SECRET/CLASSIFIED		NUMBER OST 3-943-72
	1	SHEET 1 OF 25
		SUPERSEDES.

I. 1195

OST-44

BRANCH STANDARD

IRON-BASED SINTERED, STRUCTURAL

AND ANTIFRICTIONAL PRODUCTS .

OST 3-943-72

SUPERSEDES

I - 1195

TRANSLATED	M.Uma		31/10/84	Ordnance Factory Project Hyderabad.
AUTHENTICATED	G.V.Sosuir			
TYPED	L.Devi		3/1/85	
EDITED				APPROVED
	NAME	SIGN	DATE	

The present standard refers to structural and antifictional articles of general machine- building and instrument making purpose, manufactured by powder metallurgy method from iron based materials.

1. TECHNICAL REQUIREMENTS

1.1 Articles should comply with the requirements of the present standard and drawings approved in the established order.

Note:

Deviations and additional requirements which are not stipulated in the present standard are written in the drawings.

1.2 The grade and chemical composition of materials of articles should comply with the data in table .1.

1.3 Properties of structural materials after sintering should comply with the requirements specified in table 2; and after heattreatment should comply with the requirements specified in table 3.

1.4 Properties of antifrictional materials should comply with the requirements in table 4.

1.5 Deviations in the density (porosity) as per the volume of articles should not exceed the values given in tables 2 and 4.

1.6 Sintered and heat treated articles which are not subjected to further welding, soldering and application of protective and decorative coating should be paraffined, lacquered, oxidized or impregnated with oil to protect them from corrossion on the agreement with customer.

1.7 Antifrictional articles should be impregnated with oil, which grade is agreed upon with the customer.

[illegible] articles impregnated with oil for [illegible] machining, [illegible] with oil [illegible]

[illegible]

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1.8 Temper colours on the article surfaces, not to be subjected to protective and decorative coatings, is not the cause for rejection.

1.9 Structural articles subject to protective and decorative coatings should meet the the following requirements:

a) Burrs and sharp edges are not allowed; minimum rounding off radius of edges should be 0.3 mm;

b) Scales, temper colours, covering traces, corossion and residue of hardening medium are not allowed on articles after sintering and also after heat treatment;

c) articles should be impregnated in a water-repellent ГКЖ -94, GOST 108 34.

1.10. Articles to be heat-treated are supplied with test samples for determining the mechanical properties.

1.11 The manufacturing accuracy of articles should be within the limits 4 to 7 when introducing calibration operation should be within the limits of 3 to 4 accuracy class as per GOST 7713-62.

1.12 For improving the mating of press-fits ПР 13, ПР 23, ПР 33 the lower and the upper limits of the set tolerance range should be increased by 30%

1.13 Ovality of articles(bushes) to be press fit when the arithmentic mean diameter should be within the tolerance limits, should not exceed 30% of the upper limit of tolerance range.

1.14 Variation in wall thickness of articles should not exceed 0.2mm.

1.15 Roughness of non-working, not to be machined surfaces should not be below R_z 40 as per GOST 2789-73.

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TABLE NO: I

CHEMICAL COMPOSITION OF MATERIAL, %

Grade of material	Purpose	Iron	CARBON		Copper	Nickel	Molybdenum	Columbium	Oxygen	Residue insoluble in hydrochloric acid.
			Combined	Free					MAXIMUM	
ЖГр0,6-6,5 ЖГр0,5-7,0	Structural	Base	0,55-0,60	0-0,10	-	-	-	-	0,25	0,80
ЖГр1-6,5 ЖГр1-7,0	Structural	Base	0,60-0,90	0-0,15	-	-	-	-	0,25	0,80
ЖГр1А3-6,5 ЖГр1А3-7,0	Structural	Base	0,60-0,90	0-0,15	2,50-3,00	-	-	-	0,25	0,80
ЖГр0,5Н2М-6,5 ЖГр0,5Н2М-6,5-7,0	Structural	Base	0,30-0,65	0-0,15	-	1,50-2,00	0,15-0,30	-	0,25	0,80
ЖГр3	Anti-frictional	Base	2,30-3,00	1,00-1,50	-	-	-	-	0,30	Not fixed
ЖГр3К1	Anti-frictional	Base	2,30-3,00	1,00-1,50	-	-	-	0,70-1,10	0,30	Not fixed
ЖГр1,5А2,5К0,5	Anti-frictional	Base	1,00-1,50	0,30-0.80	2,00-2,30	-	-	0,40-0,80	0,30	Not fixed

