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QUALITY CONTROL PROBLEMS IN THE PRODUCTION OF TINPLATE IN DEVELOPING COUNTRIES: HOT DIPPED [1/]

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SUMMARY

The paper deals with the problems of quality control of the manufacture of hot-dip tinplate in India. The production processes are on the two extremes of the spectrum of flat product manufacture: a replica of the Welsh tin mill on the one hand and a modern colossus of a 1.8 million tonne capacity for plates, sheets and tinplate, on the other - one highly labour-intensive and the other highly capital-intensive.

Crucial problems apparently are the need for

(a) standardisation on the part of indigenous manufacturers of components such as Hot and Cold Mill rolls, Grease-Pot rolls, Asbestos Metallic Tape, etc., among other requirements, and

(b) Manpower Development.

The author quotes a well known authority on the demand for hot-dip tinplate in preference to electrolytic tinplate, and another, on the aspect of worker and supervisory development if the cause of quality is to be served. He makes a plea for rational thinking and planning for both the objectives coupled with co-operative research in technological problems.

INTRODUCTION

UNIDO has chosen a good subject for coming to grips, in a co-operative endeavour, with the problems facing developing countries in the production of low cost, good quality, multi-purpose tinplate for local consumers in the present times as well as to cater for possible development not excluding the export potential, in the decade of the 'seventies'.

By a propitious coincidence, and quite appropriately as the crying need of the times, the Asian Productivity Organisation - and its associate, the National Productivity Council of India - have chosen 'Quality Reliability' as the main theme of the Asian Productivity Year - 1970 and are going forward with a dynamic programme. Among other activities in APY-1970, a massive scheme for Supervisory Development has been launched to ensure an adequate supply of intelligent and socially conscious first and second line supervisors who can motivate their subordinates in every field of human endeavour towards making QC not only a creed but if possible an obsession. This is based on the realisation that manpower development must precede process control which is a sine qua non for QC.

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TINPLATE MANUFACTURE IN INDIA

The first, and for 40 years, the only Indian (then British India) venture came into being in 1922 with the installation of a Works in the country under the Tinplate Co. of India Ltd., - TCIL - at Golmuri, a picturesque suburb of the Steel City of Jamshedpur. This city had earlier, in 1907, been founded by an illustrious Indian - Jamshedji Tata - following the establishment of the famous Tata Iron & Steel Co. Ltd. - TISCO.

The second tinplate manufacturing facility in the country was commissioned in 1962, after the usual period of gestation, at the first Government owned steel plant under Hindustan Steel Ltd., at Rourkela. This Steel mill was installed in 1956 as a part of the basic industry included in the First Five-Year Plan and, among other flat products like plates, sheets; HR, CR, Galvanised and Electrical grades, has been producing approximately 25,000 tonnes of hot-dipped tinplate per annum. Electrolytic tinplate production started from 1969. See Fig.1

The tinplate project at Golmuri was conceived by Sir John Lloyd of Shaw Wallace & Co., when acute scarcity of this packaging material was felt during the first world war 1914-1918. The plant came into being as a result of active collaboration between the Principals -

The American firm of Perin & Marshall were engaged as Consulting Engineers and the early Managers and Operators were of Welsh or Welsh - American origin to impart to Indians a completely new and foreign discipline in the production of tinplate after the fashion set by the American Sheet & Tinplate Co. in Gary, Indiana, where both equipment and method, were an improvement over the pristine Welsh method.[1]

ACHIEVEMENT

Be it said to the credit of the co-operative venture that the Indians in no way lagged behind in speedily acquiring the skills to successfully operate the main production equipment line the Hot Mills, the Cold Mills and the Tin Pots besides all the rest of the ancillary facilities like the Bar Shears, the sheet squaring shears, the Pickling machines and the tunnel Annealing Furnaces. Such was the measure of success of the operations that, within thirteen years of start-up, the initially rated annual output of 28,000 long tons was more than doubled ! The progress was maintained and by 1957, when another Hot Mill unit, comprising two 2-high mills and furnaces, was added the production started averaging 75000 ton annually i.e. 270% of installed capacity ! Ergonomics was conceived of and applied even in the bygone days so that every hot mill had a double crew, costing half an hour

As the performance speaks for itself, the numerous headaches and heartaches in the early years were successfully overcome and until 1962, when HSL, Rourkela tinplate came on stream, TCIL, Golmuri Works was the lone producer in the country.

Such then was, and is, the quality of the human resource engaged on mills and processes - now practically extinct elsewhere in the world, but still, like Johnnie Walker, going strong at Golmuri - that acceptable quality tinplate has continued to be produced for 48 years. During the second World War when tin became scarce, a switch over was made to blackplate and terneplate for a period.

EQUIPMENT

2 - Bar Shears

7 - Units of 2-high Hot Mills each comprising one Roughing and one Finishing stand with Pair and Pack Furnaces, 2 Doubliers and one curlend shears.

Shear & Opening building:	Squaring shears and waster shears.
Black Pickling Machines:	One operating, one standby.
Annealing Furnace:	Trolley tunnel type.
Cold Mills:	5 mills, 3 stands in tandem, 1 mill, 2 stand tandem.
White Pickling Machine:	One
Tin House:	19 single and double sweep pots with alkali washer section.
Cleaning Machines:	19 Norton make.
Ware House:	Slitting machines, Packing benches and weigh scales.

The highest output attained on the above plant was 84,307 packed tonnes in 1963 out of 87,802 tonnes gross tinned. The corresponding Hot Mill production was 89,415 tonnes 81% of which was in 49 Kg substance (30G), 11% in gauges lighter than 30 upto 32 Kg substance (34G) and the balance 8% in heavier than 30G, the heaviest being 127 Kg substance (22G). See Fig 2

In the context of such outputs it is pertinent to recall the remarks of Williams,[2] in 1915 when, not being able to visualise the evolution of the later day collosii of the Hot and Cold Strip Mill and Process Line complexes, he said :

" A Welsh tinplate Mill, to use a well worn comparison seems as unalterable as the Laws of the Medes and the Persians. Hanbury, or from whomsoever's brain it evolved, like Archimedes, appears to have hit upon the one and only way for all time, of doing the work contemplated, by a sort of inspiration; for no decisive improvements in the manner of doing that work have been brought about since - at all events not in the memory of the oldest workman now living".

The only improvements that were made over the years at Golmuri were the introduction of mechanical coal stokers for the furnaces except in the Tinhouse where hand firing still continues, automatic roll polishers, semi-automatic feeders for the Cold Mills and similar conveyors between stands, and the like. Even the intermediate step in the evolution of flat product rolling viz., the WMW Combination System of continuous bar and pack furnaces and semi-mechanised equipment like Feeder and Catcher tilting tables did not find a foothold in view of [illegible] and "tugging" complexity of the hot rolling operation for the light gauges involved.

