
Others	9	3
Total	100	100

perts, it is expected that the annual growth of this sector of the welding market till 2015 will be 7 %. It is predicted that the volume of the welding market in the power generation sector will grow from 1.9 (2009) to 3.0 billion USD (2015) [11].

As estimated by the ESAB and «Frost & Sullivan» experts, the most promising sector of the welding market is wind power generation. At present the share of the world power generation using wind power plants is not in excess of 2 %. However, the rate of increase in commissioning of new facilities continually grows. The world capacity of wind power generation in 2007 was 27,000 MW. It is predicted that in 2012 it will amount to 60,000 MW. In the EU countries (Denmark, Portugal, Spain, Ireland) the share of the power generated by using wind mills is already 10 to 20 %. In general, according to the EU Directive on development of national plans for reduction of power consumption, every EU country should reduce its annual power consumption by 1 % as a minimum in a period from 2008 to 2017. Europe has set a target to raise the share of alternative fuels in a general energy balance by 2020 to 20 %, and by 2040 – to 40 %.

The growth of commissioning of new wind power plants in the USA during a period of 2007–2009 constituted 35, 44 and 39 % of the entire volume of the new power generation facilities.

Table 7 gives data of the U.S. Department of Energy, allowing estimation of the state-of-the-art in wind power generation in leading countries of the world [12].

Investments into the welding equipment of this segment of the market continually grow. According to estimates made by the ESAB specialists, 700 kg of welding consumables and 600 kg of flux are consumed per each newly introduced megawatt of the power. This segment of the market has good prospects for further growth [9].

**Table 7.** Total and annually introduced capacities of wind power plants in world leading countries in 2009

Country	Annually introduced capacity, MW	Total capacity, MW
USA	9994	35155
China	13750	25853
Germany	1917	25813
Spain	2331	18784
India	1172	10827
Italy	1114	4845
France	1104	4775
Great Britain	1077	4340
Canada	950	–
Portugal	645	3474
Denmark	–	3408
Other countries	4121	22806
Total	38175	160080

In addition to the power generation sector, the experts also class the sector of repair and renewal operations with the industries that can become catalysts of growth of the welding market in the next few years of recovery from recession. A response to the predicted growth of prices of oil will be increase in consumption of steel for construction of pipelines and tankers. In turn, this will lead to growth of the market of welding equipment and consumables.

**European market of welding engineering products and services.** In 2007 the German Welding Society (DVS) completed a wide-scale project on estimation of contribution of joining technologies (welding and related technologies) to economy of the European countries [5]. Based on the data obtained, it is possible to sufficiently fully estimate the volume and structure of the European market of welding engineering products and services. Table 8 gives data on the volume of production of equipment for welding and related technologies, as well as value-added goods and services in the welding market of the leading European countries – manufacturers of welding equipment.

As seen from Table 8, the volume of production of equipment for welding and related technologies in the EU countries in 2007 was 7.5 billion Euro. The main manufacturers of the said equipment are Germany and Italy, which collectively manufacture half of the entire equipment in Europe, and Germany – one third. The market of value-added goods and services is 1.6 times in excess of the market of equipment. Totally, the market of the joining technologies, value-added goods and services related to the joining technologies in 2007 was almost 20 billion Euro.

Table 9 shows structure of production of equipment for welding and related technologies in Germany and other EU countries. As seen from the Table, the vol-

**Table 8.** Production of equipment and value-added services for welding, and rendering services in this sphere in EU countries in 2007, mln Euro\*

Country	Production of equipment for welding and related technologies	Production of value-added goods and services	Total
Germany	2500	2110	4660
France	320	1510	1830
Italy	1170	1800	2970
Great Britain	160	1190	1350
Poland	97	169	266
The Netherlands	29	382	411
EU (27)	7500	12480	19980

\*DVS data are used here and in Tables 9–11.

ume of production of welding equipment makes up half of the total volume of equipment for welding and related technologies produced in the EU countries. In Germany this indicator is 66 %. Production of equipment for laser technologies takes the second place. Its share in the EU countries is 18 % on the average, and in Germany – 9 %.

Table 10 gives data on the volume of production of welding equipment in the EU countries. Main manufacturers of this equipment are Germany and Italy. Totally, these countries manufacture 70 % of the entire welding equipment in the region, the share of Germany being 43 %.

Data on the volume and structure of production of value-added goods and services in the field of the joining technologies are given in Table 11.

The main share (almost 50 %) in structure of production of value-added goods and services falls on production of glue. The portion of welding gas is 18 %, and that of welding consumables is 14 %. This structure in Germany is a bit different: the first place in

**Table 9.** Structure of production of equipment for welding and related technologies in Germany and other EU countries in 2007

