

Review of Magnesium For the 75th Anniversary of the IMA

A Summary and Discussion of the Global
Magnesium Industry for the
2018 World Magnesium Conference
Hotel Monteleone, New Orleans
May 16-18, 2018

Robert E. Brown, Magnesium Assistance Group, Prattville, Alabama

May 17, 2018

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Stan Hirst - Magnesium Pioneer-1919-2014

Stan delivered the review in 1993 for the first 50 years. He had worked at MEL in 1940 for Dr. Fletcher who was one of the major figures in building the world's largest magnesium plant in Nevada in 11 months. Basic Magnesium - 43,000 tpy. Used IG Farben Technology

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Magnesium Pavilion-Frankfurt 1909



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Printed Information from 1909 ILA Air Transport Exposition

There have been several papers and books that have covered in great detail the first introduction of magnesium structural items since it was first exhibited in Frankfurt at the 1909 ILA Air Transport Exposition. At this exhibition, over 100 years ago, the first detailed information concerning the physical properties of magnesium metal was made available on an international level.

Information made available said, "The cast metal shows a tensile strength of up to 18 kg/mm² and an elongation to 5%. By means of densifying processes such as pressing, drawing, rolling, etc. its physical properties, particularly the tensile strength and elongation, are materially improved. In this way it is possible to achieve tensile strengths to 35 kg/mm² and elongations to 18 %." The paper also explained that by using specific kinds and amounts of alloying additions the properties of Elektron metals may be varied within wide limits."

The 1909 handout said, "The utilitarian aspects of Elektron metal are therefore manifold. Of quite particular value is the metal in applications where lightness coupled with strength are desired. It will find its main application in the area of air travel, but also in the construction of automobiles, in the building of machines of many kinds, likewise will it often be found to give good service in the construction of apparatus and instruments."

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Bob Brown (l) and Mr. Guo Zhou in Guangzhou, China
Chrysler-China MPV Team meetings, April 19-22, 1994

Chrysler-China and Mr. Zhou from Grp 5

Discussing the design and layout of the new Mini van plant in Guangzhou just down the street from Sun Yat Sen monument - 1994.

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Bob Brown and Prof Han Wei and Tom Chou

Prof. Han Wei is Russian educated Magnesium Specialist

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Jan Guy, Magnesium Services Inc. (left) shares words and business
Jan Guy who was first woman president of the IMA.

Jan put in a lot of time and this was before she was elected to be the President of the International Magnesium Association. Shown with Dr. M. Nakayama.

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Bob and Jan Guy..

Jan had been named as President of the International Magnesium Association.

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Visit to Magnesium Plant with Karl Laukoetter and Weinan Ding.

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Visit to China Pidgeon Process Plant

Mother and son making noodles using the waste heat from discarded retort residue which is cooling awaiting transport.

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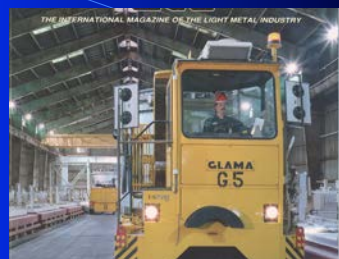


Andrew Forrest visits Noranda Magnolia Project

Andrew Forrest was interested in getting into the magnesium business by using waste MgO streams from his nickel plant in Western Australia.

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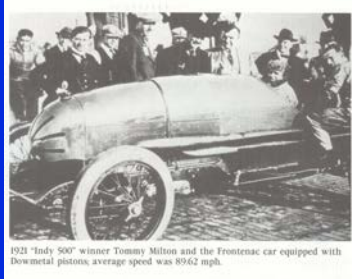
Picture in New Cell House at US Magnesium, Great Salt Lake, Utah

US Magnesium had modified their cell house and installed a new modified cell with higher productivity at a more economic and cleaner process.

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Magnesium Pistons-autos



1925 "Indy 500" winner Tommy Milton and the Frontenac car equipped with Dowmetal pistons; average speed was 89.62 mph.

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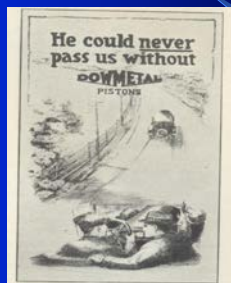
Model T Ford



Ford Model T. Early mass-produced automobiles were built almost entirely of steel.