However, as referred to earlier, HSL, Rourkela boasts of a full-fledged Hot and Cold Strip Mill complex with an annual capacity of, among other flat products, 50,000 t of hot-dipped tinplate and 150,000 [illegible] of electrolytic tinplate. This paper deals with the problems of quality control in the production of tinplate in India by the highly labour-intensive older method on the one extreme and by the capital-intensive modern plant on the other.

Quality Control Concept & [illegible]

No matter how thorough a single final inspection may be, it is always susceptible to human or machine error. Attempts to achieve absolute [illegible] end of line inspection must also be very expensive. In order, therefore, to minimise the risk of a faulty product being sent to the customer and to keep the cost of doing this under control, it has been found necessary to institute checks of the product and effectively monitor the process at each manufacturing stage.[3] What has been said above is axiomatic and of universal application in industry, but much more so in the manufacture of coated flat products so scarce in India.

Crucial Aspects in the Tinplate Industry.

The two most crucial aspects of the QC problem in this but now under severe import restrictions. Indigenous substitutes have not in all cases come up to standard while admittedly the effort is being made; and

(b) Development of operative and supervisory manpower on a continually improving basis.

These factors are the challenges which stand in the way of standardising operations at all stages and are being faced with all the imagination at the country's command. It would be interesting to compare experiences with other countries similarly placed

QC at TISCO

This begins at the Tata Iron & Steel Co.Ltd.(referred to later as TISCO) where tinbar of the specified chemical composition and in different lengths and sectional weights is rolled. The Demag Mill which rolls this product is a 9-stand continuous Mill - six horizontal, interspersed with 3 vertical stands - with a rotary flying shears actuated by photo-electric cells.

Except for [illegible] tinplate, for which specification number IS:597/62 of the Indian Standards Institute specifies a N content of not more than 0.50%; the normal run of tinbar is made to the following ladle sample analysis:

	%
C	.10 to .14
Mn	.40 to .60
S	.05 max
P	.05 to .09
Si	.04 to .06

and is largely met, except occasionally for exceeding the P levels to about 0.100% [illegible]

The sectional weight tolerance of plus 2½% minus 1½% is also mostly complied with as also the length tolerance of minus 0 plus 100 mm. Occasionally there are variations on account of voltage dips or the flying shear going berserk. The endeavour, however, is that right after the trial bar, the product of every bloom is checked for all dimensions, from crop ends, and from hot lengths marked in the piler, until the process has been brought on beam. QC charts, logging the data, are maintained by the operators themselves to keep the product within the upper and the lower dimensional control limits besides watching the surface and the edge characteristics which must be free from harmful defects. Semikilled ingot steel properly heated and rolled at the blooming mill stage, is subjected to high pressure descaling jets on emerging from the vertical stands of the continuous mill and prior to entry in the horizontal stands, and appropriate edge reduction in the vertical stands ensures clean edges. Bars with ragged edges are rejected.

The tinbar is made largely by the duplex process - acid Bessemer followed by basic Open Hearth - and is therefore high in nitrogen content. Silicon is only residual and semi-killing is done by aluminium additions. Defects that get pronounced in the cross-rolling of tinbar into the light tinplate gauges are seams, blisters and subcutaneous blow holes. Stickers and open surface sheets are caused by phosphorus running lower than 0.050% and from tinbars rolled out of thin skin and scabby ingots resulting from improper mould and teeming practice.

Keypoints of Process & Quality Control at TCIL.

At the Bar Shears:

254 mm width tinbars are cut in pairs to specified lengths with the help of a rigidly fixed adjustable stopper against which the bars are held by pinch rollers absorbing the rebound before shearing. Nonuniformity of cut results from bent and straight bars cut together or from a premature cut before the rebound of the bar from the stopper is absorbed.

Lengths are frequently checked as the cut bars are piled on crates prior to removal to the Hot Mills. Bars are also test-weighed and the data logged for guidance and feedback. Cast identities are maintained right through all stages.

Hot Rolling:

Briefly, the hot rolling process essentially entails the following steps :

(a) Pair Heating,
(b) Roughing singly, matching and rolling on the Roughing Mill to length,
(c) Opening the roughed pair and doubling it into a pack of 4's,
(d) Reheating the pack of 4's and rolling it on the Finishing Mill to length,
(e) Opening the pack of 4's and doubling it into a pack of 8's,
(f) Trimming the curl end and tail end of this pack,
(g) Reheating the pack of 8's and rolling it on the Finishing Mill to length and gauge,
(h) Repeating the cycle with alternate packs of 4's and 8's,
(i) In the case of lighter gauges, alternate pairs of 4's and 8's are rolled - the latter being "tagged" after 2 or 3 passes and finished to length and gauge,

(j) Dragging the finished pack to a cooling conveyor,

(k) Trimming and shearing the pack square into unit sizes,

(l) Opening the packs manually,

(m) Piling separately the outside and the inside sheets of the packs,

(n) Sticker opening and recovery to the next standard size, and

(o) Weighing and transport of all products and byproducts to respective destinations.

In the Pair Furnaces:

Bars are charged vertically on edge in the conventional manner and pushed in, charge by charge, with the help of a hydraulic ram.

The sheared edges are tapped or hammered as necessary, in order to avoid their burning or over-oxidation were they to protrude in a jagged manner. Coal firing is stoker - and hand-controlled to maintain a reducing atmosphere. The two-row bar furnaces are operated, charge by charge, alternately to ensure proper soaking.

On the Roughing Mills:

Pairs are generally given 4 single passes, pulled evenly to length, matched square and rolled further in 3 or 4 passes to length. Uneven matching on account of unevenly sheared bars, unevenly pulled singles by careless screw operators or bad matching by the Roughers, causes broken edges which get worse on subsequent rolling and lead to sheets with ragged edges. Unless they escape detection, they are trimmed to the next standard size.

The mill calls for assured lubrication of necks, square and true setting of rolls, with both the screws working in complete unison.

On the Roughing and the Finishing Doublers and the curl and trimming shears:

The stops must be set firmly with the pusher heads working in unison, to match the opened pair of sheets squarely along the edges; so also the length centering device to yield a squarely doubled pack of 4's or 8's. Deviations due to bad maintenance, setting of stops or operation, lead to packs rolled with saw-toothed edges and ultimate loss of yield, besides the risk of marking the rolls with spread packs or crack-edged-sheets escaping to the final stage of operation.

The curl end of a pack of 4's after doubling into 8's, is trimmed off with the least loss. Failure to trim the curl and or to open the packs fully, leads to a "jumper", a marked or a broken roll.

Reheating and Rolling of 4's and 8's.