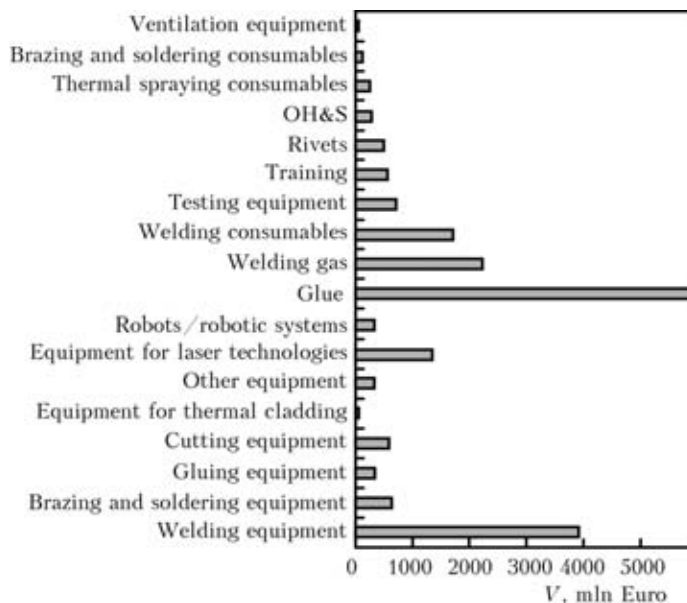
Joining technology	Volume of production, mln Euro		Share, %	
	Germany	EU	Germany	EU
Welding	1668	3916	66	52
Brazing and soldering	233	629	9	8
Gluing	112	338	4	5
Cutting	96	582	4	8
Thermal spraying	17	54	1	1
Others	80	324	3	4
Laser technologies	233	1334	9	18
Robots/robotic systems	111	323	4	4
Total	2550	7500	100	100

**Table 10.** Volume of production of welding equipment in EU countries in 2007, mln Euro

Country	Welding equipment	Spares	Total	Share, %
Germany	1433	235	1668	42.6
France	181	34	215	5.5
Italy	608	110	718	18.3
The Netherlands	–	0.80	0.80	0.01
Poland	55	4	59	1.5
Great Britain	68	15	83	2.1
Other countries	1041	131	1172	29.9
EU (27)	3386	530	3916	100

production volumes is taken by welding gas (28 %), the second place is taken by welding consumables (20 %), and the third place – by production of glue (13 %). Services in training of welding personnel constitute a substantial part in the market of the EU countries, especially in Germany, i.e. 4.5 and 11.0 %, respectively.

Figure 8 shows the volume of production of welding engineering products and services in the EU countries in 2007. Based on these data, it is possible to get a sufficiently full idea of structure of manufacture of welding engineering products and services for welding and related technologies in Europe. Glue constitutes over 30 % of the output, welding equipment – about 20 %, and welding consumables – 9 %. These data fully confirm the forecast of German manufacturers of welding engineering products on development of individual sectors of the European market of joining technologies, which was published in 2005. According to this forecast, the laser welding and gluing technologies will have the highest growth in 2005–2015 [13] (Figure 9).



**Figure 8.** Production volume  $V$  of the European market of welding engineering products and services in 2007 (according to the DVS data)

**Table 11.** Volume of production of value-added goods and services in the field of joining technologies in 2007

Value-added goods and services	Production volume, mln Euro		Share, %	
	Germany	EU	Germany	EU
Glue	271	6040	12.9	48.4
Welding gas	598	2232	28.4	17.9
Welding consumables	415	1717	19.7	13.8
Testing equipment	229	723	10.9	5.7
Training	241	561	11.4	4.5
Rivets	134	500	6.4	4.0
OH&S	49	277	2.3	2.2
Thermal spraying consumables	78	256	3.7	2.1
Brazing and soldering consumables	83	127	3.9	1.0
Ventilation equipment	9	50	0.4	0.4
Total	2106	12483	100	100

**World market of welding consumables.** The value of the world market of welding consumables during a period of 2007–2009 was about half of the entire volume of the welding engineering market. In 2009, its value was approximately 6.0–6.5 billion USD. According to estimates of the ESAB specialists [9], in 2009 the world volume of consumption of welding consumables calculated per weight of the deposited metal was about 4.1 million tons, this being 13 % lower than the level of 2008. Figure 10 shows the world structure of consumption of welding consumables in main types of products.

Electrodes for arc welding (about 40 %) and solid wire (about 40 %) predominate in the world structure of consumption of welding consumables. The diagram

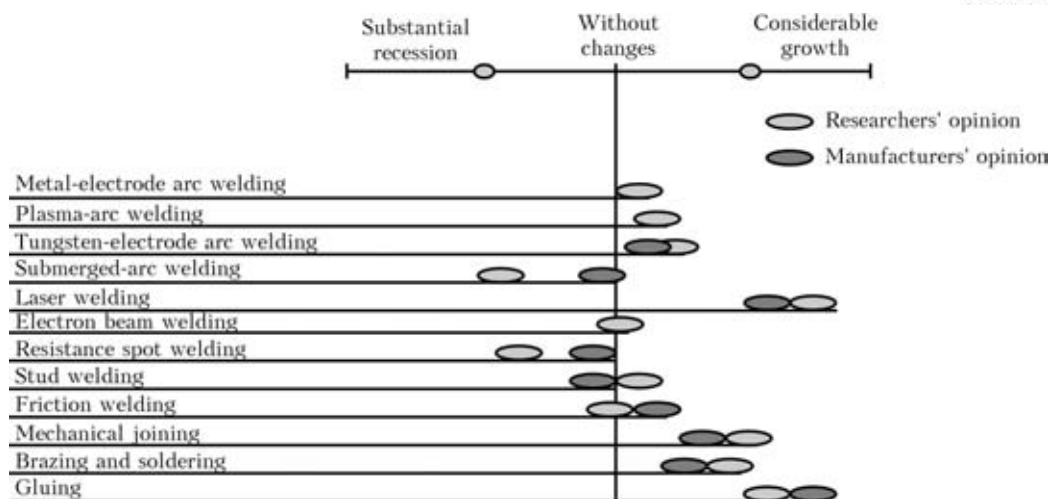


Figure 9. Forecast for development of individual sectors of the European welding market for a period of 2005 to 2015