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Magnesium Piston Ad-1920's



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Magnesium Castings-Dow-1927



Dowmetal castings, as of 1927. Behind this repertory of castings were eight years of metallurgical research which Dow had to do because no one else would do it. Dow had hoped that if he had not done it, someone else would.

Magnesium Gondola, 1933



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Magnesium Extrusion Usage

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SM.55X Isotta Fraschini



Flying from Italy to Chicago

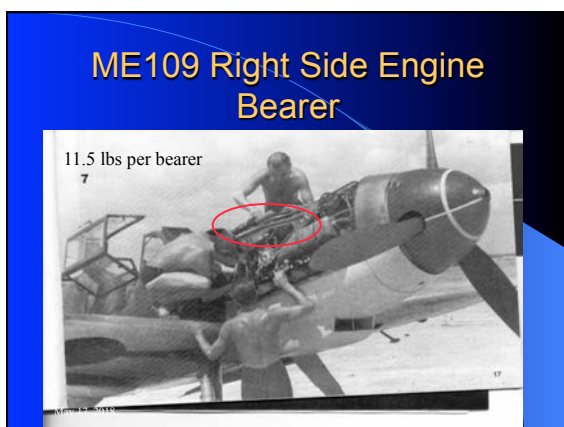
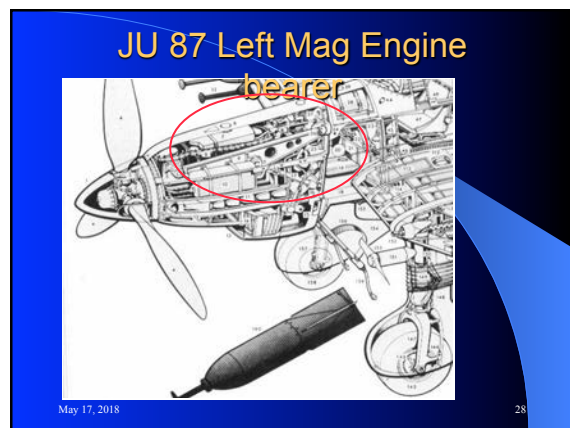
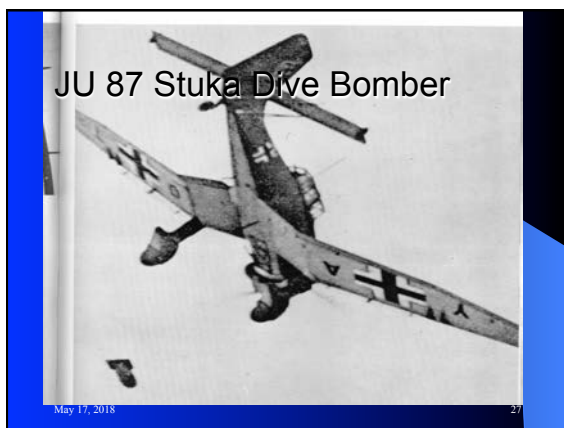
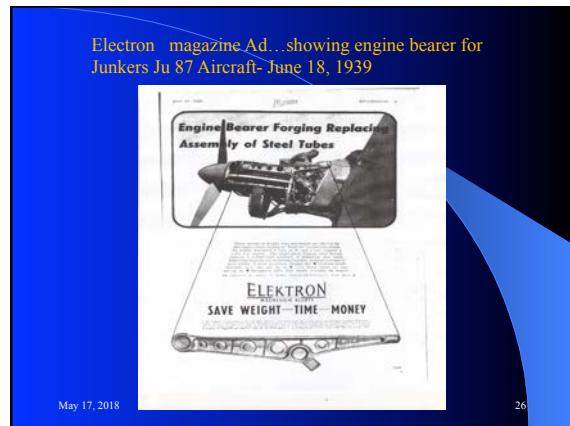


Savio Marchetti S55 Flying Boats Over Chicago, Illinois 1933



DH 1934 Comet





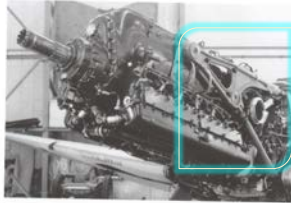
Me 109 left side engine bearer assembly 1944

RIGHT: DB605 fitted and ready for dressing. Black 6 beam

propeller pitch control gear is flanged on to the reduction gear casing.