Note:- 1. Designations in grades of materials: Ж-iron, Гр-Graphite, А-Copper, Н-Nickel, М-Molybdenum, К-sulphur; digits after letter designation express the conventional percentage content of components in the material: figures 6.5 and 7.0 express the convertional designation of density of structural materials.

2. When manufacturing articles of sintered materials specified in Table.1 the following basic components are used:
   - iron powder, GOST 9849-74, grades ПЖ 1М, ПЖ 2М
   - copper powder, GOST 4960-75, grades ПМА, ПМ
   - nickel powder, GOST 9722-79, grades ПНК-1, ПНК-2
   - pencil graphite GOST 4404-78, grades А and Б
   - sulphur powder, GOST 127-76
   - Molybdenum powder.
3. Sintered articles may be manufactured from powders of other grades on the agreement with the customer, if the obtained physical-mechanical properties are in compliance with tables 2,3,4.
4. The content of copper, nickel, molybdenum and sulphur which are not the alloying elements in the material should comply with their quantity in initial powders.

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Table - 2

PROPERTIES OF STRUCTURAL MATERIALS AFTER SINTERING

Grade of material	Density, gm/cm³	Porosity % (reference).	Hardness HB ultimate 5/250/30	Tensile strength kgf/mm²	Relative elongation, %	Impact strength, kgf.m/cm²	Microstructure
			* Minimum				
*Fp0,5-6,5	6,4-6,9	12-17	60	20	2,0	1,3	Pearlite, ferrite upto 70%,
*Fp0,5-7,0	6,9-7,3	7-12	80	25	4,0	2,0	Cementite inclusions
*Fp1-6,5	6,4-6,9	12-17	70	23	1,5	0,5	Pearlite, ferrite upto 40%,
*Fp1-7,0	6,9-7,3	7-12	90	30	2,0	1,0	Cementite inclusions
*Fp1/3-6,5	6,4-6,9	12-17	90	30	1,2	0,5	Pearlite, ferrite upto 35%,
*Fp1/3-7,0	6,9-7,3	7-12	120	40	2,0	1,0	Cementite inclusions Structural-free copper is not allowed.
*Fp0.5H2M-6,5	6,4-6,9	12-17	70	28	3,0	1,3	Pearlite, ferrite upto 70%,
*Fp0,5H2M-7,0	6,9-7,3	7-12	80	35	4,0	2,5	Cementite inclusions unpickling white spots (soli solutions of nickel in iron and of iron in nickel

NOTE: 1) Nature of distribution of cementite should not be above mark 5 on scale 5 as per GOST 8233-56.

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Table-3

PROPERTIES OF STRUCTURAL MATERIALS AFTER HEAT TREATMENT

Grade of material	Heat treatment mode	Hardness HB 5/750/30.	Tensile strength kgf/mm (minimum)	Relative elongation, % (minimum)	Impact strength, kgf.m/cm² (minimum)	Microstructure.
ЖпрО,5-6,5	Hardening, from 870+10°C into water,	180-300	30	0,8	0,5	Troostite-
ЖпрО,5-7,0	Tempering at t=200to300°C.	240-340	50	1,0	0,9	Sorbite.
Жпр1-6,5	Hardening, from 850+10°C into water	220-320	40	0,5	0,5	Troostite
Жпр1-7,0	Tempering at t=250-320°C	250-390	60	1,0	0,8	
Жпр1Ф3-6,5	Hardening, from=850+10°C into oil	220-350	45	0,5	0,5	Troostite-
Жпр1Ф3-7,0	Tempering at t=250 to 350°C	250-390	65	0,6	0,6	martensite.
ЖпрО.5Н2М-6,5	Hardening from =850+10°C into oil	220-350	55	0,8	0,7	Troostite-
ЖпрО,5Н2М-7,0	Tempering at t = 250 to 360°C	250-390	75	1,2	1,0	Martensite.