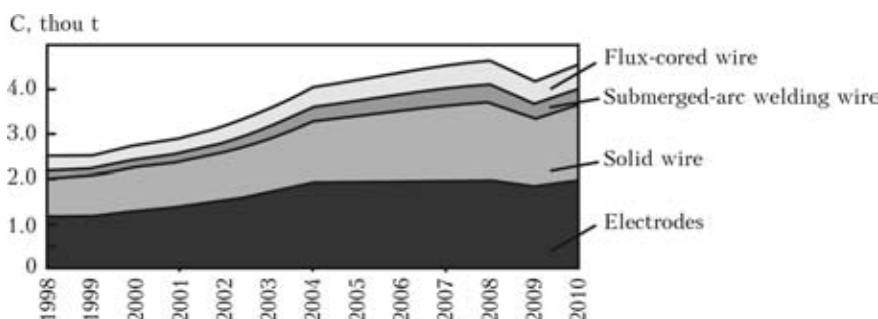


Figure 10. Consumption C of welding consumables in main types of products (according to the ESAB data)

shown indicates that no significant changes took place in a period of 2007–2009 in trends and structure of demand for welding consumables. The trend to decrease in consumption of covered electrodes for arc welding and to growth of demand for flux-cored wire persists. The volume of consumption of solid wire remains invariably high and also shows a trend to growth, which will persist in the next years as well, thus leading to stabilisation of application of covered electrodes at a level of 15–20 %.

**Regional markets of welding consumables.** Asia dominates here, its share in the world market of welding consumables being 70 %. The share of Europe is 15 %, and that of North America is 10 %. All markets of welding consumables in the main regions, except China and India, experienced a substantial recession in 2009. The volume of sales reduced most significantly in the markets of the USA, Europe and Japan (about 30 %). The market of welding consumables shifted to Asia. Figure 11 shows data on the volume of consumption of welding consumables in main world regions.

China has a world lead in production and consumption of welding consumables. In 2009, according to the data of Chinese experts, the volume of consumption of welding consumables was about 2.5 million tons. As estimated by «Thermadyne», the value of the Chinese market of welding consumables in 2009 was 1.1 billion USD [7, 14].

Electrodes for manual arc welding constitute the major part of all welding consumables manufactured

in China. In 2009, their share in structure of production of welding consumables was about 58 %, the share of solid wire was 25 %, and that of flux-cored wire and submerged-arc welding consumables was 17 %. The volume of application of welding consumables for welding of aluminium was roughly 5 thousand tons.

In the last years the structure of production of welding consumables is quickly changing: manufacture of solid and flux-cored wire is growing, and manufacture of welding electrodes is decreasing. According to the forecast of the China Iron and Steel Research Institute, by 2015 the volume of production of welding consumables in China will amount to 3.5–4.0 million tons, the share of production of covered electrodes for manual arc welding will decrease to 22 %, the share of solid wire for CO<sub>2</sub> welding will grow to 50 %, that of flux-cored wire will increase to 15 %, that of wire for submerged-arc arc welding and fluxes will remain at a level of 12 %, and that of consumables for TIG welding will remain at 1 % [15].

In Japan the total volume of production of welding consumables reduced almost by 30 % in 2009, compared to 2008, and reached the minimal level fixed over the last 20 years. This resulted in reduction of manufacture of welding consumables in individual types of products (from 9 to 44 %).

The data on the volume of domestic consumption of main types of welding consumables are given in Table 12 [16].



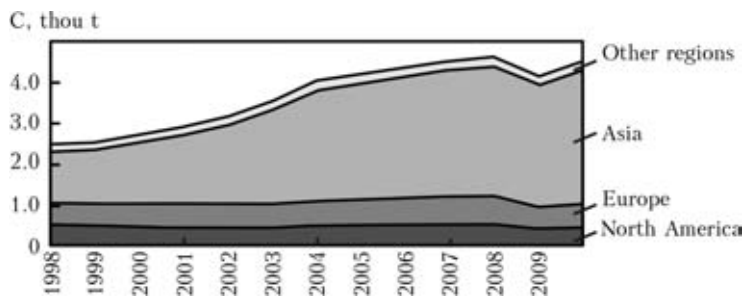


Figure 11. Consumption C of welding consumables in main regions (according to the ESAB data)

Reduction of the total volume of consumption of welding consumables affected the consumption of individual types of welding consumables. Consumption of flux-cored wire decreased to the least degree (-9%), its share in the consumption structure grew to 38.7% and became comparable with the share of application of solid wire, the volume of consumption of which reduced most significantly (44.2%).

The volumes of foreign trade of welding consumables also reduced: decrease in import of welding consumables being 40% and making up 33.62 thousand tons. Import of solid wire decreased by 56.6% (to 11.5 thousand tons), and that of covered electrodes — by 20.4% (to 1.58 thousand tons). At the same time, import of flux-cored wire increased by 4%, and in 2009 it amounted to 14.4 thousand tons. Export of welding consumables decreased by 31.5% and made up 39.98 thousand tons.

