

A new zinc-base alloy—ILZRO 12

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GRAVITY casting is one of the oldest processes of fabricating metals and alloys, and even today has special significance in a developing economy such as India's. The volume of production in developing countries is often so low that rapid mass production methods, such as pressure die-casting, are often not economically very attractive. For making castings in small numbers, gravity casting method will continue to play an important role. Although brasses and bronzes have been widely used as gravity casting alloys since long and some aluminium gravity casting alloys have come into vogue in comparatively recent times; they are costly and present difficulties due to their high melting temperature. The present-day world is a competitive one and only materials having low costs and improved properties can survive the competition.

In the quest for a low cost gravity casting alloy, extensive research work has been done under the sponsorship of the International Lead Zinc Research Organisation, Inc. (ILZRO), New York, and a new zinc-base alloy has been developed which promises to replace effectively the most costly brasses, bronzes and aluminium alloys for many applications. This alloy, which is designated ILZRO 12, has extremely good qualities as a gravity casting alloy and is capable of meeting a wide range of industrial demands.

Unique features

The unique features of ILZRO 12 are :

- (a) insensitivity to cooling rates, which permits it to be gravity cast in various types of moulds without any loss in properties ;
- (b) as-cast properties better than most of the non-ferrous sand casting alloys and grey cast irons ;
- (c) excellent castability resulting in better reproduction of pattern details ;
- (d) excellent machinability ;
- (e) lower casting temperature than brasses, bronzes and aluminium alloys, which provides better working conditions for workers and reduces cost of production ;

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SYNOPSIS

Gravity casting process has its own place in Indian economy, since often the casting requirements are so small that pressure die-casting is not justified. However, the two conventional zinc alloys used for die-casting are not suitable for gravity casting purposes. A new zinc-base alloy known as ILZRO 12 has been developed under the sponsorship of the International Lead Zinc Research Organisation, Inc., New York, which shows promise for use as sand and permanent mould or gravity die-castings. The paper describes the composition, properties and technique of melting and casting of this alloy. The information needed by the foundry in casting the alloy, including the effects of foundry variables on properties and data needed by the designer, is given. One of the special characteristics of this alloy is that it can be readily electroplated by conventional methods. The recommended procedures for electroplating are described in the paper. The suitability of this alloy for low volume production is discussed and examples of the castings made from ILZRO 12 in India and elsewhere are presented.

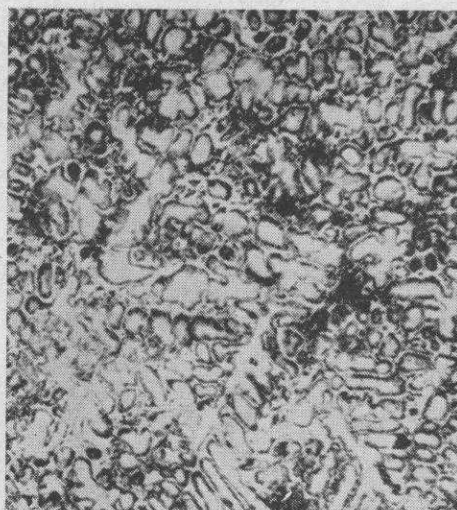
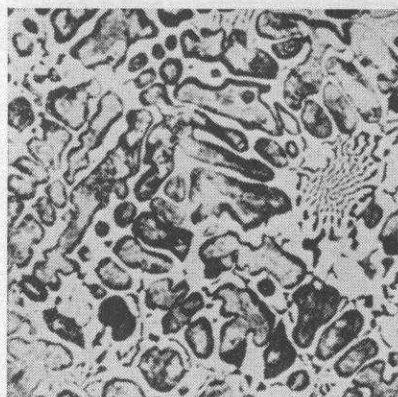
- (f) excellent platability, which makes it particularly suitable for components to be electroplated ; and
- (g) lower material cost as compared to brasses, bronzes and aluminium alloys.