Packs of 4's are charged in succession and placed flat or on edge in the side heating chamber, alternately, along the two sides for preliminary heating which is uneven. To soak evenly, alternate packs from either side are placed, one on top of the other, in a neat square pile in the center. The bottom-most pack, which is under a pile of 6 or 9 packs, is pulled out for rolling, just as a pack of 8's is being given the last pass in the Finishing Mill. The Roller picks up the pack of 4's in a smooth circular movement and enters it in the mill as the screw is set for the first pass. The 2nd or the 3rd pass is given and before this pack is returned by the Catcher for opening and doubling, a pack of 8's which has been reheated and soaked in a similar manner, is pulled out, picked up from the mill floor and rolled to length; all these operations in a finely balanced rhythm of alternate 4's and 8's. Before a pack of 8's is pulled off to the cooling conveyor, enroute to the shears, it is checked for length marked on a measure, as surety for gauge control.

Like the Roughing Mill, the Finishing Mill must also be set up true and square, with screws running in unison, and necks properly lubricated. Pot Neck grease getting on the edge of the rolls or spurting on to the barrels damages the packs and even the roll surface with "pinchers" or "floppers".

Surface cleanliness and Shape Control:

The roll surface must be kept in a state of polish with the help of scouring blocks. For the top roll the block holders automatically reverse back and forth across the roll barrel. The bottom roll is scoured periodically by an operator using a polishing block.

Constant lubrication of the necks, applied manually, has to be ensured if gagged or patched rolls and stickers are to be avoided. There is no worse enemy of quality production than a dry neck.

Secret of Success:

The entire technique of successful pack-rolling of sticker-free sheets is rooted in the mill Supervisor striking and maintaining a first class balance of heating and rolling operations, with anticipatory manipulation and co-ordination of the "shapes" of the Roughing and the Finishing Mill. This must be done without exceeding the limits of safe barrel and neck temperature, with the help of cooling media provided and judicicusly used. Verily, a tall order ! But there is no alternative. It is somewhat paradoxical, but it is the author's experience that the conventional 2-high mills produce the finest quality sheets, imaginable on this equipment, with minimum steel usage, when exploited to their maximum capabilities commensurate with complete safety of equipment. The secret of the high production rates established on such mills in India, whether rolling sheet iron or tinplate, has lain in the high mill utilisation factors.

Since the evolution of chill roll manufacture in the country, imports of dependable quality rolls, proved over the years, have been further restricted. The local rolls have yet to prove their quality and reliability and to that extent are a problem to reckon with.

In the Shearing & Opening Section:

Burr-free, sheared unit sizes are checked frequently for size and squareness with measures and jigs provided for the purpose. 56 sheets, or 7 unopened packs of 8 sheets each in the unit size, are test-weighed against minima and maxima of the standard weight tolerance. Although in the final stage of shipment a tolerance of ± 2½% is accepted trade practice, the limits for control at the Hot Mill stage are kept at ± 1½% and deviations logged for corrective action as appropriate. Dimensional tolerance is minus 0 plus 5 mm. Askewness must not exceed 3 mm.

In the Black Pickling Section:

Process control is exercised in maintaining Sulphuric Acid strength and temperature within the healthy range. For better control, outside sheets and inside sheets from the Hot Mills are loaded in different cradles in consideration of the different surface oxide characteristics calling, in turn, for longer and shorter pickling times. Inspite of these measures, some sheets do escape with pickle patches which can be discarded only at the Cold Rolls, if visible on top surface when feeding, or at the Tinhouse if similarly visible. An inhibitor is used to prevent overpickling but there is no substitute for keen observation.

Packing Annealing Trays:

Pickled sheets, after thorough rinsing, are stacked on cast iron bases in fabricated mild steel annealing trays to a height not exceeding 1050 mm, in 2 to 4 piles depending on size, avoiding protrusion of sheet edges, so as to prevent their oxidation. Envelopes containing defective sheets are placed on the top of each pile to prevent burning of that portion which is more loose than the rest of the pile and receives the maximum heat.

Finely sieved sand is then shoveled carefully along the edges of the tray on which the steel cover is lowered and the sand tamped tight all round.

Black Annealing.

Four trays or bottoms, with covers, are loaded on each bogie travelling through the tunnel annealing furnace. They are charged and pulled out at regular intervals to suit production rate. Firing is regulated by mechanical stokers and hand shoveling of coal, to maintain the heating zone thermocouple between the range 930° to 1040°C. The soaking zone temperature is controlled between 780° to 820°C. On discharge, the boxes are allowed to cool in atmosphere for 48 hours when the contents drop to about 100°C and then the cover is removed for further cooling of sheets to handling temperature. The sheets are fairly white with a thin blue border.

2 random samples per 8-hour turn are taken for hardness, cupping and bent tests. See Fig. 3

Beating Off:

The sheet stacks are fairly tight after annealing and need beating off with sledge hammers before the sheets can be taken off and separated for cold rolling.

Cold Rolling:

With rolls polished glossy, set square and tight, the sheets are fed on to the belt conveyors in front of the 3-stand tandem 2-high mills. Twin screws for top roll chocks permit fine pressure control to yield square, glossy sheets, with bowness not exceeding the permissible limit of 15 mm. All setting is done by acquity of perception and experience. The reduction is from 1 to 1.5%.

2 random samples per 8-hour turn per mill are taken for mechanical property tests.

Availability of proper quality rolls and bronze bearings are nagging problems.

White Annealing:

The process is controlled similar to the Black Annealing except that the soaking temperature is of the order of 520° to 550°C.

White Pickling:

The process is essentially similar to Black Pickling but needs special watchfulness to avoid over-pickling. Unloading of pickled sheets into water boshes where their edges must not be exposed above the slightly acidulated water level, also requires attention.

Availability of phosphor bronze cradles, bolts and nuts and lead lined wooden pickling vats poses operational and quality problems.

Hot-dip Tinning:

9 double-sweep and 10 single-sweep units constitute the equipment in all their simplicity. Sheets are manually transferred to wet trays from the water boshes and hand fed 2-ways or 4-ways, depending on the size. The fabricated pots are coal fired with flues and dampers regulating heat in the tinpot and the wash pot. Thermocouples record tin and oil bath temperatures. Zinc Ammonium Chloride is used as flux and, since 1968, ground-nut oil is used in place of the imported palm oil in the grease pot.

Coating control is effected by co-ordinating linear speed, temperatures, pressure on grease pot rolls and brushes, and ranges from 22 to 27 grams per square meter for Coke U/S grade. Charcoal grades are also produced.

Considerable difficulty is being experienced in the prôcurement of good quality, hard wearing grease pot rolls and asbestos metallic tape with the requisite stiffness to measure up to the service standard of the previously imported materials.

Indigenous Ground Nut Oil, while generally satisfying the requirement of a grease pot oil, as will be seen from the various values indicated in the table overleaf/Table 1, has, in recent times, become almost twice as costly as the imported Palm oil with tin price also spiralling similarly. Experiments carried out at TCIL suggest that with descending values of the tin-coating, the oil carry-off on the tinplate rises sharply upsetting the economics of oil usage.