According to estimates of the Japanese experts, no substantial growth of production in metalworking industries and in construction was expected in 2010. Hence, the demand for welding consumables remained at a level of 2009. It was predicted that the volume of production of welding consumables in 2010 would grow by 2.1% and make up 257.6 thousand tons, export of welding consumables would increase by 2% (to 36.7 thousand tons), and import would increase by 2.3% (to 34.38 thousand tons).

The *India* market of welding consumables is one of the most dynamically developing markets in Asia. Based on the estimate made by Ador Welding Ltd., which is the India-largest welding manufacturer, the market of welding consumables constitutes about 70%

of the entire welding market of India, and in 2009 it made up about 450 million USD. During a period of 2007 to 2009, the growth rate of the market increased. For example, the growth of revenues of ESAB INDIA Ltd in 2009 was 15%.

The Indian market of welding consumables is fragmented: about 50% of it is controlled by «non-organised» participants, and over 50% of the «organised» market is covered by such companies as AWL (23%), ESAB (17%) and D&H Welding. As estimated by the Indian experts, the annual growth of the market of welding consumables in the next years will be approximately 15–16%.

Table 13 gives data on the volume of consumption of welding consumables according to the structure of application of different arc welding processes in 2007–2010, as well as the forecast for 2011.

The dominant position (about 80%) in the Indian market of welding consumables is taken by electrodes for manual arc welding. It is predicted that in the next 3–5 years the share of application of covered metal electrode arc welding will reduce to 65%, the share of gas-shielded covered metal electrode arc welding will grow from 17 to 27%, and that of other welding processes will remain unchanged. The volume of consumption of welding consumables during this period will increase by 30–35% [17, 18].

As reported by «Frost & Sullivan», in the *Republic of Korea* the value of the welding market in 2005 was 656.2 million USD. According to the forecast, by 2012 it will amount to 955 million USD. Consumables and equipment for arc welding constitute 85.6% of the entire welding market, 27.1% of it is taken by welding

Table 12. Volume and structure of domestic consumption of main types of welding consumables in Japan

Welding consumables	2008		2009		2009 / 2008, %	2010	
	Thou t	Share, %	Thou t	Share, %		Thou t	Share, %
Covered electrodes	40.6	11.4	30.6	12.1	75.4	29.4	11.5
Wire and flux for submerged-arc welding	40.2	11.3	28.9	11.4	71.9	31.3	12.3
Thin solid wire	167.5	46.7	93.4	37.0	55.8	95.5	38.2
Wire for TIG welding and other processes (gas welding and cutting)	2.1	0.6	1.9	0.8	90.5	1.9	0.8
Flux-cored wire	107.5	30.0	97.4	38.7	90.9	99.5	37.2
Total	358.4	100.0	252.2	100.0	70.4	257.6	100.0

**Table 13.** Estimated volume of consumption of welding consumables in India according to structure of application of arc welding processes, thou t

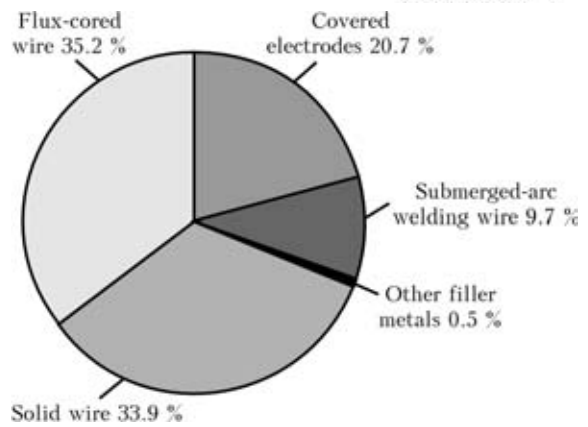
Year	Arc welding				Total
	Covered metal electrode welding	Gas-shielded covered metal electrode welding	Submerged-arc welding	TIG welding	
2007	262	58	17.5	2.6	340.1
2008	278	65	19.0	2.8	364.8
2009	296	74	20.5	3.0	393.9
2010	315	82	22.0	3.2	422.2
2011	335	93	24.0	3.4	455.4

consumables. Therefore, in 2005 the value of the market of welding consumables was 177.7 million USD [19].

The market of welding consumables in the Republic of Korea features a very dynamic development. During a period from 1995 to 2005, the volume of production of welding consumables in the country grew 5 times (about 300 thousand tons). Domestic consumption was 62 % of the manufactured welding consumables, the export being 38 % [20]. Out of the welding consumables manufactured in the country, solid and flux-cored wires constitute over 70 %. Figure 12 shows the structure of production of welding consumables in the Republic of Korea.

The growth of consumption of steel was noted in the country during a period of 2006–2008 (11.5 %). Production of welding consumables also grew, this being confirmed by the data on increase in the volume of production of welding consumables by main manufacturers of welding consumables in the Republic of Korea. Table 14 gives data on the volume of production of welding consumables by Hyundai Welding Co. Ltd. in 2006 and 2009. In the domestic market of welding consumables, the share of sales of this Company is 62 %. As seen from the Table, in addition to growth of the production volume, the structure of the manufactured welding consumables also experienced substantial changes. The output of electrodes for manual arc welding was reduced almost twice. Production of flux-cored and solid wires, as well as wire and flux for automatic welding has been growing [21].