Note:- Austenite upto 30 % may be present in the microstructure.

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PROPERTIES OF ANTIFRICTIONAL MATERIALS — TABLE-4

Grade of material	Porosity, %	Hardness, HB 5/250/30 (minimum)	Compression strength kgf/mm² (minimum)	Bending strength kgf/mm² (minimum)	Oil absorption, % (minimum)	Friction coefficient when lubricated.	Microstructure	Permissible working parameters: Temperature, °C	Pressure kgf/cm²	Velocity, m/sec
ЖМр3	17-23	60	35	20	1,5	0,006-0,09	Pearlite, ferrite upto 30 %; free graphite, cementite upto 10% is allowed.	180	100	5,0
ЖМр3К1	17-23	60	40	20	1,5	0,005-0,07	Pearlite, ferrite upto 30%, sulphides, free graphite, cementite-upto 10% is allowed	180	100	5,0
ЖМр1,5А2,5К0,8 1	17-23	70	50	30	1,5	0,01-0,10	Pearlite, ferrite upto 50%, sulphides, free graphite, cementite upto 5% is allowed, structural-free copper is not allowed.	200	100	4,0

Note:- Structural-free cementite may be in the form of separate inclusions and broken lattice.

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1.16 Cavities, partial mottings, cracks, peeling off, chips, porosity and nicks are not allowed on the article surfaces.

1.17 Separate dents of diametermore than 2 mm and depth more than 0.5 mm spaced at a distance of atleast 5 mm and also longitudinal marks of depth more tha 0.2 mm covering more than 30% of the surface are not allowed on non-working, not to be machined surfaces.

1.18 Longitudinal tool marks to a depth more than 0.2 mm covering more than 10% of the surface are not allowed on working not - to be machined surfaces.

1.19 All the above mentioned defects if they exceed the value of allowance for machining are not allowed on the surfaces subjected to machining.

1.20 Burrs on the end planes of articles should not exceed in height 0.5 mm and in thickness-0.25 mm when necessary various types of treatment (grib-blasting, vibro-blasting, machining, etc) may be used to remove the burrs.

1.21 Depth of the decarbonized layer on not to be machined surfces of articles subjected to heat treatment should not exceed:
- 0.10 mm when wall thickness is upto 3 mm
- 0.15 mm when the wall thickness is from 3 to 6 mm
- 0.20 mm when the wall thickness is above 6 mm .

Decarbonized layeris not allowed on working surfaces of antifrictional articles.

1.22 Turning, milling, reaming, broaching, drilling and grinding are used for machining the articles.

Note:

To avoid ingress of abrasive particles into the pores which may cause scores on frictional surfaces grinding of working surfaces of antifrictional articles is not desirable.

1.23 Structural articles with density less than 6.9 gm/ cm^2 are welded in shielding medium.

1.24 Example of conventional designation of materials in technical documents

contd....9/-

and when placing order is: M5 p0.5 to 6.5, OST 3-943-72.

2. ACCEPTANCE RULES

2.1 Acceptance of articles is carried out by TID of the manufacturing plant in compliance with the requirements of the present standard and drawings.

2.2 The articles are supplied for acceptance in batches, of Articles of similar type manufactured from same charge and sintered in same furnace at steady sintering mode are included in the batch.

Note: On the demand of TID of the manufacturing plant or Customer test samples should be prepared for mechanical testing included in the acceptance batch as per item 2.2 & the number of test samples should be at least 15 pcs for each type of test.

2.3 Inspection of articles and check tests are conducted in the scope specified in table 5.

2.4 Customer has the right to check articles on all the parameters as per the present standard excluding density (porosity) and oil absorption of impregnated articles.