Although the development of ILZRO 12 has been very recent, because of the above-mentioned properties it is already in commercial production and use in the U.S. The alloy has recently been introduced in India and a number of non-ferrous foundries have carried out successful trials. It will not be out of place to point out that 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%
Copper	0.5 to 1.25%
Magnesium	0.01 to 0.03%
Zinc (SHG)	Balance



1 Microstructure of ILZRO 12 from an unchilled plate (left) and a chilled plate (right)

The nominal composition is 12% Al, 0.75% Cu, 0.02% Mg and balance Zn. It has been found that this particular composition gives the best combination of properties. Although the variation of aluminium within specified limits has little effect on the proof stress and tensile strength of the alloy, the elongation and impact values decrease with increase in aluminium, more predominantly in sand castings. Aluminium content near 11% improves the ductility and impact properties, but the tensile strength is lowered. For maximum toughness, an alloy with 11-11.5% Al is recommended. In a 12% Al alloy, the presence of 0.75% Cu gives the highest tensile strength and elongation in chill castings whereas in sand castings maximum properties are attained with 1.0% Cu.

The alloy should be free from impurities like lead, cadmium, tin, iron, indium and thallium. The limits prescribed for these elements are the same as for pressure die casting zinc alloys (IS : 713-1966). Lead, cadmium and/or tin above the prescribed levels cause a deterioration in the mechanical properties and decrease the corrosion resistance of the alloy. Any increase in the iron content of the alloy may affect casting characteristics; therefore, melting in iron crucibles should be avoided unless they are properly coated with a refractory wash to prevent iron pick-up. The effect of the presence of 0.06% Pb on the hardness and impact strength of the alloy is shown in Table I.

The table shows that although the hardness is not much affected by the presence of lead, the impact strength of the alloy is drastically reduced. This makes the castings unsuitable for applications where they are required to withstand sudden shocks. Furthermore, lead-contaminated alloy is prone to severe corrosion in a relatively humid tropical climate.

Structure

The alloy is primarily composed of aluminium-rich dendrites (dark areas) in an eutectic matrix made up of α and β (zinc-rich phase) as shown in Fig. 1. With

TABLE I Effect of lead additions on the mechanical properties of ILZRO 12

	No lead	0.06% lead
Brinell hardness :		
As cast	101	98
10 days at 95°C (dry air)	80	80
30 days at room temperature	89	92
Impact strength (ft-lbs) :		
As cast	16	3.0
10 days at 95°C (dry air)	15	2.0
30 days at room temperature	17	2.0

the increase of aluminium content to 13%, the eutectic phase becomes less well defined and the structure shows only α dendrites in a β matrix. During cooling, β separates within the α by an eutectoid type of reaction at 275°C and by precipitation during further cooling. The continuous phase in the structure is the β of the eutectic which shows fine grains irrespective of the method of casting. This is the reason why there is not much variation in the impact values of the castings made in sand moulds of permanent moulds. This also explains the insensitivity of ILZRO 12 to cooling rates.

Properties

Mechanical

The typical mechanical properties of ILZRO 12 in

TABLE II 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	1 000
Elongation (%)	3.5	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 × 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*	

*Similar to Zamak 3

the preferred composition range of 11-12% Al are given in Table II.

The strength and hardness of this alloy are superior to all other non-ferrous sand casting alloys (except the strongest aluminium and manganese bronzes) and compare favourably with most general purpose grey cast irons as shown in Table III.