In 2009 there was a fall in production of welding consumables because of reduction of orders in the industries that are key customers for welding consumables (first of all, ship building and motor car construction). According to our estimate, in 2009 the volume of production of welding consumables in the Republic of Korea decreased approximately by 20 % (about 260 thousand tons). As shown by the UN data (database COMTRADE), the volume of export of welding consumables decreased in 2009 by 7 % (73 thousand tons), and that of import – by 34 % (26 thousand tons) [22].



**Figure 12.** Structure of production of welding consumables in the Republic of Korea in 2005

As estimated by the DVS experts, in 2007 the value of production of consumables in the *EU countries* was 2100 million Euro, the value of welding consumables being 1717 million Euro. The key manufacturers and customers of welding consumables in Europe are Germany, France and Italy. Table 15 gives volumes of production of the main types of welding consumables in the EU countries, which are used for welding and related technologies [5].

Germany produces 30 % of the total volume of welding consumables manufactured in the EU countries, while Germany, France and Italy collectively produce more than half of all consumables.

Solid wire predominates in structure of production and application of welding consumables in the EU countries (its share is about 70 %). The share of flux-cored wire is about 10 %, and that of arc welding electrodes is approximately 10 %. Consumption of welding electrodes, which are intended for application in special areas, continues decreasing in Europe.

According to the DVS data, in 2009 the value of production of welding consumables and filler metals in the EU countries decreased by 30 % on the average, this being confirmed by the data of the leading European manufacturer of welding consumables – ESAB, whose return from sales in the European market in 2009 reduced by 30 %.

The volume and structure of production of consumables in Europe during a period from 2007 to 2009 can be estimated from the data on the value and quantity of individual types of welding consumables manufactured in Germany, which are given in Tables 16

**Table 14.** Volume of production of welding consumables by Hyundai Welding Co. Ltd., thou t

Welding consumables	2006	2009
Covered electrodes for manual arc welding	60	36.0
Flux-cored wire for gas-shielded welding	25	45.0
Solid alloyed wire for gas-shielded arc welding	25	36.0
Wire and flux for automatic welding	6	19.2
Total	116	136.2

**Table 15.** Volume of production of consumables in EU countries in 2007, mln Euro

Country	Consumables			Total
	Welding	Soldering and brazing	Thermal spraying	
Germany	415	83	78	576
France	213	51	47	311
Italy	264	10	28	302
The Netherlands	42	22	9	73
Poland	35	5	10	50
Great Britain	142	19	48	209
EU (27)	1714	127	256	2100

and 17. According to these data, the value of production of welding consumables in Germany in 2009 reduced by 32.6 %, and quantity – by 23.9 %, while by the individual types of products, e.g. covered electrodes, this reduction was 2 times [10].

Based on the data given in Tables 16 and 17, and proceeding from the fact that Germany manufactures 30 % of the entire European volume of welding engineering products, the value of production of welding consumables in the EU countries in 2009 was approximately 1.2 billion Euro, the volume of production of welding consumables being about 420 thousand tons.

In the *CIS countries*, and Russia in particular, welding electrodes constitute 80 % of the entire output of welding consumables. The key advantage of using welding electrodes, compared to other welding con-

sumables, e.g. flux-cored wire, is a low cost of the equipment involved.

The trend in the last 3–5 years in the Russian market, like in the world one, is to decrease of the share of welding electrodes in the total volume of utilisation of means for welding of metals. This trend is associated with increase of the share of wire and resistance welding as the most cost effective and sound welding methods. At the same time, with development of construction, railway, defence and oil and gas industries the demand for welding electrodes among the Russian customers increases by 10–20 % every year, in absolute values. Table 18 gives data on the volume and structure of production of welding consumables in Russia in a period of 2004–2007 [23].

Out of the general-purpose electrodes, Russian enterprises produce more electrodes with rutile (MR-3, ANO-21, OZS-12) and ilmenite (ANO-6) coverings. The share of such electrodes is about 60 % of the total output. They are in great demand, because they can be used in welding at both alternating and direct current almost in all welding positions. Welding can be performed even by low-skill welders. Basic electrodes (UONI-13/45, UONI-13/55) are produced in lower volumes. Their share is about 36 %. These electrodes are used for welding of super critical structures, and welding should be performed by high-skill welders.

In the last years the Russian market of welding electrodes has been characterised by a trend to increase in import and decrease in export, the share of import being low, i.e. no more than 10 % of the output. In 2007 the volume of import of welding electrodes ex-

**Table 16.** Production of welding consumables in Germany in 2007–2009

Welding consumables and auxiliary materials	Production volume, mln Euro			Change 2009/2008, %
	2007	2008	2009	
Welding wire and strip (excluding wire and strip with covering and filling)	221.2	221.2	145.4	–34.3
Covered electrodes for arc welding	64.5	71.6	31.6	–55.9
Flux-cored wire for arc welding	46.4	53.1	33.0	–37.9
Covered rods for soldering, brazing and autogenous welding	56.1	61.0	44.7	–26.7
Auxiliary materials and consumables for welding, soldering and brazing of metals	109.6	113.4	95.6	–15.7
Total	497.8	520.1	350.3	–32.6