Accessory drive

The gear wheels for the injection pump drive and accessory drives are located in the accessory gear case. This is bolted on to the rear wall of the crankcase. Fitted to this are: the twin magneto, the starter, fuel pump, coolant pump, oil pump and the supercharger. There is also provision to fit the following: generator, hydraulic pump and air compressor, if required, for pressurized aircraft.



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Engine bearer forging 1944



LEFT: Engine bearer, Airframe Assemblies

Engine bearer

The engine bearer consists of two cast Elektron alloy beams and three tubular struts. These beams are attached, using rubber mounts, to the side of the engine and the rear of each beam is attached to the top of the fuselage engine bulkhead.

Two of the tubular struts attach to the engine beams and to the fuselage. The third acts as a bracing strut to the starboard one.

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Aircraft Use of Magnesium



Sand Cast Magnesium Aircraft Wheels. All US military aircraft used these wheels in WWII. The British also produced over 900,000 magnesium wheels and there are no records of any wheel failures from all military records concerning aircraft accidents.

Dec 1943

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German Mg Fabrication in 1943 (metric tons per month)

Sand Casting	1800 mt
Chill Castings	100 mt
Die Castings	150 mt
Sheet	200 mt
Extrusions	100 mt
Forgings	200 mt
Pure Ingot	600 mt
Total magnesium used per month	3150 mt.

Post war estimates..T. H. McConica,III. August 1945

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**Table 1 WORLD PRODUCTION OF PRIMARY MAGNESIUM
Then and Now**

Country	Metric tons 1938	Metric tons 1944	Metric tons 2010
Germany	20,000	50,000	0
England	5,000	32,000	0
France	2,500	3,300	0
United States	2,500	293,000	50,000
Japan	1,000	10,000	0
Soviet Union	2,000	7,000	*62,000
Switzerland	500	5,000	0
Australia	0	1,000	0
Canada	0	6,000	0
Brazil	0	0	16,000
Israel	0	0	30,000
China	0	0	620,000
Totals	33,500	407,300	778,000

Source: The History of Magnesium, Major CJP Ball, Author's notes and interviews, USGS, Klappshum Report 1945. *now covers CIS States Ukraine,Russia, Kazakhstan

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**Table 2. World Production of Primary Magnesium
Recent reports from USGS**

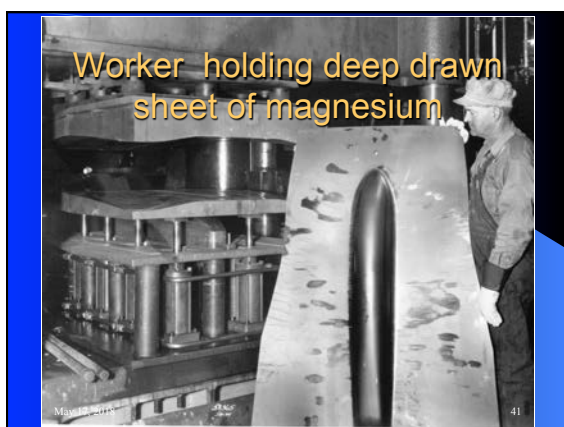
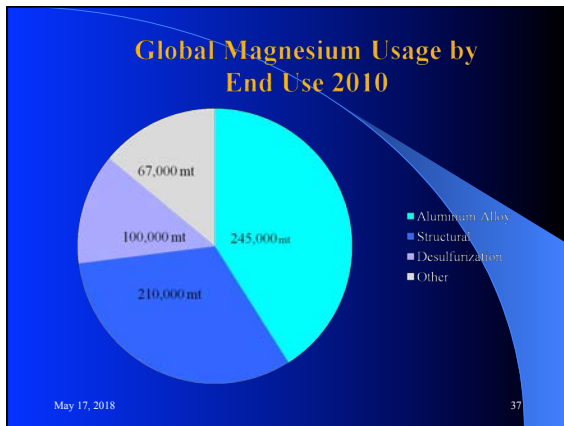
* USGS w/o US production not reported					
	2011	2012	2013	2014	2015
Brazil	16,000	16,000	16,000	16,000	15,000
China	675,000	698,000	770,000	814,000	852,000
Israel	26,300	27,300	27,400	26,000	19,300
Kazakhstan	21,400 r	21,200 r	13,000 r	9,500 r	8,100
Korea, Republic of --		2,500	7,500	10,000	10,000
Malaysia	200				150
Russia	58,000 r	65,000 r	66,000 r	62,000 r	60,000
Serbia					200
Turkey					200
Ukraine	9,000 r	10,300 r	9,400 r	7,200 r	7,700
United States	W	W	W	W	W
Total	806,000 r	840,000 r	909,000 r	1,000,000 r	972,000