Table 1

	Palm Oil	Ground Nut Oil.
Moisture	0.40% max	0.13 %
Insoluble matter	Trace	Trace
FFA	4-6 % (as Palmitic acid)	2.25% (as Oleic acid)
Viscosity at 140°F	82-85 RI	88RI
Iodine value (Wijs)	52-58	91
Sp.Gr. at 30°/30°C	0.915	0.91
Saponification value	[illegible]	190
Flash point open °C	276	310

The modest catcher section does not have a device for turning over every other sheet and the sheets, with their list edges all on one side, pass through the wet cleaner. The detergent employed is a mixture of Sodium Carbonate and Soap solution.

Batches of tinplate, collected at the end of the line, are carried manually to the Morton branners and worked off. Oil absorbent media used are saw dust and kaolin.

Visual inspection and manual assorting follow. Selling boxes and bulks include upto 15% of wasters with primes. Menders are retinned. Waste-waste is bulk packed. Slitting machines do sizing or recovery as required.

Quality Control:

For quality control, apart from an acute watch on all the tinning and cleaning operations to keep the process on the beam, 100 random defective sheets are sorted out once a day, defectwise, to pinpoint attention where appropriate.

2 sheets per machine per 8-hour turn, are taken for the coating test.

Two bulk packs, selected at random, are opened and reassorted to check the standard of inspection.

A box of 112 sheets is selected at random for determining the gauge of the individual sheet and to check whether it

Comparative Values:

Table 2 gives comparative physical values of tinplate hot-dipped at TCIL with different origins of blackplate. Column 1 values are for US origin hot-dip tinplate from cold reduced black plate. Column 2 values are for UK origin cold reduced black plate, hot-dip tinned at TCIL. Column 3, however, gives values for pack rolled black plate of the Eagle Bush (U.K.) origin, hot-dip tinned at TCIL with comparative values appearing in column 4 for the normal run of product at TCIL.

Quality Control at HSL, Rourkela.

As described earlier, this is a modern plant specifically designed and operated for producing quality flat products including hot-dip tinplate.

Quality Control techniques follow the familiar pattern for such sophisticated plants right through all steges from steel making by the LD process to meticulous scarfing of slabs for tinplate and through subsequent stages of processing MR type of steel.

For tinplate, the hot band is cold reduced on a single-stand 4-high reversing mill and a 5-stand tandem 4-high mill.

After annealing, the cold reduced coils are skin-passed at a single stand 4-high mill or a 2-stand tandem 4-high mill. On the single stand mill, the strip is first given a pass with shot-blasted work rolls and the required mechanical properties obtained on the basis of earlier operation data vis-a-vis properties. Then another pass is given, this time with polished rolls to close the pores. Samples are taken after this pass and the data in respect of hardness, Erichsen and Jenkins values of each coil, logged.

Shearing line for ... inspection devices for pin holes and off-gauge sheets. Cut sheets are picked up every 20 minutes for checking and correcting dimensional accuracy. Sheets from the off-gauge pile are also checked for gauge to monitor the operation of the rejection device.

The hot-dip tinning lines work with automatic dry feed. Apparently because large quantities of palm oil are required for the Cold Mills, this tinhouse has not had to worry about substitutes like ground-nut oil.

2 samples are taken per line per 8-hour turn for checking the coating thickness by the weighment method. One sample per turn per line is taken for determining the distribution of the tincoating. This sheet is also checked for dimensional accuracy.

Sheets are taken out for determination of tin coating by the chemical method and also tested for hardness, ... and bend, and the results correlated with those obtained earlier for the coil after skin pass.

Out of the previous day's production, 3 boxes picked up at random, one from each turn, are opened and re-assorted to check the quality of inspection.

Customer Reaction:

All QC systems must aim at maximum customer satisfaction. With all the development of specifications to suit "engineering tolerances", and control of raw material and process towards their consistent attainment, customer reaction is the final determinant of the quality of the product as it reaches him.

TCIL and HSL, Rourkela, recognise this axiom and strive, by providing full field assessment of customer complaints with a view to obtaining correct feed-back information. They also take cognisance of opinions expressed by responsible bodies representing actual users of tinplate such as/the one recently voiced by the President of the All India Food Preservers' Association at its Annual Conference held in Bombay on April

On the most important problem concerning the supply of good quality tinplate, Mr. Wadud Khan said :

" The Industry's biggest single problem is the need to obtain adequate quantity of tinplate of acceptable quality for packaging various food products. Recently, there have been reports of a high percentage of spoilage by way of internal staining and corrosion of cans. Our members might recall the serious complaint of spoilage reported in the consignments of preserved foods supplied to the Army in 1968. It is gratifying to note that the Central Food Technological Research Institute, Mysore, has conducted valuable studies on the suitability of tinplate with various levels of phosphorus content in the basic sheet. Some very useful work has been done in countries abroad on the use of electrolytic tinplate with organic coatings for packing various fruit and vegetable products. But unfortunately, no similar work has been done so far for packaging tropical fruits and vegetables, indigenous to India. I would therefore urge our Research Institutions to continue their useful work in this direction and assist the Industry."

" In the absence of reliable data, it can only be surmised that electrolytic tinplate may be responsible for excessive spoilage. This presumption is further strengthened by the fact that when fabricators used hot-dip tinplate and supplied cans to packers, instances of spoilage were comparatively less. This would mean that hot-dipped tinplate would perhaps be better than electrolytic tinplate under Indian conditions......."

In this context, a wealth of information appears in chapter 10 dealing with "The Corrosion of Tinplate" in the monumental work "The Technology of Tinplate" by Hoare Hedges and Barry[5]. The Indian producers and consumers of tinplate could take advantage of the enormous research already done which, as suggested above, could also be usefully supplemented and brought uptodate by the chain of Research Institutions in the country.

The last remark, quoted above, expressing a preference for hot-dip over the electrolytic tinplate, has also to be borne in mind by the country's Planners for a rational, integrated approach to the future provision of production facilities and the economic exploitation of those already existing in India.

Manpower Development:

All said and done, it is the man behind the machine that makes all the difference between quality and the lack of it. Inevitably, this calls for human organisation for peak performance and their motivation towards this goal. These desiderata are not lost on the Indian entrepreneur, and one of the two tinplate producers, happens to be the Government of the country itself, with all the advisory and executive services at its command.

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Besides the availability of numerous training establishments all over India, these two producers are practically self-sufficient for training their workers and supervisors who are key men in the control of process and quality of product.

And yet, right now, it turns out to be not such a success story on the industrial labour front in general, and in the steel industry in particular. The avowedly socialistic twist given to its policies without an unshakeable economic base, rooted in productivity, has roused ambitions which the economics of the country is unable to sustain, and the current domestic scene is threatening to erode all the cherished norms and values and to put the clock back.