Effect of ageing

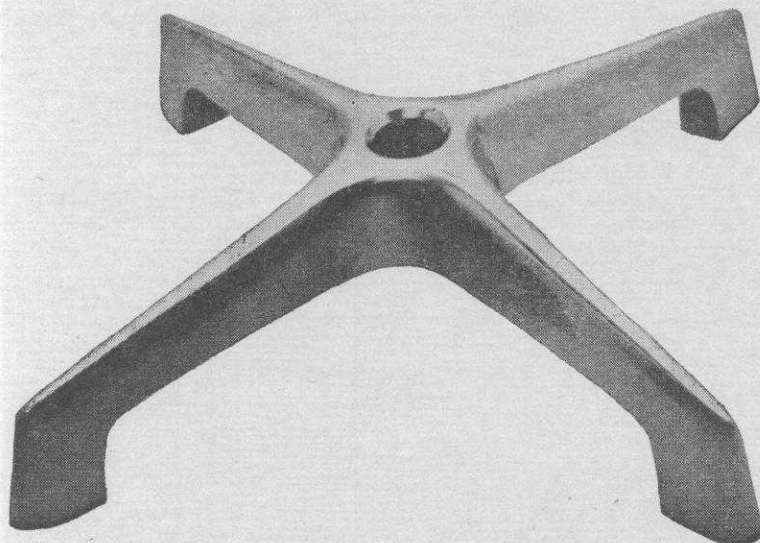
ILZRO 12 possesses remarkable stability and the mechanical properties are not much affected after ageing. Extensive stability tests have been carried out by heating the alloy at 95°C for ten days. This test is considered to be equivalent to more than ten years of ageing at ambient temperatures for zinc-base alloys. The effect of such a test on the properties of a 12% Al alloy is given in Table IV. It will be seen that properties of sand-cast bars are hardly affected by this treatment. In chill castings ductility improves after ageing, while the tensile value falls to almost the same level as for sand-casting.

Dimensional stability

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

TABLE III Comparison of the mechanical properties of ILZRO 12 and other non-ferrous sand casting alloys and grey cast irons

	Tensile strength psi	Yield strength psi	Elongation %	Hardness BHN	Impact strength ft-lbs
Sand cast zinc alloy ILZRO 12	43 500	30 000	3.5	110	17
Sand cast aluminium alloys:					
Al-5Si	19 000	9 000	6	40	—
Al-4Cu-3Si	21 000	14 000	2.5	55	—
Al-3.8Mg	25 000	12 000	9	50	—
Al-10Mg	46 000	25 000	14	75	—
Sand cast copper alloys:					
66Cu-1Sn-3Pb-30Zn	34 000	13 000	35	50	—
60Cu-1Sn-1Pb-38Zn	40 000	14 000	25	65	—
87Cu-7Sn-1Pb-5Zn	36 000	18 000	30	68	9
Grey cast irons:					
ASTM Class 20	18 000 to 26 000	—	—	130-200	—
ASTM Class 30	30 000 to 35 000	—	—	179-228	—
ASTM Class 40	41 000 to 46 000	—	—	180-241	—



2 Office chair-base, gravity cast in ILZRO 12 in a permanent mould

TABLE IV 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	41 850	44 250	41 500
Elongation, % on 2"	5	27	3.5	3.5
Hardness, V. P. N. (10 kg. load)	115	96	113	98

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.

Thermal properties

The linear thermal co-efficient 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 co-efficient 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. Therefore, the recommended pattern maker's shrinkage allowance of 0.15" per foot for ILZRO 12 compares favourably with 0.125" per foot for cast iron. This indicates that no special care has to be taken in preparing the patterns and moulds for gravity casting of this alloy.