**Table 17.** Production of welding consumables in Germany in 2007–2009

Welding consumables and auxiliary materials	Production volume, t			Change 2009/2008, %
	2007	2008	2009	
Welding wire and strip (excluding wire and strip with covering and filling)	93437	90873	59159	–34.9
Covered electrodes for arc welding	5379	5351	2967	–44.6
Flux-cored wire for arc welding	18276	22397	14527	–35.1
Covered rods for soldering, brazing and autogenous welding	–	–	9281	–
Auxiliary materials and consumables for welding, soldering and brazing of metals	45584	46010	39313	–14.6
Total	162676	164631	125247	–23.9

**Table 18.** Volume of production of welding consumables and filler metals in Russia in 2004–2007, t

Type of welding consumables	2004	2005	2006	2007
Covered electrodes	223743	24000	255600	266600
Alloyed welding wire with 2 or more mm diameter, including:	32635	33400	35100	39600
with 0.8–1.4 mm diameter	13980	18200	22400	18800
Flux-cored wire, including:	3458	2965	4785	4800
for welding	2212	1380	1603	2300
for coating	1246	1585	3182	2500
Welding fluxes	10585	12473	10300	8600
Total	270421	289238	305785	319600

ceeded 26 thousand tons, in 2008 – 33 thousand tons, and in 2009 – 21 thousand tons. The volume of export was 14, 13 and 9 thousand tons, respectively.

At present, the major manufacturers of electrodes in Russia are three enterprises – Novosibirsk Electrode Factory, its share in the Russian electrode market being 35.2 %, according to the Factory data, Novocherkassk Electrode Factory, the share of which is 26.8 %, and Chelyabinsk Electrode Factory with a share of 23.2 %. All these three enterprises are governed by Company «Energoprom Management».

In the opinion of experts, the short- and medium-term prospects of development of the Russian market of welding consumables are linked with further growth of the electrode market in the absolute values. The share of electrodes in the total volume of production and consumption of welding consumables will reduce. The growth of consumption of solid and flux-cored wires will continue, but the dominant position in the market will still be occupied by electrodes [24].

Economy of *Ukraine* is among the economies that were most affected by crises in Europe. Because of reduction of demand and revenue, as well as absence of credits, enterprises of Ukraine decreased their pro-

duction. In 2008 the industrial production reduced by 3.1 %, and in the first quarter of 2009 this reduction exceeded 30 %. The general state of the economy influenced the volume of production and consumption of welding equipment and consumables.

Table 19 gives data of the State Statistic Committee of Ukraine on the volume of production and consumption of the main types of welding consumables, as well as their marketing in 2007–2009 [25].

The structure of production and consumption of welding consumables in Ukraine consists of over 50 % of welding electrodes, among which the share of electrodes of the ANO type is over 70 %. In 2007–2009, production of welding consumables in the country reduced almost two times. This applies to all of the main types of products. Utilisation of welding consumables was reduced by 40 %. Fused fluxes constituted the main part of export of welding consumables, and alloyed welding wire – the main part of import.

**Market of welding equipment.** The largest regional markets of welding equipment are the USA, as well as the EU and Asia countries (Japan, China and the Republic of Korea). Total sales in these markets constitute 3/4 of the entire world market of welding

**Table 19.** Apparent consumption of welding consumables and filler metals in Ukraine, thou t

Year	Index	Welding wire		Flux-cored wire	Electrodes	Fluxes	Total
		Conventional	Alloyed				
2007	Production	8.4	13.6	0.9	59.0	29.5	111.4
	Export	–	6.1	0.2	3.9	21.4	31.6
	Import	–	4.7	0.8	2.2	0.3	8.0
	Apparent consumption	8.4	12.2	1.5	57.3	8.4	87.8
2008	Production	9.0	12.8	0.6	43.0	27.8	93.2
	Export	–	5.3	0.3	3.9	19.7	29.2
	Import	–	6.6	1.2	3.7	0.9	41.6
	Apparent consumption	9.0	14.1	1.5	42.8	9.0	76.4
2009	Production	7.1	9.2	0.2	33.7	18.7	68.9
	Export	–	3.0	0.2	5.9	13.1	22.2
	Import	–	2.3	0.7	0.8	1.9	5.7
	Apparent consumption	7.1	8.5	0.7	28.6	7.5	52.4



equipment. In 2009, a fall in sales (by 6.4 % on the average) took place in the world market of welding equipment, this being related to a substantial reduction of demand in the majority of metalworking industries. That affected to the highest degree the markets of Europe and America (up to 30–40 %). However, increase in sales in the markets of Asia and South America, as well as the increased demand for welding equipment in power engineering (manufacture of turbines for wind power stations) and in the sector dealing with repair and renewal operations allowed the fall in sales to be compensated for to a substantial degree.

The world market of welding equipment is highly fragmented. Welding equipment is produced by over 1500 major and medium manufacturers, among which the main ones are ACRO Automation Systems, Inc., Böhler Thyssen Welding USA, Inc., Datalogic Automation S.r., ESAB Holding Ltd., KUKA Aktiengesellschaft AG, L'Air Liquide S.A., Lincoln Electric Holdings, Inc., Miller Electric Mfg. Co., Miyachi Corp., Motoman, Inc., OBARA Corp., Panasonic Welding Systems Co., Soudronic AG, Schlatter Holding AG, etc. As to turnover, in 2008 the top five of the world leaders included Lincoln Electric (2.5 billion USD), ESAB (2.5 billion USD), ITW (1.8 billion USD), ALW (900 million USD), and Böhler (800 million USD) [26].