What does the producer do under such circumstances ? When even the existence or survival of the industry is at stake and the production levels, when permitted to operate, fall below the break-even point, what miracle does he invoke to maintain, if not improve, the quality of his products ?

CONCLUSION:

The demand for packaging material in the country is growing rapidly. There is considerable export potential as well. Fabricators of containers and cans are supplanting their earlier slow machines with fast automats. The need for high quality tinplate is thus most acute. Right now, when the production potential of the country could be utilised to the full and the foreign exchange spent on importing tinplate, utilised for providing established producers their much-needed material and equipment resources, the position is just the reverse. While the key to productivity and quality must inevitably rest with the producer, it does not appear to be in his possession at the moment.

In the context of the observations of the President of the All India Food Preservers' Association, it may be a sound idea to maximise the output of hot-dip tinplate for domestic consumption while exploring the possibilities of exporting the electrolytic variety, perhaps more suitable for other countries' needs. Co-operative research in the corrosion problem facing tinplate users, may prove rewarding.

A healthier environment for the Tinplate Industry to fulfil its obligations to the customer is needed in which workers and supervisors could be adequately trained and motivated to play their respective roles towards prosperity through Quality-Reliability.

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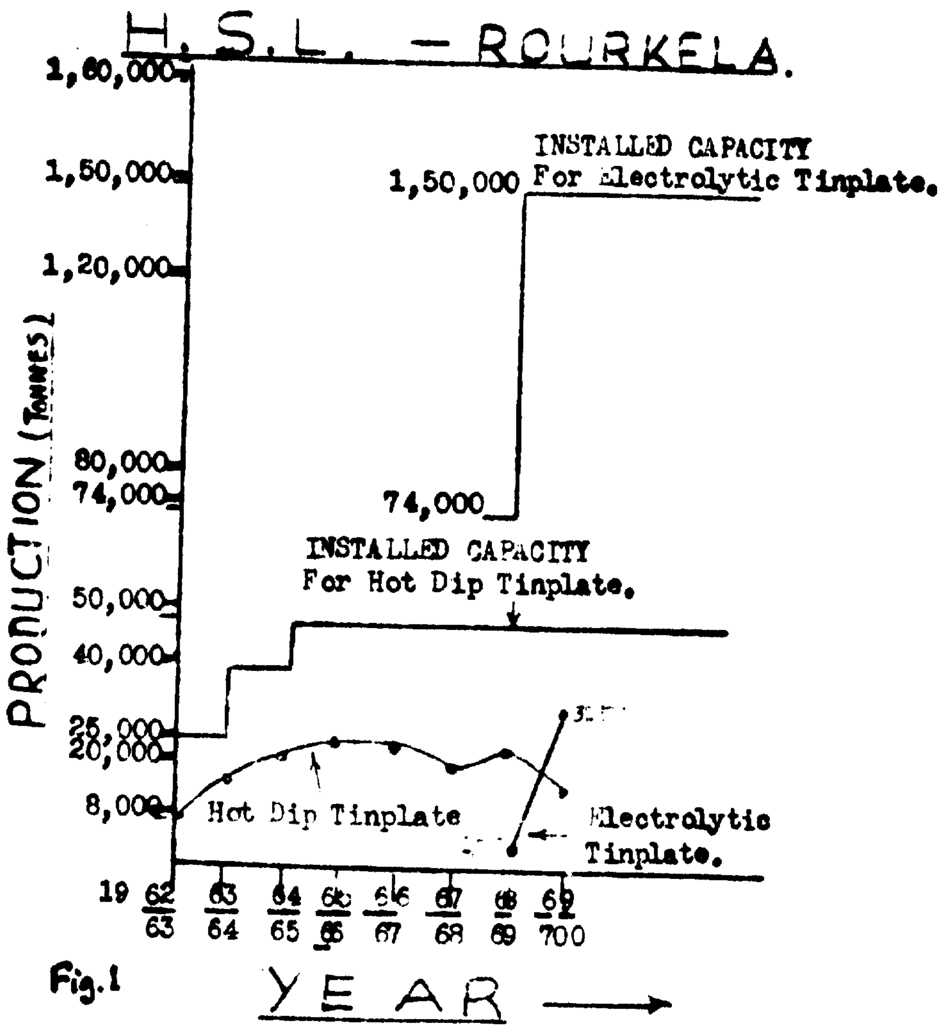
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25,000
20,000
8,000
PRODUCTION (Tonnes)
INSTALLED CAPACITY
For Electrolytic Tinplate.
1,50,000
74,000
INSTALLED CAPACITY
For Hot Dip Tinplate.
Hot Dip Tinplate
Electrolytic
Tinplate.
19 62/63 63/64 64/65 65/66 66/67 67/68 68/69 69/700
YEAR