Machinability

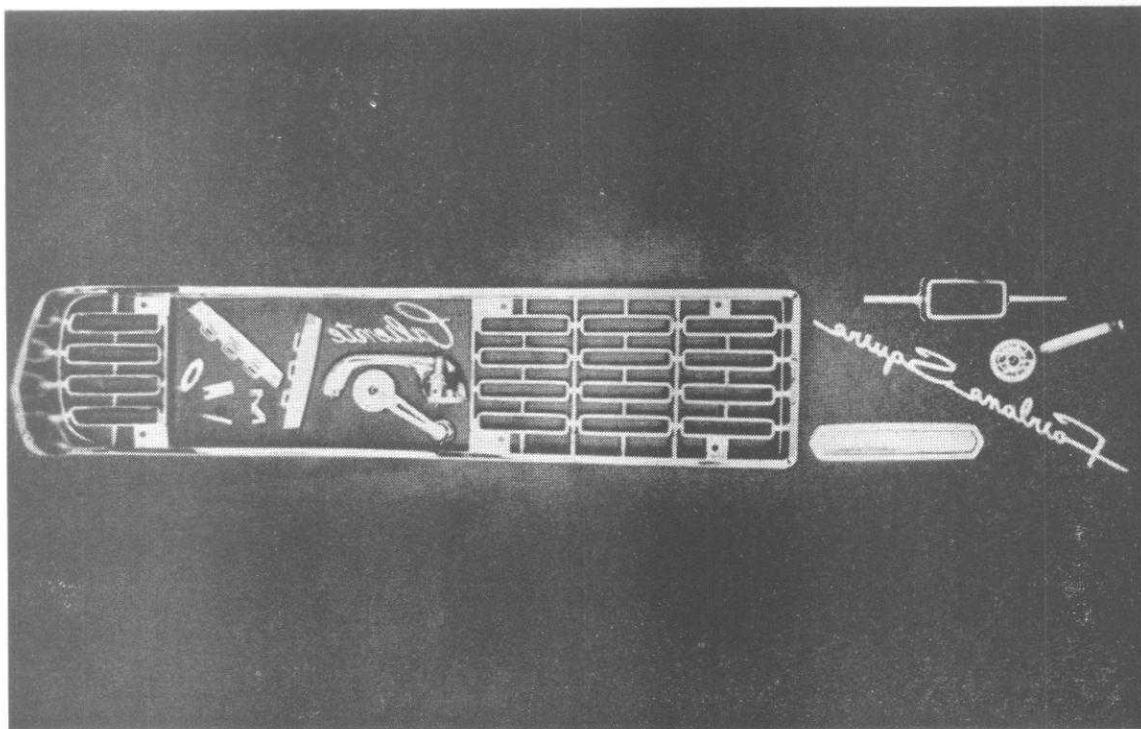
The machinability of ILZRO 12 is excellent and no difficulty is experienced in roughing, finishing, milling and screw cutting. This property of the alloy is a distinct advantage in gravity cast components which have to be normally machined. The general observations made during the turning of test pieces of ILZRO 12 are given in Table V.

TABLE V Machinability of ILZRO 12

Approximate depth machined per turn	0.1 in.
Speed (for 1 in. diameter bar)	390 surface ft/min.
Type of tool	Carbide-tipped
Clogging at cutting edge (built-up edge)	None
Chips	0.125–0.25 in. (discontinuous)
Surface finish	Good

Finishability

ILZRO 12 has very good finishing properties and can be electroplated easily by any commercial technique used for conventional zinc die cast components. A little care at the time of casting would enable the production of parts which may not require much of surface preparation prior to plating. 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.



3 Auto-trim parts, gravity cast prototypes in ILZRO 12; the parts are plated, names of cars are photographed in reverse to minimise commercialisation

Resistance to hot tearing

Castings of complex shapes can be produced both in sand and chill moulds, since the alloy is not susceptible to hot tearing. Tests carried out in severely restrained moulds showed no tearing.

Specific gravity

The presence of about 12% Al has an appreciable effect on the specific gravity of the alloy as shown in Table VI. From these figures it is apparent that ILZRO 12 is approximately 10% lighter than standard zinc die casting alloys and 40–50% lighter as compared to brasses and bronzes. This property is a distinct advantage in favour of this alloy for many applications.

Manufacture of the alloy

The alloy should be made from the highest purity raw materials for reasons already described. Zinc of 99.99% purity conforming to IS : 209–1966, high purity aluminium, cathode grade copper and cell grade magnesium should be used. Zamak 3 scrap (Alloy 1, IS : 713–1966) may be utilised if more conveniently available, as the impurity limits are similar in both the alloys.