3 Reported figure.

4 Includes magnesium consumed for titanium sponge production.

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Northrop XP-56 (R-40C)



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XP-56 showing weld seams



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Curtis XP-55 (R-40C)



All magnesium aircraft
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Vultee XP-54 (R-40c)



All Magnesium welded Aircraft
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Volkswagen Foundry 1955



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Whitelight Mag Truck Body



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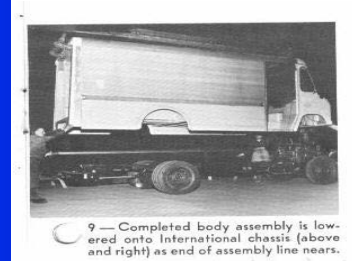
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Magnesium Van Bodies



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Putting Body on the Truck Chassis



9 — Completed body assembly is lowered onto International chassis (above and right) as end of assembly line nears.

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Truck with magnesium bodies



Ward's emphasis on light weight shows in fleet of Metro-Lites at Medford, Mass., part of 150 acquired by Ward since 1918.

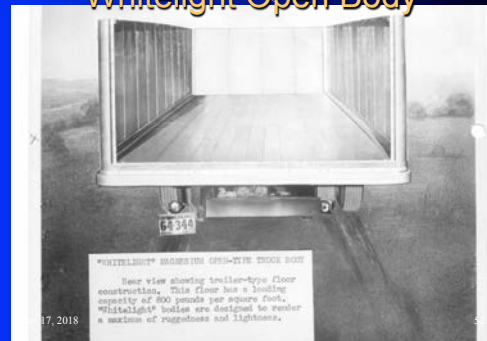
Ward Baking Uses 'Metro-Lites' To Reduce Fleet Operating Costs

moving 110 times a day. If our fleet was completely converted to light-weight trucks, we would eliminate a total of 2,400,000 pounds of dead weight."

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Whitelight Open Body



"WHITELIGHT" MAGNESIUM OPEN-BODY TRUCK BODY
Rear view showing trailer-type floor construction. This floor has a loading capacity of 800 pounds per square foot. Whitelight® bodies are designed to render a maximum of ruggedness and lightness.

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Magnesium Use In Autos



Orville Wright (with hat) looking at magnesium auto wheel at Dayton, Ohio Magnesium Exposition in 1947

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Magnesium Sheet

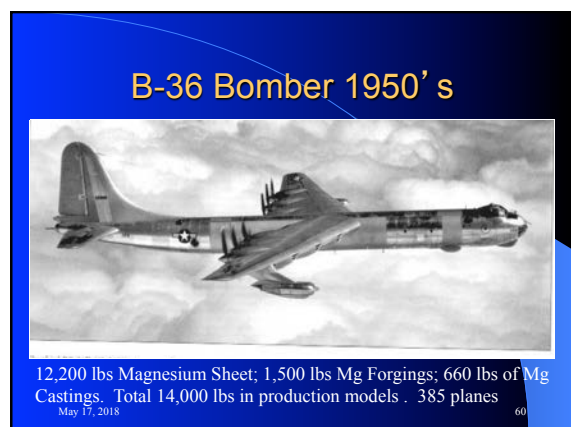
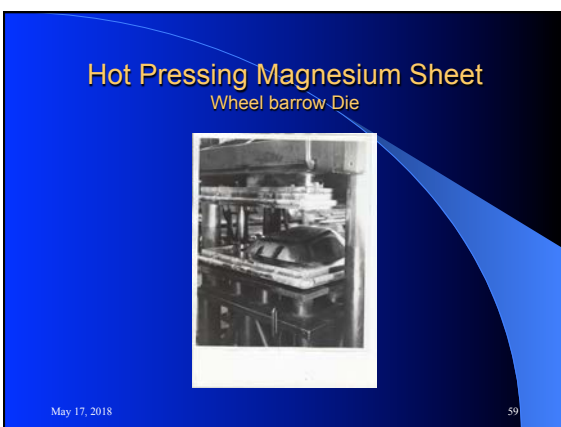
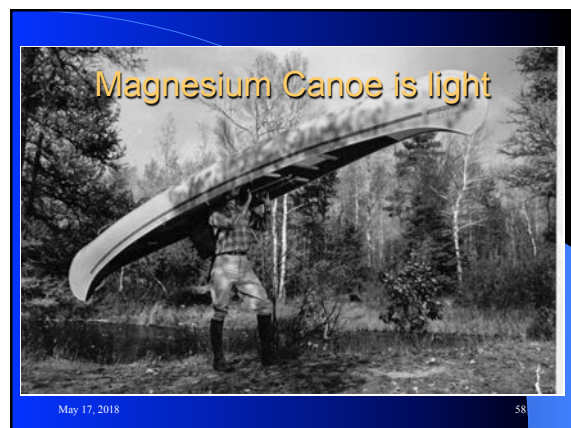


