

A NEW ZINC BASE ALLOY -- ILZRO 12 (*)

B.C. Agrawal
Indian Lead Zinc Information
Centre, Calcutta -16
And
Donald C. Herrschaft
International Lead Zinc Research
Organization, Inc.
New York, U.S.A.

'ILZRO 12', has extremely good qualities as a gravity casting alloy and is capable of meeting a wide range of industrial demands. The alloy is already in commercial production and use in the United States. It has also recently been introduced in India and a number of non-ferrous foundries have carried out successful trials. ILZRO 12 is not covered by patent rights and can be exploited without any restrictions.

COMPOSITION

The recommended composition limits for the alloy are as follows :

Aluminium	...	11 to 13 per cent
Copper	...	0.5 to 1.25 per cent
Magnesium	...	0.01 to 0.03 per cent
Zinc (SHG)	...	Balance

The nominal composition is 12 per cent aluminium, 0.75 per cent copper, 0.02 per cent magnesium and balance zinc. It has been found that this particular composition gives the best combination of properties.

PROPERTIES

The typical mechanical properties of ILZRO 12 in the preferred composition range of 11-12 per cent aluminium are given in Table I :

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National Metallurgical Laboratory, Jamshedpur.

TABLE- I
Mechanical Properties of ILZRO 12 Alloy

	Sand Cast	Chill Cast
Tensile strength (lb/in ²)	43,500	53,500
Proof stress (lb/in ²)		
0.1%	24,000	24,500
0.2%	30,000	31,000
Elongation (%)	3½	5
Hardness (VPN)	110	115
Impact Strength at 21°C (ft.lb)		
11% aluminium	17	13
12% aluminium	7	5
Young's modulus	12-13 x 10 ⁶ for all alloys and conditions	
Shear strength (lb/in ²)	32,000	
Fatigue, endurance limit 10 ⁸ cycles (lb/in ²)	8,000	
Creep stress to give 0.1% strain at 500 hours (lb/in ²)		
20°C	8,000	
50°C	3,000	

ILZRO 12 possesses remarkable stability and the mechanical properties are not much affected after ageing. Extensive stability tests have been carried out by heating the alloy at 95°C for ten days. The effect of such a test on the properties of a 12 per cent aluminium alloy is given in Table II.

TABLE II
Effect of steam ageing on mechanical properties of 12% Al-0.75% Cu 0.02% Mg Alloy

Properties	Chill Cast		Sand Cast	
	Before	After	Before	After
0.1% proof stress, psi	24,600	22,200	24,050	26,000
Tensile strength, psi	54,750	41,350	44,250	41,500
Elongation, pct. on 2"	5	27	3½	3½
Hardness, V.P.N. (10 kg load)	115	96	113	98

ILZRO 12 has fairly good dimensional stability, the shrinkage being 0.00013 in./in. in a year at room temperature. At 100°C, after an initial rapid shrinkage, the alloy shows an expansion at the rate of approximately 10^{-6} in./in./day till it increases by 0.000065 in./in. in 200 days and then almost levels off.

The linear thermal coefficient of expansion of ILZRO 12 is 27.1×10^{-6} in./in./°C over the range of 20-100°C. This compares favourably with those of zinc die casting alloys and other non-ferrous sand casting alloys. The coefficient of thermal expansion of cast iron over the same temperature range is 11.7×10^{-6} in./in./°C. However, as the temperature range from solidification to room temperature is much greater for cast iron, the shrinkage allowance for making patterns is not much different in both cases.

The machinability of ILZRO 12 is excellent and no difficulty is experienced in roughing, finishing, milling and screw cutting. This property of the alloy is a distinct advantage in gravity cast components which have to be normally machined.

ILZRO 12 has very good finishing properties and can be electroplated easily by any commercial techniques used for conventional zinc die cast components. Castings made in ILZRO 12 can also be painted, anodized or given any other decorative finish. The excellent flow characteristics of the alloy enable fine mould details to be easily reproduced with low surface porosity which enhance the finished quality of a subsequently plated, painted or otherwise finished casting.

Castings of complex shapes can be produced both in sand and chill moulds, since the alloy is not susceptible to hot tearing.

The presence of about 12 per cent aluminium has an appreciable effect on the specific gravity of the alloy. The specific gravity of ILZRO 12 is 6.0 as against 3.4 - 3.9 for most of the brasses and bronzes.

MANUFACTURE OF THE ALLOY

The procedure for making this alloy is simple. The zinc (or Zamak 3 scrap) is melted in the crucible and the temperature of the metal is raised to above 550°C. The required amount of aluminium is melted in a separate crucible and superheated to about 740°C in which copper is dissolved as pure metallic copper, 50-50 copper-aluminium alloy or Pb/Cd/Sn free brass. This aluminium alloy is poured into the zinc bath, whilst stirring vigorously using a flat-ended plunger. After thorough mixing, the bath temperature is brought down to about 500°C and then the magnesium is plunged into it. By this method, there is no pre-

-ferential loss of alloying elements and no allowance need be made in calculating the charge.

FOUNDRIY TECHNOLOGY

ILZRO 12, being relatively insensitive to cooling rates, can be cast in a wide variety of moulds, such as those made of sand, plaster of paris, shell or metals. Since the pouring temperature of this alloy is low, clay-bonded natural sands of low refractoriness can be used. No additions, except water, are required and excellent surface finish may be obtained by using a fine-sieved sand for facing. If graphite or chalk is dusted on the mould surface, a further improvement in the finish will be obtained. For best results, quick melting to pouring temperature (475-520°C) is recommended. No gas pick-up occurs at these temperatures and the castings remain free from porosity. However, the melt can be held for a couple of hours at 500°C without any deterioration in the properties. This allows the alloy to be held in a bale-out furnace for permanent mould casting.

ELECTROPLATING OF ILZRO 12

ILZRO 12 has very good platability and, if conventional polishing and buffing procedures are adopted, can be satisfactorily electroplated in the same manner as the normal zinc die castings. However, special procedures have been developed where buffing prior to plating may be minimised or eliminated, which result in great economy. Further details about the new procedures may be obtained from the Indian Lead Zinc Information Centre upon request.

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