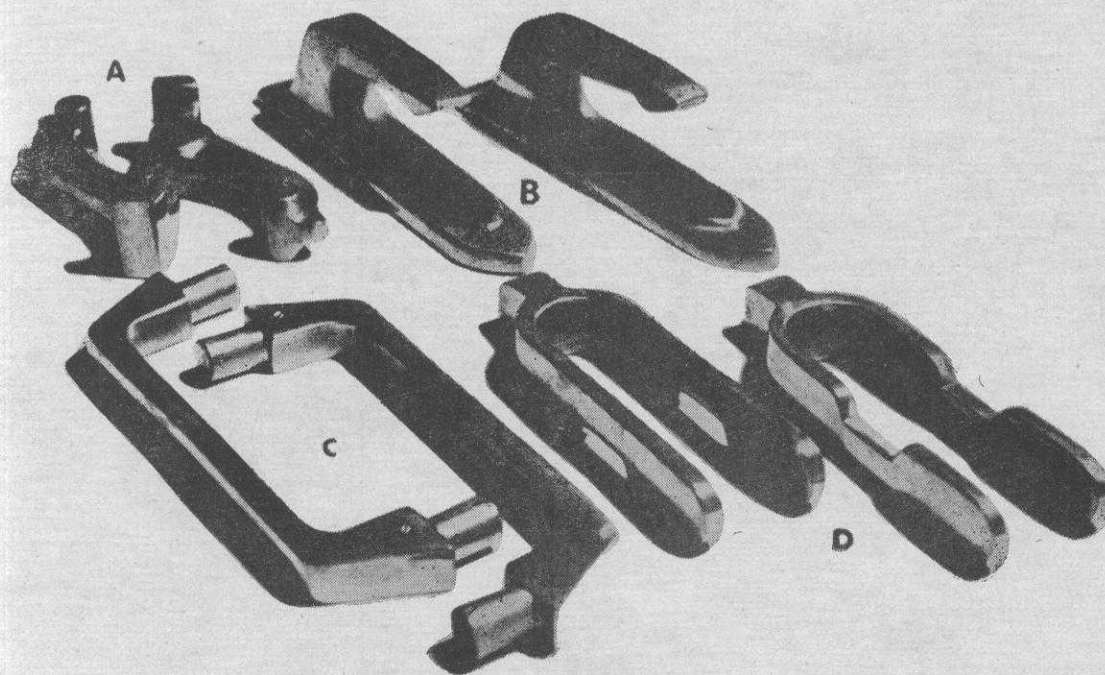
The furnaces and crucibles should be exclusively used for making ILZRO 12 or pressure die-casting

TABLE VI Specific gravities of various non-ferrous alloys

Alloy	Specific gravity
Brasses and bronzes	8.4–8.9
Zinc	7.13
Zinc die casting alloy 1*	6.6
Zinc die casting alloy 2*	6.7
ILZRO 12	6.0

*IS : 713–1966

zinc alloy. Clay-graphite crucibles lightly coated with alumina-wash are preferred but cast iron crucibles, as used for zinc die-casting alloys, may be satisfactory so long as the refractory wash is adequate to prevent iron pick-up. 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



4 Sample castings made in ILZRO 12; A—Dog for paper insulating machinery (original metal brass); B—Door handle of German design (original metal bronze with over 90% copper); C—Handle for refrigerator (original metal aluminium alloy or Zamak); D—Lever for paper mill machinery (original metal brass)

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 preferential loss of alloying elements and no allowance need be made in calculating the charge. Other methods of mixing may also be used but where the furnace itself provides no stirring action, the procedure described above proves very reliable. No flux is required when melting the alloy in indirectly-fired crucible furnaces which are normally used for such purposes, since a small quantity of dross formed is easily skimmed off just before pouring. The proportions of the alloying elements should be properly calculated depending on the type of raw materials used, viz. Zamak 3, copper-aluminium alloy or Pb/Cd/Sn-free brass.

Foundry technology

Moulding

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. It is recommended that sand moulds should be dried as much as possible before pouring the metal.

To achieve a high degree of surface finish, dimensional accuracy and reproduction of fine details in castings where their number does not justify a metal mould, ILZRO 12 may be cast into plaster moulds. In this category, two main types of moulds are in common use—a dense, rigid mould of low permeability formed in plaster of Paris, or by Shaw process a less rigid mould of higher permeability formed by foaming plaster or Antioch process. The ability of these moulds to reproduce fine details originates from the low chilling power (particularly of the porous moulds). However, the resultant slow solidification gives rise to the formation of surface shrinkage defects on the underside of the heavy sections following upward segregation of the primary aluminium-rich dendrites. The plaster mould should be preheated to about 200°C to remove absorbed moisture.

Cast iron moulds with a white dressing, as used for casting aluminium, may be utilised as permanent moulds for ILZRO 12. This type of mould is much simpler and cheaper to make than steel moulds.