*Equipment for arc welding.* Like steel preserves its position as a basic material for welded structures, fusion arc welding remains the basic technology among a wide range of technologies for making of permanent joints. A characteristic trend in development of arc welding is reduction of the share of manual covered-electrode welding at the expense of widening of application of more efficient automated gas-shielded welding using solid and flux-cored wire. For instance, during the last 30 years the share of application of manual covered-electrode welding in the leading regions of the world reduced almost twice. In the last years the rate of reduction of utilisation of this welding method slowed down to some extent, and there are good reasons to expect that in the nearest future the share of manual arc welding (by weight of the deposited metal) in industrialised countries will stabilise at a level of about 15 %. In the developing countries the share of application of manual arc welding is still high and constitutes about 60 %.

In 2008, the arc welding equipment segment of the world market was estimated by «Frost & Sullivan» at 3.3 billion USD. The share of the market of welding equipment in the West Europe is approximately 30 % of the entire market of welding equipment in this region. In 2007, sales in this segment of the market were 572.4 million USD or 29.6 % of the entire West Europe market of welding equipment. A fall in sales in the sector of arc welding equipment caused by the crisis of 2009 in Germany, which is the main manu-

facturer of welding equipment in Europe, was about 10 % (in industry on the average — 33.5 %). Reduction of production of standard arc welding equipment in Japan was 66 %.

Machines for gas-shielded arc welding dominate in the market of arc welding equipment. For example, in Japan this type of equipment constitutes 90 % of the market of arc welding equipment. Demand for gas-shielded arc welding is invariably high. Modern machines for arc welding (MIG/MAG and TIG) are fitted with power supplies with numerical control systems. Application of high-end computers and inverter circuits allows the arc processes to be controlled at a high speed, accuracy and optimality. The equipments is also fitted with numerically controlled wire feed mechanisms. The equipment for combined and hybrid welding processes, such as gas-shielded metal-electrode, hybrid laser-arc and plasma-arc welding, is in high demand.

The market of equipment for aluminium welding, where at present the gas-shielded metal (MIG/MAG) and tungsten-electrode (TIG) equipment also constitutes the major part, grows with increase in the volume of consumption of aluminium. According to the data of «Frost & Sullivan», in 2009 the world market of equipment for aluminium welding amounted to 912.4 million USD. It is predicted that by 2015 this market will make up 1,222 million USD, the annual growth being 5 %.

The main requirements of customers to the arc welding equipment include reduction of weight, improvement of reliability of devices and their quality, consistency of welding parameters and a wide application field of the equipment. The need for automated welding equipment has grown. For instance, in Japan every fourth of ten power supplies used in industry is equipped with numerical control [27, 28].

*Equipment for gas welding and cutting.* The volume of application of gas-oxygen welding continues to be reduced and replaced by other, more advanced technologies. Equipment for the gas-oxygen welding processes is characterised by a low cost. The cutting equipment is portable and automated. However, slow manual work and shortage of skilled manpower for operation with this equipment limit its application. Machines for automated cutting are the most promising type of equipment in this segment of the market. Utilisation of this type of the machines continually grows despite a serious competition on the side of equipment for laser, plasma and water jet cutting. With a predicted annual mean growth of the market by 2.3 %, the market of gas-oxygen cutting looks better: according to the forecast, its growth will be 3.2 %. In 2009, the share of equipment for gas welding and cutting was about 8 % of the world welding market, this making up approximately 1 billion USD [29].

*Resistance welding equipment.* The market of resistance welding equipment is about 20 % of the entire

market of welding equipment, and annual sales amount to about 2 billion USD. The key customers of the resistance welding equipment are such industries as motor car construction, ship building and construction industry. However, at present the customers of this type of the equipment, especially automakers, prefer to buy the automated laser equipment, this leading to certain difficulties for resistance welding equipment manufacturers in terms of retaining their share in the market. The highest growth of sales of the resistance welding equipment is predicted for Asia (China, Japan, Malaysia, Thailand, Indonesia, Republic of Korea, Singapore), this being favoured by growth of foreign investments into this region, especially into motor car construction and electronics, where demand for the resistance spot welding equipment has grown [29].

**Laser welding equipment.** The market of the laser welding and cutting equipment is characterised by stable development in all regions of the world. Despite a high cost, this joining technology provides the high quality of welding, as a result of which it has found a wide application in motor car construction, metal-working industry and aerospace engineering. According to the data of «Optech Consulting» [30], the volume of sales of macroprocessor-based industrial laser systems, which include equipment for cutting, welding, marking and other processes, was 3.8 billion Euro in 2009, this being 40 % lower than in 2008. The share of laser systems used for welding and cutting in 2008 was 51 %.

The world market of industrial laser systems for welding and cutting is more than half of the world market of industrial laser systems. According to the estimation made by «Frost & Sullivan», the European market of laser welding equipment will amount to 802 million USD by 2011. This growth is favoured by improvement of the laser technologies and, in particular, equipping the laser systems with disk and fibre lasers, the volume of sales of which continually increases [29].