Fig.1

TCIL - GOLMURI

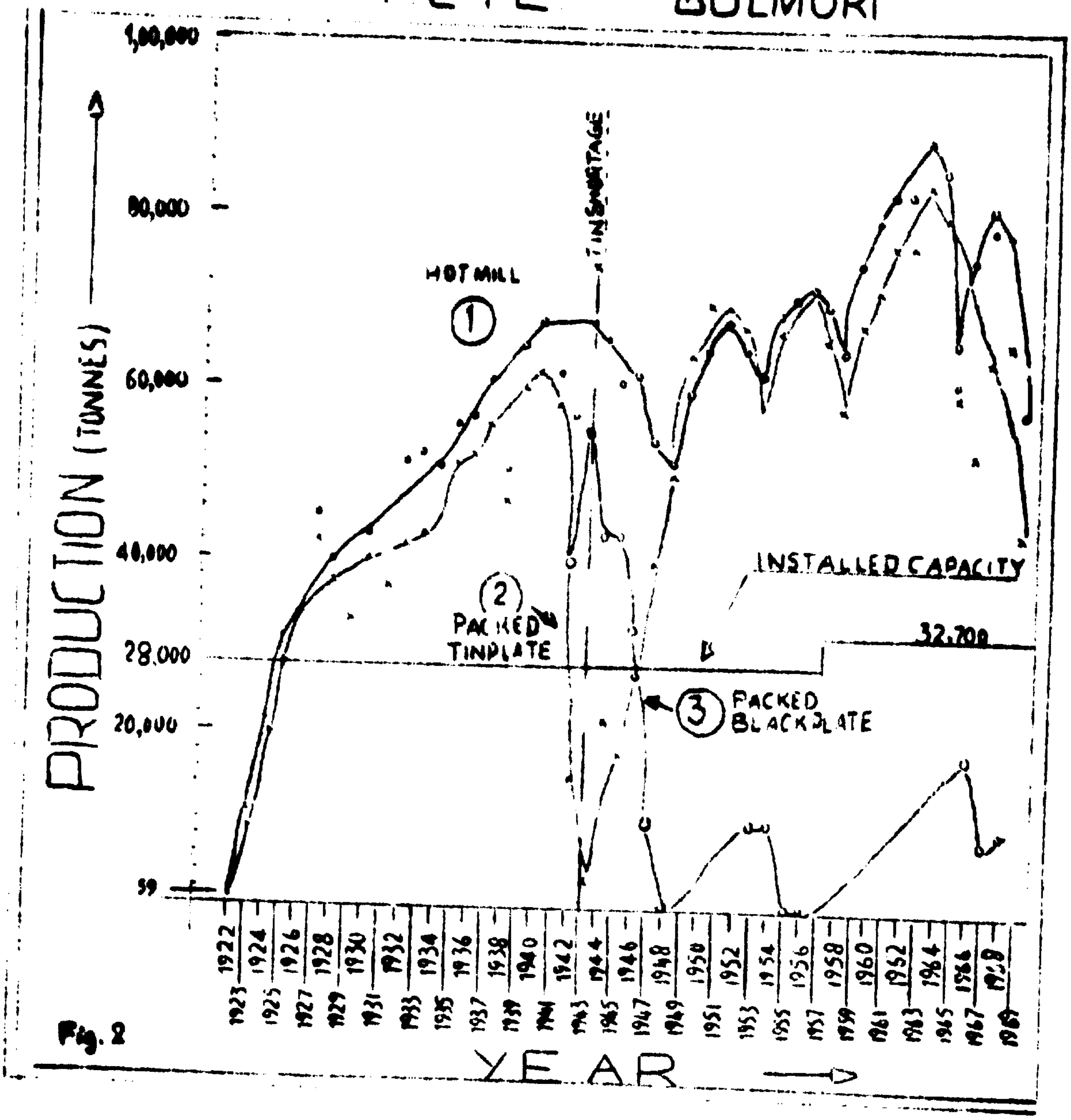


Fig. 2

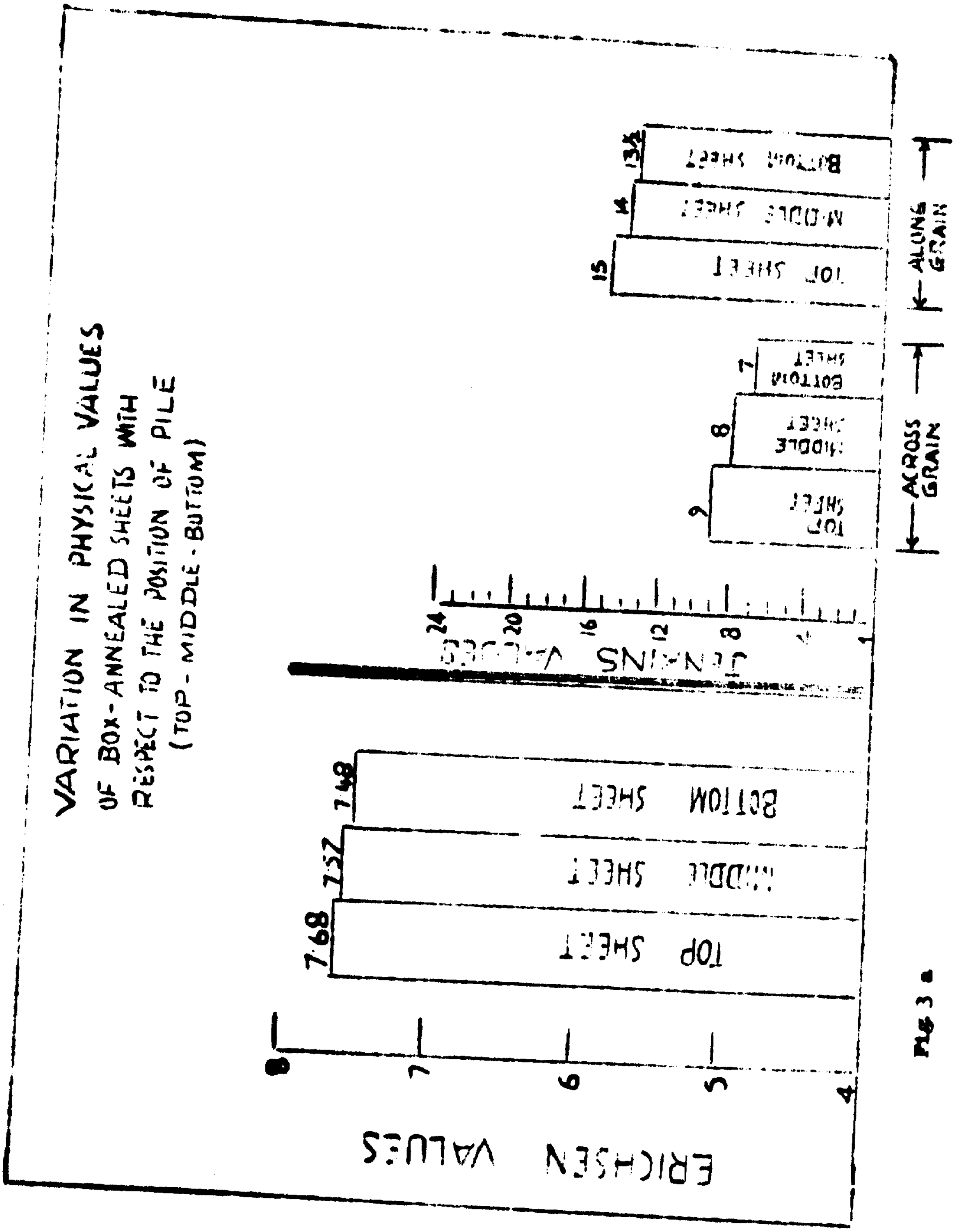

VARIATION IN PHYSICAL VALUES
OF BOX-ANNEALED SHEETS WITH
RESPECT TO THE POSITION OF PILE
(TOP - MIDDLE - BOTTOM)
ERICHSEN VALUES
8
7
6
5
4
7.68
7.52
7.48
TOP SHEET
MIDDLE SHEET
BOTTOM SHEET
JENKINS VALUES
24
20
16
12
8
4
9
8
7
15
14
13½
ACROSS GRAIN
ALONG GRAIN