Gating

A gating ratio of 1:2:2 as recommended for long-freezing range aluminium alloys is ideal for ILZRO 12. Since this alloy has a high fluidity and does not dross

as much as aluminium-base alloys or aluminium bronzes, systems not suitable to the latter alloys may also be used. Due to the same reasons, bottom gating is usually not needed. No defects due to drossing, cold shuts or porosity (except those given below) have been observed in the castings made in this alloy.

Feeding

ILZRO 12 is a pasty alloy and, therefore, when inadequately fed may give rise to defects such as surface sinks and draws with dispersed microshrinkage. To promote mass-feeding, it is recommended that feeders are located above the sections where the temperature gradients may not be favourable to feeding. In heavy sections with a feeder above, there is a likelihood of slight segregation of aluminium upwards into the feeder, which can be reduced by the use of chills. The segregation of the primary aluminium-rich dendrites upwards causes the surface feeding defect to form on the lower surface. In plaster moulds where the cooling rate is low, it is not possible to obtain a good surface finish on the underside of the sections over $\frac{1}{8}$ " thick. Under these conditions, additional feeding does not improve the surface finish and, therefore, the details should be confined to the top surface or the section thickness be reduced to $\frac{1}{8}$ ". Slightly larger feeders than are normal for aluminium are needed for permanent moulds.

Melting

It is always advisable to use ILZRO 12 alloy ingots manufactured by a reputable firm which has proper quality control facilities. Normal clean foundry scrap may be mixed with the virgin ingots in proper proportions. Since it has been found that recycling of foundry scrap does not affect the tensile properties and no loss of magnesium has been detected, no adjustment of the metal composition is required. However, where a large proportion of the charge is in the form of heavy risers enriched in aluminium, a zinc addition may be needed to lower the mean aluminium content. The alloy is also not sensitive to foundry variables such as superheating, stewing and repeated remelting, but 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.

Casting

Since pouring temperature of the alloy does not affect the mechanical properties, this may be chosen to suit the minimum thickness of the casting. The pouring temperatures for various casting sections in sand moulds are given in Table VII.

In plaster moulds, the final dimensions of a casting are greatly affected by the pouring conditions and

TABLE VII Pouring temperature for various casting sections in sand moulds

Minimum section (in.)	Suggested pouring temperature °C
3/32	520–500
$\frac{1}{4}$	500–480
$>\frac{1}{4}$	475

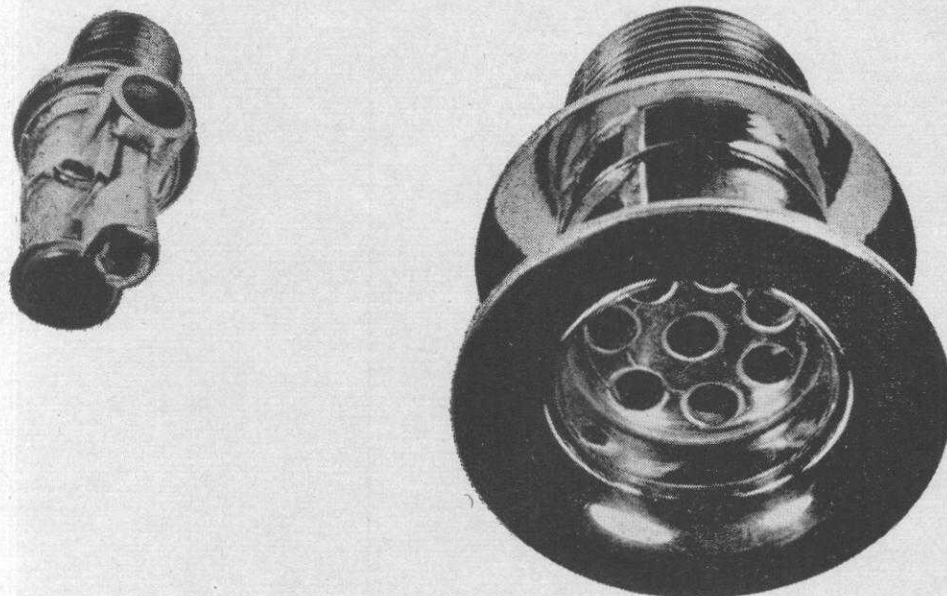
the temperature of the casting when it is removed from the mould. Since zinc alloys have low creep resistance above 80°C, close control over pouring and knock-out temperature is essential for dimensional accuracy and reproducibility. Dimensions over restrained lengths decrease by about 35×10^{-6} in./in./°C rise in pouring temperature. To minimise distortion, the casting should be knocked out of the mould as soon as it has solidified and should be fully supported on a jig or dry sand bed. Bad handling of warm castings may lead to distortion. To obtain a casting with good surface finish from a plaster mould, it is recommended that the mould is cooled to room temperature before pouring and the pouring temperature of the alloy is kept between 450°C and 500°C. Wherever possible, the cross-section of the casting should be restricted to $\frac{1}{8}$ " but when heavy sections cannot be avoided, the important surfaces should be kept the uppermost, since the underside surfaces are likely to contain all the defects.