Magnesium Rolling at Dow 1950's



Magnesium Rolling at Alcoa 1950's

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Magnesium Use in Aircraft B36



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B 36 Assembly Line



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CONVAIR B-36 MAGNESIUM WHEEL

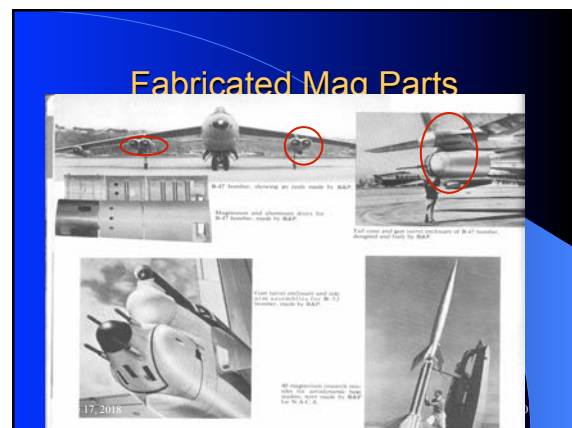
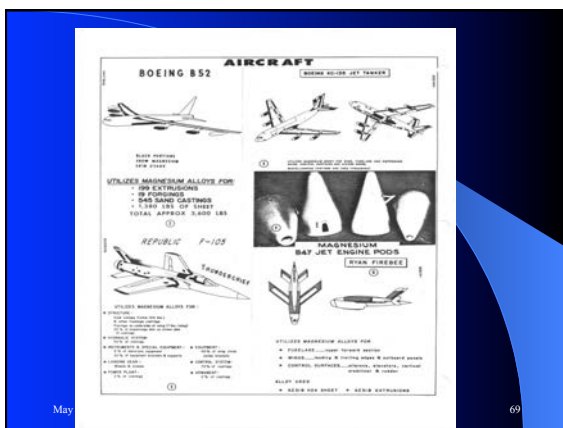
Manufactured By

GOODYEAR AIRCRAFT



The original main landing gear on the B-36 consisted of a single very large wheel and its 30 inch axle. This arrangement exposed the main pressure on the ground that only three airfields in the entire United States were capable of handling. In B-36 landing, Convair engineers were forced to redesign the main landing gear to spread the weight of the aircraft over a larger ground contact area. The magnesium landing gear consisted of main wheels with four smaller wheels and tires. This new arrangement was incorporated into all production B-36s and resulted in the B-36 and YB-36. The modifications to the B-36 were completed in June 1948. The B-36 remained in service until 1967 and was used primarily for special projects and crew training.

REGISTRATION
 Serial: 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 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Magnesium Fabrication



Magnesium Exhibit of various products produced by Milwaukee company shortly after WWII.

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Magnesium Tote Bins



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Magnesium Fabrication

The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been moved. Restart your computer, and open the file again. If the red x still appears, you may have to delete the image and then insert it again.



Electronics cabinet for military system that would be delivered by air. All magnesium sheet and extrusions. 1960's

May 17, 2018

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Magnesium Armor for Movie



MAGNESIUM ARMOR
When "Joan of Arc" opens at theaters throughout the country in a few months, the hero in the cast will be clad in armor fashioned from the "heavy metal," 1410 alloy. But because the armor is made of magnesium, these suits will weigh only 10% of the standard

May 17, 2018

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Hollywood Special Armor Built For Bergman Picture By Bob Thomas Hollywood.

Ingrid Bergman's next epic on the life of Joan of Arc is being planned on such a large scale that 10 Los Angeles manufacturing plants have been contracted to make armor for the film's actors.