Fig 3 a

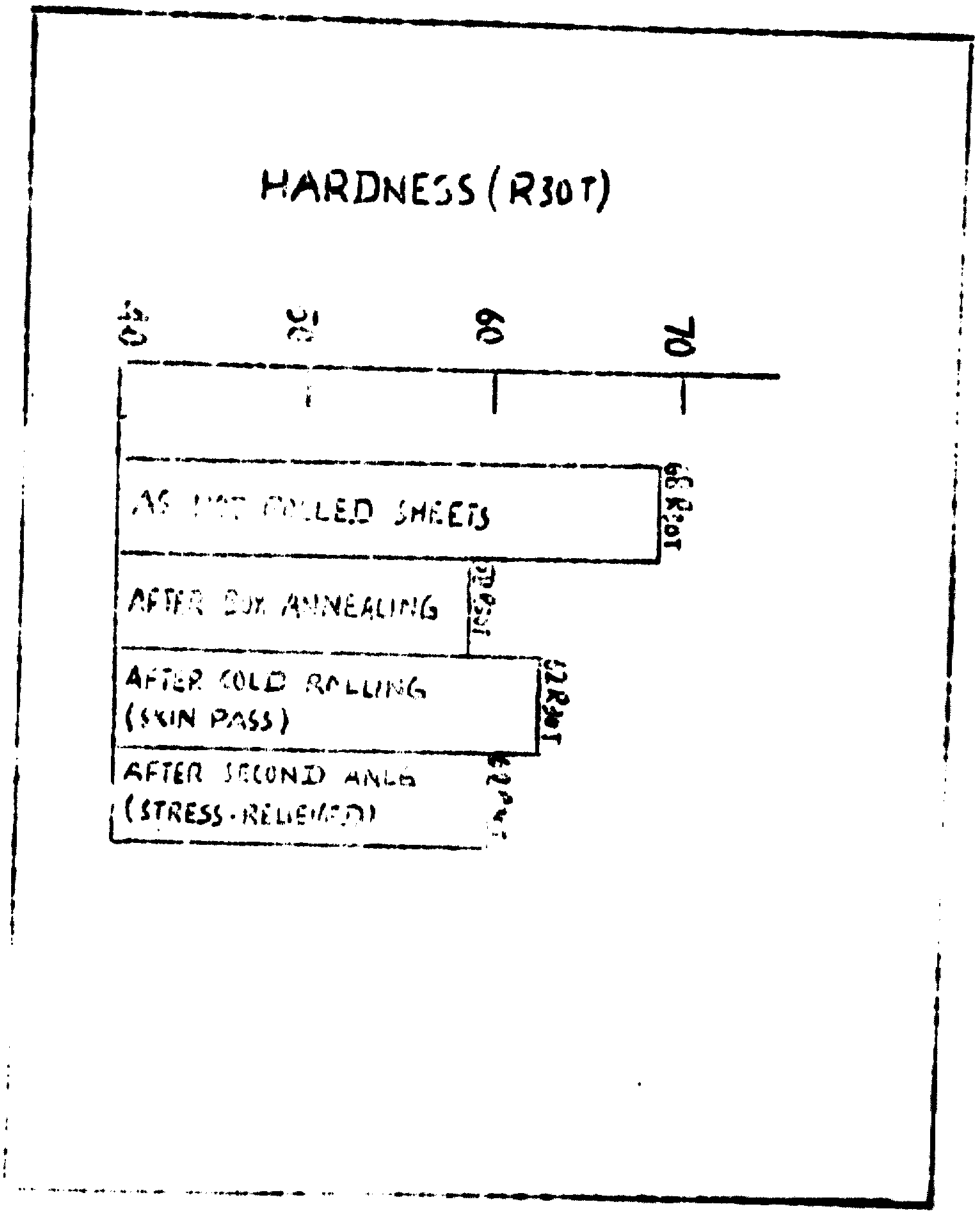
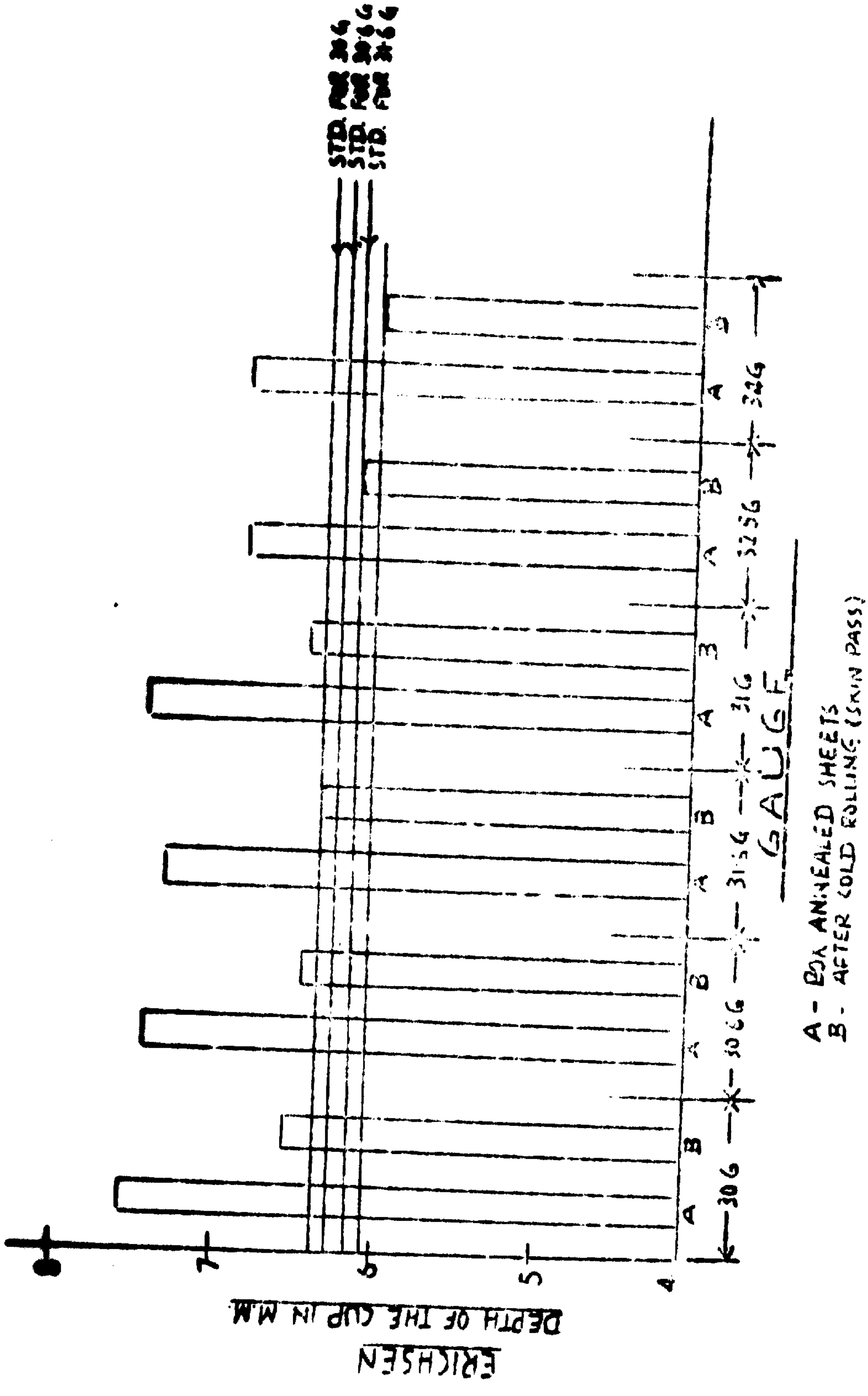