2.5 If unsatisfactory test results are obtained on any parameter, then repeated tests are conducted on a double number of articles. The batch is rejected, if during repeated tests unsatisfactory results are obtained.

Note: The supplier has the right for 100% sorting out of the rejected batch per all the parameters specified the articles, elimination of the defects and resubmitting it as a new batch.

3 TEST PROCEDURE

3.1 External appearance of articles (surface roughness, cavities, partial meltings, cracks, peeling-off, chips porosity and nicks) are checked visually.
Surface finish is determined by comparing with the standard as per GOST 2789-73.

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3.2 Articles are checked for dimensions with measuring tools in conformity with the accuracy class specified in the drawing.

~~3.2~~ Articles are checked for dimensions with measuring tools in conformity with the accuracy class specified in the drawing.

3.3 Density (porosity) is checked immediately after sintering and determined by hydrostatic weighting as per the procedure given in appendix.1 to the present standard.

3.4 Mechanical properties are checked on samples sintered simultaneously with batch of articles.

3.5 Samples with ~~breaks~~ cracks, peeling-off and other defects as per item 1.16 of the present standard are ~~not~~ not tested.

3.6 Tensile strength tests are carried out on propertional samples of section 5x4mm and estimated length of 25 mm as per GOST 1497-73.

3.7 Impact strength tests conducted on rectangular samples with dimensions 10x10x65 mm without cutting as per GOST 9454-78

3.8 Compression test is conducted on cylindrical samples of diameter 10 mm and height 15 mm when the velocity of the support during the test does not exceed 2 mm per minute as per GOST 2055-81.

Table - 5

Parameters	Testing volume from an article batch		Checking norms
	Structural	Antifrictional	
(1)	(2)	(3)	(4)
External appearance	0.2%, at least 25 pcs	0.2%, atleast 25 pcs	Deviations from requirements are not allowed
Outline	0.1%, at least 10 pcs	0.1%, at least 10 pcs.	Deviation from requirements are not allowed.
Density (porosity)	0.05% at least 3 pcss	0.05%, at least 3 pcs	Deviation from requirments are not allowed.

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(1)	(2)	(3)	(4)
Tensile strength	3 check pieces	-	Deviations from requirements are not allowed.
Impact strength	Check samples	-	Deviations from requirments are not allowed
Compression strength	-	3 test pieces	Deviation from re requirements are not allowed
Banding strength	-	3 test pieces	Deviation from requirements are not allowed
Hardness	0.05 % atleast 3 pcs.	0.05% at least 3 pcs.	Deviation from requirments are not allowed
Chemical composition	0.01% atleast 2 pcs	0.01%, at least 2 pcs.	Deviation from requirements are not allowed.
Microstructure chem.	0,05% at least 3 pcs.	0.05% at least 3 pcs	Deviation from requiremens are not allowed
Oil absorption	-	0.05 % at least 3 pcs	Deviation from requirements are not allowed

Note: 1) Quality of parts may be checked by technological sampling (determining the breaking force of parts and blanks)

2) Checking ratings may be changed on the agreement with the customer.

3.9 Bending tests are conducted on samples of rectangular sections with dimensions 10x10x65 mm. Distance between the supports should be 40 mm. Velocity of the support when testing should not exceed 0.1 mm per second as per GOST 2055-81.

3.10 Test results are considered as failure under the following conditions:

a) breakage of samples occurs beyond the limits of estimated length and the value of mechanical parameters do not comply with the specified requirements;

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b) destruction occurs due to the defects (foreign inclusions, cracks, peeling off, etc).

c) Chemical composition, density (porosity) and microstructure of samples do not comply with the requirements of Table 1,2,3,4 of the present standard.

3.11 Hardness is checked as per GOST 9012-59 Conditions to determine the hardness of articles after sintering are HB 5/250/30, after heat treatment are HB 5/750/30. When the wall thickness is less than 5 mm, conditions to determine the hardness of articles after sintering are HB 2.5/62.5/30; after heat treatment- HB 2.5/187.5/30. ~~The wall thickness is less than 3mm.~~ Hardness may be measured as per GOST 9013-59 when the wall thickness is less than 3 M.M.

