Preview Development of modern industry requires an increase in the temperature limit of exploitation of elastomer materials including extreme conditions in the field of thermal decomposition which is achieved by using new components that provide the flowing of physical and chemical transformations enhancing their operational stability. Additives that can change their structure under external influences (e.g., layered, intumescent additives, etc.) play an important role in improvement of rubber operational stability [1, 2]. In extreme operating conditions, at temperatures near and above the temperature working capacity of a material, functionally active fillers can play a stabilizing role in thermal destruction of the material [1, 2]. One of the perspective directions for solving the problem is to use intumescent and highly dispersed metal-containing fillers in elastomeric compositions, as also aluminum silicates, fillers with a catalytic activity, highly dispersed silicon carbide [3-5] including the compounds of the transition metals. Some of the metals related to d-elements have properties which enable to apply them as protective and wear resistant coatings, a fireproof material for aircraft and rocket engines, a component of multilayer coatings for laser mirrors and beam splitters [6], for production of refractories for increasing campaign in furnaces for melting glass and aluminum. Such refractories are used in the metallurgical industry for gutters, glasses in the continuous casting of steel and crucibles for melting rare earth elements. They are also used in some ceramic-metal coatings, which have high hardness and resistance to many chemicals and keep short-term heating up to 2750 °C. It is also known the use of metal organic compounds containing these elements as a crosslinking agent for polymers [7]. Experimental Results and Discussion The research was devoted to a study of influence of transition metal compounds on the properties of rubber mixtures and their vulcanizates based on general-purpose raw rubbers. Rubber mixtures were prepared according to the standard recipes based on styrene-butadiene raw rubber using the sulfur vulcanizing group with partial replacement of carbon black on the analyzing compounds (Table 1). Table 1 - Filler content in the studied compositions Filler Number of a rubber mixture Z-0 Z-1 Z-2 Z-3 Z-4 Z-5 Carbon black П-324 40 35 30 25 20 15 $ZrO_2$ - 5 10 15 20 25 Kinetic parameters of rubber mixtures were determined by using Monsanto 100S rheometer. Research has shown that introduction of transition metal compounds increases the induction period, but it practically does not change the vulcanization rate (Fig. 1). In addition, there is a reduction of elastic-strength properties, however, resistance to thermal-oxidative ageing and resistance to flame action rises (Table 2). To estimate fire resistance, the dependence of temperature on the unheated sample surface from the exposure time of the plasma torch flame was determined (Fig. 2). Temperature on the sample surface was generated about 2000 oC.For the experimental samples the heating time increases and degradation occurs at higher temperatures compared with the control sample. When the experimental samples are exposed to flame, a dense and flame retardant coke which protects the sample from burning is formed on their surface (Fig. 3). Fig. 1 - Kinetic curves of vulcanization: 1 -

Control rubber mixture Z-0; 2 - mixture Z-1; 3 - mixture Z-2; 4 - mixture Z-3; mixture Z-4 Table 2 - Physical and mechanical properties of vulcanizates* Parameter Number of a rubber mixture Z-0 Z-1 Z-2 Z-3 Z-4 Tensile strength (fp), MPa 18,0 14,0 15,0 12,2 13,3 Elongation at break, % 420 410 590 560 490 Relative residual elongation after fracture, % 12 9 11 9 9 Change of parameters after aging (100 °C x 72 hrs), %: Δfp Δε -45 -67 -36 -61 -40 -63 -34 -64 -31 -59 Linear combustion velocity, mm/min 24,56 23,96 22,72 15,96 15,18 Warm-up time of the sample surface to 100 °C, sec 60 60 60 80 90 Time of burning-out of the sample, sec 100 110 110 120 130 *Vulcanization mode:145ºC, 30min Fig. 2 - Dependence of temperature on the unheated sample surface on the heating time Fig. 3 - View of carbonized surface of an experimental vulcanizate sample (coke layer) under the flame exposure Conclusion So, the research has shown that the investigated transition metal compounds can be used to effectively enhance the fire resistance of elastomeric materials and reduce their cost.