

## NEW BOOKS

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### EXTRUSION OF STEEL TUBES AND SECTIONS\*

Reviewed by M. V. Korolev

The book being reviewed consists of nine chapters, and the material presented in it embraces all the basic problems in the process of extruding steel tubes and sections, including theory, technology, equipment, tooling, lubrication, and economic aspects. The book may be used by plant and equipment designers, researchers, and students in higher and secondary educational institutions.

Chapter I sets out the history of the development of steel tube extrusion, the present situation, and the importance of the process in tube production.

Chapter II gives experimental data on the nature of metal flow in piercing and extrusion which enable the reader to form an impression of the extrusion process, its peculiarities, and the laws which govern it.

Chapter III is devoted to a mathematical description of the stress-strain state in the process. The second part of this chapter gives formulas for calculating extrusion forces obtained at various times by Sejournet, L. V. Prozorov, and S. I. Borisov with A. E. Pritomanov. Both the formulas and the results of calculation differ substantially in structure, indicating different limits of applicability of the formulas. It is therefore a pity that the authors have not made a mathematical analysis of the formulas and have not indicated their limits of application.

Chapter IV contains the initial data for designing a section or shop. Methods of calculating the extrusion and output scale, and also recommendations on permissible ratios based on Soviet and foreign practical data, are given here, together with the calculation of metal consumption in each process operation defined in dimensionless values in the form of a coefficient, which the authors erroneously call the metal consumption coefficient. It would be more correct to call it the coefficient of inevitable process losses. In contrast to a consumption coefficient, which reflects the actual conditions in which the process takes place, it depicts ideal conditions, i.e., without rejects and waste.

Chapter V contains detailed information on the process technology, practical and experimental data, and the features of each process operation from billet preparation to the dressing of the finished tube. The material in the chapter embraces Soviet and foreign practice in the extrusion of steel tubes and profiles, and laboratory and plant investigations.

Chapter VI is devoted to lubrication, one of the most vital factors in the process of steel tube extrusion. This chapter gives theoretical data on the nature of lubricant action, supplemented by practical data and by the results of laboratory investigations.

Chapter VII gives data on the selection of material for tools (dies, rams, mandrels, containers, etc.), their finishing, accuracy of manufacture, heat treatment routines, and life.

Chapter VIII contains detailed information on the basic equipment in modern Soviet and foreign extrusion shops, including the equipment for the billet preparation, heating, piercing, extrusion, reduction, and finishing sections. Standard layouts of operational shops are also given.

\*Metallurgiya, Moscow (1973), 188 pages, illustrated.

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TABLE 1. Comparative Data on Consumption of Metal and Production Tooling

Indices	Source	Tube rolling unit			
		with 5000-ton press	with automatic mill	with continuous mill	with pilger mill
Metal consumption coefficient	Table 24, p. 177 of book	1.117	1.12	1.109	1.2
Production tooling, kg/ton		3.4	4.6	1.5	6.3
Rolls, kg/ton		0.26	3.2	0.49	1.81
Total cost of production tooling and rolls, rubles/ton		2.48	5.05	1.35	5.86
Metal consumption coefficient	Technological design norms	1.137	1.083	1.077	1.2
Production tooling, kg/ton		6.72	2.5	3.24	4.54
Rolls, kg/ton		0.75	2.93	0.614	1.26
Total cost of production tooling and rolls, rubles/ton		5.11	2.98	2.61	3.87

The last chapter in the book, which is devoted to the economic aspects of the process, sounds a discordant note. Here methods of calculation (and the calculation itself) of corrected expenditure are given for extrusion and other comparable processes of tube production: in tube-rolling units with automatic, continuous, and Pilger mills.

Unfortunately the calculation is based on erroneous initial data; this has led the authors to incorrect final results and consequently to erroneous conclusions as to the place and importance of this process in tube production. The erroneous initial data include the following: the metal consumption coefficient, which is understated for the extrusion process and overstated for the comparable processes relative to the results which have been achieved in operational mills; the consumption and cost of production tooling, which are also understated for extrusion and overstated for comparable mills; the output adopted for comparative calculation is almost twice that of a new extrusion shop planned for construction and, conversely, in the case of the 48-168 mm continuous rolling mill it is considerably below the production level already achieved on the operational 30-102 mill at the Pervoural'sk new tube plant, and consequently below the output of the 42-146 mm continuous mill which is being designed.

To prove the above statement, metal consumption coefficients and data on production tooling consumption adopted for calculation in the book under review and according to the technological design norms confirmed in 1972 are given in Table 1.

If we now adjust the prime cost of production according to the Table, even without taking account of the mistakes made in defining output, we obtain the following results, rubles/ton:

	Under Table 4, p. 177	Under adjusted table
Tube rolling units:		
with 5000-ton press		80-82
with 140 automatic mill	82-81	79-56
with continuous mill	78-65	78-88
with pilger mill	82-06	80-07

As can be seen from the data given above, the results (and so the conclusions) are directly opposed to the conclusions set out in Chapter IX. If an adjustment is made to take account of the output of mills being designed or of results achieved in similar mills abroad, the difference will be still greater.

The corrected expenditure per ton of usable product is wrongly calculated. It does not accord with the formula  $C = P + SI$ , where  $C$  is the corrected expenditure,  $P$  is the prime cost,  $I$  is the specific capital investment, and  $S$  is the standard for the industry, equal to 0.12. However, it would be a mistake to reject the process on the basis of these calculated data, just as the attempt made in the book to prove its universal efficiency was a mistake.

The process has been widely developed in the world. Its advantages in tube production from deformation-resistant steels and alloys, and also in the production of sections and tubes in commercial-grade steels (but in very small batches), need no proof. The extrusion process supplements other processes for the mass production of tubes because it expands the range and gives flexibility in planning. The product prime cost calculation adjustment given therefore has but one purpose: to show that the calculations in Chapter IX are wrong and that this chapter should be excluded when the book is reprinted.

The authors' recommendation that the extrusion press should be used in combination with a reducing mill does not appear to be well founded. The fact is that the inclusion of a reducing mill in the extrusion assembly deprives the process of some of its main advantages, including:

a) the possibility of producing tubes in deformation-resistant steels and alloys, because tensile stresses inadmissible in these steels arise in the metal during reduction;

b) maneuverability, because as in any other process each changeover necessitates the resetting of the reducing mill and, as can be seen from the material set out above, production of an ordinary commercial range by this process is inefficient.

In conclusion I wish to say that these comments do not detract from the value of the book, with the exception of the comments on Chapter IX. The book is useful both as teaching and reference material, and it will be a work of reference for extrusion shop designers. The book was sold out immediately, almost before it came from the press, which is evidence of its real value. It should be reprinted, taking account of the comments on Chapter IX.