Note: 1, Th conditions for determining the hardness of samples should be similiar

2. Places for measuring hardness is indicated in the drawings.

3. Impression due to measuring of hardness is not the cause for rejection.

3.12 Chemical composition is checked by analysing speciments from articles and samples. Sampling is carried out as per GOST 7565-73.

3.13 Content of carbon is determined by chemical enalysis as per GOST 12344-78, copper as per GOST 12355-78; nickel as per GOST 12352-81; molybdenum as per GOST 12354-66; oxygen as per GOST 164126-70, insoluble residue as per GOST 16412.8-70.

3.14 Oil obsorption ability of artifrictional parts is checked immediately after sintering as per procedure given in Appendix.2 to the present stadard.

3.15 Microstructural analysis is carried out in compliance with the procedure given in appendix 3 of the present standard.

3.16 The ~~s~~ value of the decarbonized layer is checked as per GOST 1763-68 (procedure M) upto the basic structure.

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4. MARKING, PACKING, TRANSPORTATION AND ~~STORAGE~~ STORAGE.

4.1 Articles should be packed in wooden boxes lined from inside ~~the~~ with paper ensuring protection of ferrous metal from corrosion. Gross weight of the box is 50 kg.

4.2 Articles which are not subject to impregnation as per item 1.6 should be packed in polyethylene bags with silica gel GOST 3956-76 which are then packed in compliance with item 4.1 on the agreement with the customer.

4.3 The packing should protect the articles from damages during transportation.

4.4 Each box should contain a packing list with TID Stamp where the following should be indicated:
- manufacturer;
- batch number;
- description and drawing number;
- number of articles in the box;
- manufacturing date;
- number of the present standard.

4.5 Each batch of articles should be accomplanied by certificate with TID stamp, in which the following are specified
-manufacturer;
-batch number;
-description and dr wing number;
-number of articles in the batch and number of boxes,
-data specifying the compliance of articles with the present standard and drawing.

4.6 A copy of the packing list should be pasted on to the box. Tags or inscription with indelible paint on the side walls of the box may be used instead of a packing list copy.

4.7 Articles may be transported by all means of transport ensuring their intactness and safety.

Contd.....15/-

4.8 To avoid corrosion, articles should be stored in dry closed premises.

The supplier is not responsible for the quality of products if st storage rules are not observed.

5 SUPPLIER'S GUARANTEE

5.1 Articles should be accepted by the TID of the manufactureing plant.

5.2 Manufacturer should guarantee the compliance of artilces with the requirements of present standard provided the customer observes the storage conditions specified in the standard.

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HYDROSTATIC METHOD OF DETERMINING DENSITY AND POROSITY

The present method is intended to determine the density and porosity of articles which are made by powder metallurgy method.

1. Equipment, fixtures, materials:
- laboratory balance
- breaker of 250 to 500 mm capacity
- hot plate
- distilled water,
- paraffin
- fillter paper
- vessel for heating paraffin.
- ~~vessel for hea~~
- special stand for beaker.
- capron thread.

2. Preparation of samples

2.1 Articles are delivered for testing with the accompanying notice, in which the description and type of article, grade of material, drawing number and batch number are specified.

2.2 Number of articles which undergo testing are selected in compliance ~~wit~~ with the present standard.

2.3 If it is not possible to carry out test due to the dimensions of the article, it is cut into several samples and then tested.

2.4 Batch number or conventional designation should be stamped on the article.

3. Test procedure

3.1 Mass of the article is determined in air with accuracy upto 0.01 gm.

3.2 After weighing the article in air it is dipped in melted paraffin and kept it until the air bubbles disappear. Excess of paraffin is drained off from the surface or absorbed by the filter paper.

3.3 Article impregnated in paraffin is suspended using thin

contd...16/-

wire or thread to the hook of the balance pan and the mass is determined together with the thread.

3.4 A beaker with water is placed on a special stand on the balance pan and the article is dipped in it on thread and the mass of the article with the thread is determined in water.