Flexibility of production systems, high reliability of equipment and easy integration into production lines are the factors that suggest further growth of scopes of application of this type of the welding equipment. At the same time, high initial costs, lack of knowledge of advantages of this process among the end users and their insufficient skill hamper the growth of sales of this equipment.

**Ultrasonic welding equipment.** As estimated by the «Frost & Sullivan» experts, the market of ultrasonic welding equipment has a substantial potential. This welding process is applied to join both plastics and metals. Predicted is a 6 % growth of sales of the equipment for welding of plastics, and approximately 9 % growth of sales of the equipment for welding of metals. The volume of the world market of ultrasonic welding equipment was 630 million USD in 2006. A

factor that promotes growth of application of this process is reduction of utilisation of adhesion for thermoplastic compounds [29].

**Market of welding robots.** Along with renovation of technologies, modern welding production is characterised by a high level of mechanisation, automation and robotics by using information technologies, computer control systems, diagnostics and monitoring.

Increase in the world population of industrial robots during the last decade is impressive. In 1990 the number of the robots used in the world was 460,000 pieces, in 2003 this number was 886,000 pieces, and in 2010 this number increased to 1.2 million pieces. Japan and the Republic of Korea use almost 50 % of the total world population of industrial robots. Table 20 gives data on the volume of annual sales and population of industrial robots in the world during a period of 2008–2010, as well as the forecast for 2013.

In 2009 the volume of sales of industrial robots in value terms reduced by 39 %, compared to 2008, and made up 3.8 billion USD. Figure 13 shows data on the quantity of industrial robots annually installed all over the world.

Being the major world manufacturer of industrial robots, Japan has constantly reduced investments into production, starting from 2006. In 2009 the volume of production of robots in this country decreased by 50 %, compared to 2008. In the Republic of Korea the volume of application of industrial robots decreased from 11,600 (2008) to 7,800 pieces (2009). The sales in Europe fell by 41 % (to 20,500 pieces). Motor car construction (–52 %) and machine building (–64 %) decreased their purchases to the greatest degree. The sales of robots in China, India, Thailand and Taiwan decreased, and only in Mexico in 2009 there was some growth of the sales (up to 1,100 pieces), mostly in motor car construction.

According to the estimate made by the International Federation of Robots (IFR) experts, starting from 2010 the world market of industrial robots will annually grow by 5.5 %. In the next few years the largest customer in this sphere will be China, its share in the world consumption will increase to 29 %.

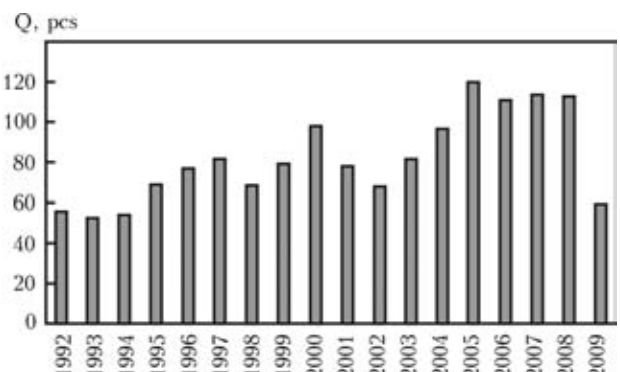


Figure 13. Quantity Q of industrial robots installed in the world in 1992–2009 (according to the IFR data)

**Table 20.** World market of industrial robots in 2008–2010, pcs

Index	2008	2009	2010	2013 (forecast)
Sales	113345	60018	76000	102300
Sales, excluding Japan and Republic of Korea	68635	39412	49200	69300
Total quantity (population) of industrial robots in operation	1035674	1020731	1173300	1119800
Total quantity (population) of industrial robots in operation, excluding Japan and Republic of Korea	603189	609008	693800	746300

Industrial robots in the current welding production are a basic element in the process of high-efficiency manufacture of the increased-quality welded items and structures. The share of production of welding robots is about 30 % of all industrial robots. Including robots designed for cutting, soldering, brazing, coating and gluing, this share grows to 40 %. In Spain, Great Britain, USA and a number of other countries the share of welding robots constitutes about half of the entire population of industrial robots [31].

Therefore, it can be concluded on the basis of the above-said that the world market of the joining technology and equipment continually grows. At present its growth is attributed mostly to the Asian countries, especially China. Consumption of solid and flux-cored wires dominates in the market of welding consumables, although the share of covered electrodes is also high, particularly in the growing markets of Asia, South America and CIS.

Demand for the arc and resistance welding machines predominates in the world market of welding equipment. The market of equipment for high technologies, i.e. laser welding and cutting, hybrid welding, as well as other joining technologies, such as gluing, soldering, brazing and mechanical joining, grows at a high rate.

The modern welding market is characterised by the following trends: increase in demand for automation of the joining technologies, this corresponding to addressing the problems associated with a rise in productivity, improvement of quality and speed of the welding processes and reduction of production, labour and training costs; growth of the volume of application of special steels and alloys, aluminium alloys and plastics in the key industries, e.g. motor car construction and aerospace engineering, which requires corresponding joining technologies, equipment and materials; and increase in the output of higher valued-added products due to the use of various monitoring sensors, digital control circuits and computerisation of the technological processes.

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