HARDNESS (R30T)
60
70
AFTER COLD ROLLING
(SKIN PASS)
(STRESS-RELIEVED)

Fig. 3 b



ERICHSEN VALUES OF VARIOUS GAUGE SHEETS

Fig 4

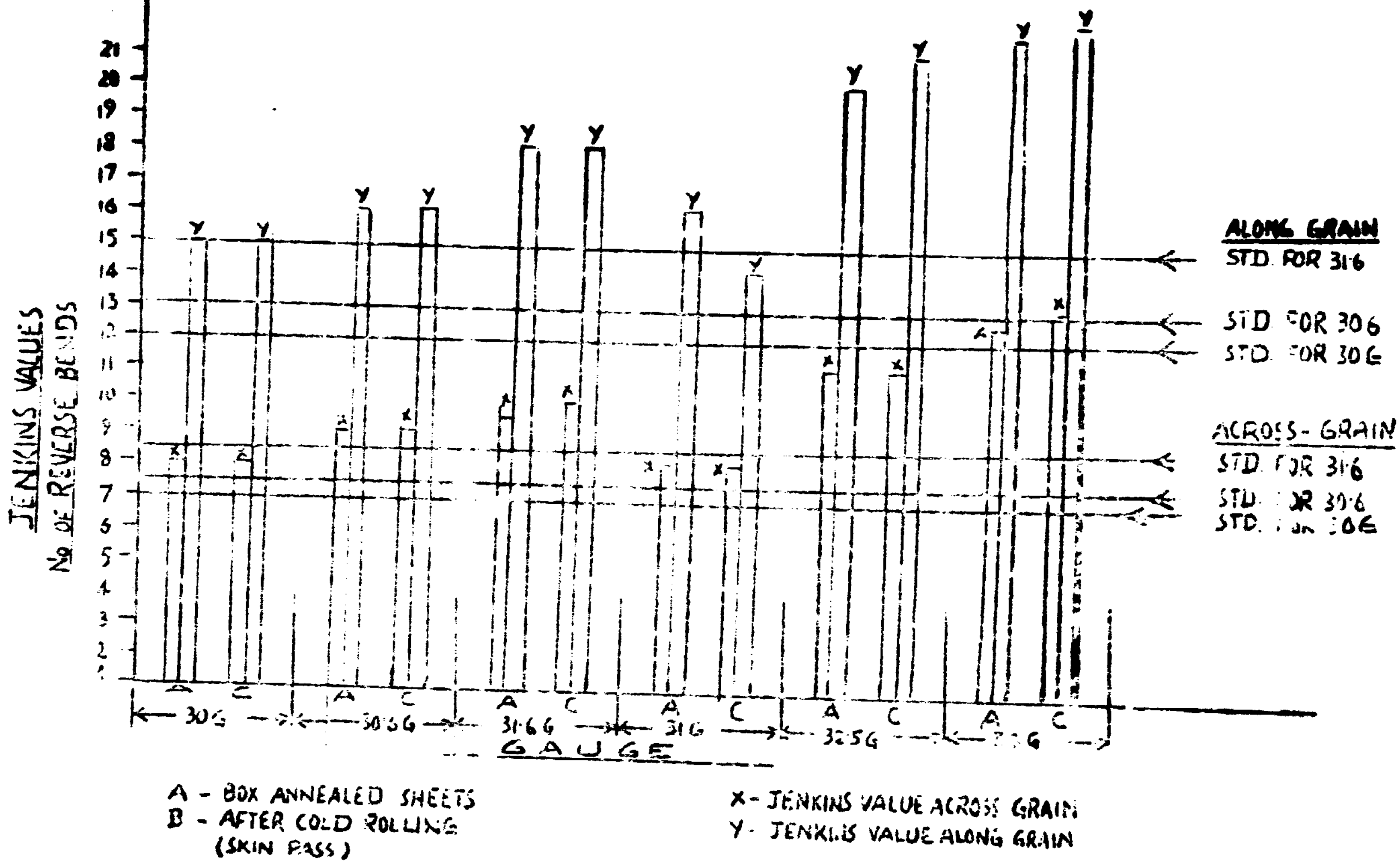


Fig. 5 JENKINS VALUES OF VARIOUS GAUGE SHEETS

TABLE 2 **COMPARATIVE PHYSICAL VALUES OF DIFFERENT TINPLATES**

PROPERTIES TINPLATE	U.S.A. COLD REDUCED HOT DIP TINPLATE	U.K. COLD REDUCED Sheets - Tinned at T.P.Co. by Hot dip process	EAGLE BUSH U.K.PACK ROLLED SHEETS Tinned at T.P.Co. by Hot dip.	TINPLATE Produced by T.P. Co.
Chemical Composition of Steel	C - 0.12 % Mn - 0.39 % P - 0.009% Si - 0.018% S - 0.03 % Cu - 0.017% Al - 0.013%	C - 0.11% Mn - 0.33% P - 0.005% Si - 0.012% S - 0.023% Cu - 0.092%	C - 0.081 % Mn - 0.37 % P - 0.031 % Si - 0.018 % S - 0.030 % Cu - 0.16 % Al - 0.018 %	C - 0.12 % Mn - 0.45 % P - 0.05 % Si - 0.04 % S - 0.05 %
Gauge	30 G	30 G	30 G	3[illegible] G
Thickness	0.0115" - 0.282 mm	0.0125 - 0.315 mm	0.012" - 0.312 mm	0 [illegible] 15" - 0.29 mm
Erichsen	7.83 mm.	8.68 mm.	6.29 mm.	6.94 mm.(Std.6.3/6.9)
Jenkins	12-17	13-15	8-16	9 18 (Std. 7-12 8-13)
Hardness	120 VPN-52.5 R30T	112VPN-50.5 R30T	110 VPN-50 R30T	[illegible] VPN - 63.5 R30T
Temper	T3	T3	T[illegible]	T[illegible]
U.T.S.	47 [illegible]/mm^2	[illegible]0 [illegible]/mm^2	4[illegible] [illegible]/mm^2	50 [illegible]/mm^2
% Elongation	20 %	10 %	20 %	14 %
Tin Coating	18.2 oz/basis box	17 to 20 oz/basis box	18-20 oz/basis box	18-20 oz/basis box
Porosity	482 to 550 pores per sq.dm.	600 to 750 pores per sq.dm.	700 to 950 pores per sq. dm.	800-1000 pores per sq. dm.

74.10.15