The plants, which formerly did war work, will use assembly-line methods to stamp out and mold 525 full suits of armor and 215 partial suits. They will be made of magnesium and the full regalia will weigh but 18 pounds, plus 12 pounds of mail. Ingrid has already tried on her suit, which is made of aluminum. It permits sitting, kneeling and other comforts unknown to knights of old

St. Petersburg (Florida) Independent, , July 10, 1947

Magnesium Thorium Alloy Sheet



(1) Magnesium-thorium 98%21A sheet (2) 98%21A sheet (3) 98%21A sheet (4) 98%21A sheet
Total magnesium sheet 1000-1200 lbs. per missile.

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Forged Mag Aircraft Wheel



Forged magnesium alloy aircraft wheel used interchangeably on B-52 and B-47.

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Forging-Ring Roll & Press



Magnesium rolled-ring forgings for missiles, shown prior to machining, have 20-inch diameter, 3-inch wall.



Magnesium casting forging for Echo satellite program weighs 225 pounds. A 30,000-ton forging press was used.

May 17, 2018

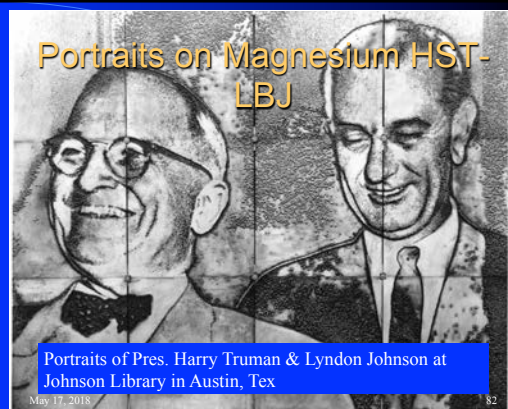
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Portraits on Magnesium-LBJ-JFK



Portraits on panels of 4" x 4" magnesium photoengraving panels...Pres. John F. Kennedy & VP Lyndon B. Johnson at the LBJ Library in Austin, Texas.

Portraits on Magnesium HST-LBJ



Portraits of Pres. Harry Truman & Lyndon Johnson at Johnson Library in Austin, Tex.

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Magnesium Griddle - Hamburgers



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Sand Foundries

- Casting metals in sand molds is very old technology. The Chinese did this many thousands of years ago. Magnesium sand foundries are only about 100 years old, but played a vital part in the development of magnesium uses, especially during the 1920's to 1950's.

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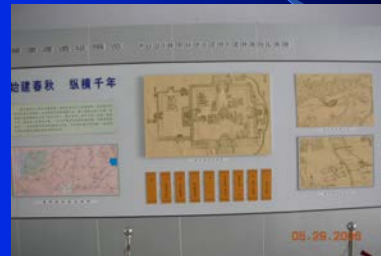
Chinese Iron Sand Casting 4000 years old



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Chinese Iron Sand Castings



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Sand Foundry WWII Sand Bin with Wheel Barrow



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Sand Foundry WWII Molding Floor with mold conveyers



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Sand Foundry WWII Molding Floor w/sand chutes



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Sand Foundry WWII
Sand Slinger with mold transfer buggy




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Sand Foundry WWII
Jolt Rollover Molding Machine with Pattern Draw




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Sand Foundry WWII
Hand Molding with Match Plates




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Sand Foundry WWII
Core Making Area with rollover machine




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Sand Foundry WWII
Making Cores on Hand Machines




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Green Sand Foundry
Removing gates and risers from sand castings



Green Sand Foundry


Removing Gates and Risers from Castings



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Sand Foundry WWII


Cutting off Gates and Risers on Magnesium Castings



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Sand Foundry WWII


Grinding and Smoothing Magnesium Castings



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Sand Foundry WWII


Sand and Polishing Magnesium Castings



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Sand Foundry WWII


Heat Treating Magnesium Castings



May 17, 2018 101

Cleaning Castings by Shot Blast

Curtis Wright Foundry Engine Castings



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Inspection and Qualification Castings being Checked in Targeting Fixtures



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Inspection and Qualification Checking Castings and Cutting Machining Pads



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Sand Foundry-Post WWII Large Magnesium Sand Casting – Missile Base



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Dedication of Volkswagen Plant in 1938

Note one of the new demonstration models in front of speaker.

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