For permanent mould casting, a metal temperature of 550–570°C may be used. This provides a mould temperature of about 290°C at 2–3 minutes casting cycle. In this case, slightly larger feeders than those needed for aluminium alloys will give castings free from surface sinks.

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.

In one case, the parting lines and other significant surfaces of the casting are polished with a hard buffing wheel coated with a 200-grit greaseless abrasive and degreased with liquid and vapour phase trichloroethylene. The castings are then immersed for 30 to 45 seconds in an alkaline cleaner (pH 9.3) at about 65°C. After a warm water soak rinse, the casting is electro-polished at 200 amp./sq. ft. current density in a patented electro-polishing bath for two minutes. The current is disconnected 10–15 seconds before the removal of the casting from the tank. The castings are then spray-



5 Bathroom fixtures cast in ILZRO 12 and plated with nickel and chromium

rinsed with water at 50°C, followed by a soak rinse at the same temperature for 30-45 seconds and a cold water spray rinse. After thorough rinsing, the castings are immersed for 30-45 seconds in a 0.5 per cent by weight sulphuric acid bath which should be ultrasonically agitated. This is recommended to ensure complete removal of smut and neutralisation of any residual alkali. This also helps in improving the adherence of copper, nickel and chromium electroplates. The casting is then again soak-rinsed for 30-45 seconds in tap water having a pH of 6.5 to 8.5. After this pretreatment, the castings are given a copper strike. The recommended composition of the copper cyanide strike bath and the operating conditions are as follows:

Sodium cyanide, NaCN	4.6 oz/gal
Copper cyanide, CuCN	3.6 oz/gal
Sodium carbonate, Na ₂ CO ₃	1.0 oz/gal
Anodes	Oxygen-free, high conductivity OFHC copper
Free sodium cyanide	1.0-1.5 oz/gal
pH	11.0
Temperature	50°C
Plating time	5 minutes
Average cathode current density	40-60 amp./ft ²
Agitation	Ultrasonic agitation with 20-100 kc/s 7.5 W/in ²

The castings should be preconnected to the cathode bar with a jumper connection before immersion in the copper bath. After the copper strike, the castings are rinsed in tap water for 30-45 seconds and re-rinsed in tap water for 35-45 seconds.

The next step is to provide an average of 0.5 mil copper in a levelling bright acid bath. This bath is prepared with 225 g/l copper sulphate (CuSO₄ · 5H₂O), 50 g/l sulphuric acid, 0.4 g/l of Cuplex 780 and 1.5 ml/l of Cuflex 78 (patented brighteners of Dayton Bright Copper Co). The plating is carried out at a current density of 40 amp./sq. ft. for 15-20 minutes and the bath temperature is maintained at 25-30°C. The castings are then removed from the copper bath, rinsed in tap water and then immersed in a 5% by weight of sulphuric acid solution for 5-10 seconds.

The castings after removal from sulphuric acid bath are rinsed and then immersed in the semi-bright nickel bath. A deposit of an average thickness of 0.9 mil nickel can be obtained in about 27 minutes when this bath is operated at 50 amp./sq. ft. current density. The castings are then transferred at an exit current density of 5 amp./sq. ft. to the bright nickel bath at an entrance current density of 5 amp./sq. ft. without rinsing. They are then plated at 50 amp./sq. ft. for nine minutes which deposits about 0.3 mil nickel. After soak rinsing in water at 50°C and then cold tap water, the castings can be plated with conventional or micro-cracked chromium.

In an alternative procedure, the use of a copper pyrophosphate strike bath has been suggested instead of copper cyanide bath. The composition and operating conditions of the copper pyrophosphate strike bath are as follows:

Tetrapotassium pyrophosphate K ₄ P ₂ O ₇ · 3H ₂ O	34 oz/gal (254 g/l)
Copper pyrophosphate Cu ₂ P ₂ O ₇ · 3H ₂ O	2.7 oz/gal (27.6 g/l)
Copper metal	1.34 oz/gal (10 g/l)

Potassium citrate $K_3C_6H_5O_7 \cdot H_2O$	3.0 oz/gal (22.5 g/l)
Anodes	Oxygen-free, high conductivity copper
pH	8.0 to 8.3 (lowered with tetraphosphoric acid)
Temperature	22-28°C
Plating time	2 to 3 minutes
Initial cathode current density	5 to 15 amp./ft ²
Average cathodic current density	30 to 40 amp./ft ²
Agitation	Ultrasonic agitation with 20-100 kc/s.

Because no acid dip is required after copper striking, the bright acid copper levelling may be carried out just after a 30-45 seconds rinse in tap water at 25°C. The remaining steps are the same as in the previous procedure.

Applications

Because of the admirable physical and mechanical properties and low cost of ILZRO 12, the alloy has great potentialities as a gravity casting non-ferrous alloy. It is very suitable for low volume production which does not justify the initial investment in costly die casting equipment and dies. It can also replace costly gravity cast brasses and bronzes for a number of applications. ILZRO 12 is particularly suitable for Indian conditions where often non-ferrous foundries have to execute orders which do not exceed a few thousand castings per month. By using permanent moulds, very good surface finish can be obtained with this alloy. The alloy can also replace certain parts which are currently cast in ferrous alloys.

Another projected use of this alloy is in the production of prototype castings of parts designed for manufacture by zinc die casting. Since the properties and finishing characteristics of the components made in ILZRO 12 closely resemble those made by zinc pressure die-castings, it will no longer be necessary to design die casting dies in the hope that the part will function without excessive modification in design and tooling. Instead of theoretical calculations, interpolations and often mere guess work, it is now possible to have a factual idea of how the die will behave during actual casting. In fact, the Ford Motor Company has adopted it as a standard alloy for all their prototype work. They have made prototypes of window vent regulators and window frame by casting the alloy in sand moulds.

The excellent finishing and plating characteristics of ILZRO 12 render it useful in the production of decorative and functional components for automobiles, refrigerators, household appliances, building hardware, etc., where at present costly sand-cast brasses and bronzes are being used. A few castings made out in this alloy are shown in Figs. 2 and 3.

As a result of interest developed in ILZRO 12, a number of trials have been made in India. The alloy has been successfully produced on a commercial scale by The Binani Metal Works Ltd., Calcutta, and has been supplied to a few small foundries. Other non-ferrous alloy manufacturers in India have also been informed about this new material and they will be able to produce and supply this alloy if there is a demand from non-ferrous foundries. Sample castings in ILZRO 12 have also been cast and electroplated by a couple of firms which have shown excellent results. Figs. 4 and 5 show a number of castings which have been made by Indian firms.

Conclusion

ILZRO 12 alloy exhibits all good qualities of zinc die-casting alloys and has certain properties better than sand-cast aluminium and copper-base alloys and general purpose grey cast irons. The alloy is admirably suited for gravity casting purposes and will fulfil a long-felt need of the non-ferrous foundry industry. Since sand or permanent mould castings produced in ILZRO 12 can be easily finished and electroplated, they can substitute many decorative and conventional copper and aluminium-base alloy castings. The manufacture and use of ILZRO 12 alloy does not involve any patent rights and, therefore, it can be produced on an unrestricted basis.

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