When weighing, the article should be completely dipped in water and should not touch the walls and bottom of the beaker; no air bubbles should be visible on the article surface.

The volume of the article is determined as per the formula:

$$V = \frac{P_1 - P_2}{\gamma_B},$$

Where V = volume of article in cm^3;

P_1 = mass of the article impregnated in paraffin with the thread in air in gms;

P_2 = mass of the article impregnated in paraffin with the thread in water in gms;

γ_B = density of water at the temperature of test in gm/cm^3;

3.5 Density is calculated as per the formula:

$$\gamma_n = \frac{P}{V}$$

Where γ_n - density of article in gm / cm^3;

P - mass of the article in air in gms;

v - volume of article in cm^3.

3.6 the porosity is the relation the of pore volume to the volume of article; is expressed in percentage and determined as per the formula:

$$= \Pi = \frac{\gamma_T - \gamma_n}{\gamma_T} \cdot 100$$

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Where

Π - porosity of the article in %;

γ_T - theoritical density of compact material in gm/cm^3;

γ_Π - density of porous article in gm/cm^3;

Theoretical density of materials is given in the table.

Material	Density, gm/cm^3
ЖП р0,5	7.81
ЖП р1	7.79
ЖП р1А3	7,85
ЖП р0,5Н2М	7,83
ЖПр3	7,55
ЖПр3К1	7.44
ЖВр1,5А2,5К6,5	7,66

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Appendix-2

DETERMINATION OF OIL ABSORPTION ABILITY OF SINTERED ANTIFRICTIONAL ARTICLES.

1. Equipment, devices , materials:
   - laboratory balance
   - drying cabinet
   - thermometer
   - bath of 1.0 to 0.2 litres for oil impregnation
   - bath of 1.0 to 2.0 litres for gasoline impregnation
   - stand with gauze for draining oil
   - spindle oil
   - aviation petrol
   - cleaning cloth.

2. Preparation of article

2.1 Article are delivered for analysis with the accompanying notification in which the type of articles, drawing number and batch number are specified.

2.2 Number of articles to be tested are selected in compliance with the present standard.

2.3 Batch number or conventional designation should be stamped on the articles.

3. Test procedure

3.1 Article should be cleaned from charge powder ~~thoroughly~~ roughly in gasoline and then dried at 100°C for one hour.

3.2 Dried articles are weighed to an accuracy of 0.01 gm and placed for impregnation into the bath with oil at 80 to 100°C.

3.3 Articles are kept at specified temperature for 2 hours.

3.4 After impregnation, articles are cooled down in oil upto room temperature.

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3.5 Cooled parts are removed from the oil, set on the stand for draining, after which the parts are wiped until the oil from the surface is removed and weighed.

3.6 Oil absorption ability is determined as per the formula;

$$M = \frac{P_2 - P_1}{P_1} \cdot 100$$

Where M - oil absorption ability of article in %,

P_2 - mass of the article after impregnation in oil in gms,

P_1 - mass of the article before impregnation in oil in gms.

Appendix-3

MICROSTRUCTURAL ANALYSIS

Microstructural analysis is carried out on metallographic sections cut out from blanks and check samples. Orientation of section plane of is selected in the pressing direction. Microsections are made by mechanical method.

Electro polishing is not allowed. Surface finish of the microsection should conform to class 14 as per GOST 2789-73.

Sulphides are determined in unpicked section at 150 to 100 magnification . A 4 to 5% solution of nitric acid as per GOST 4461-77 in ethyl spirit is used as pickling agent. Other reagents giving the exact distribution pattern of components may be used as pickling agent.

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Microstructure of articles after sintering is determined at 250 to 300xmagnification ; after heat treatment at 600 to 800Xmagnification

Quantitative characteristics of basic elements of microstructure: pearlites, martencites, carbides are carried out on the basis of comparision of structure with standards of corresponding scales as per GOST 8233-56. For more accurate quantitative metallographic analysis of structure components a linear or planimetric method is used.

85055/OFPM/DS/86-87

Date: 20.1.87

Notification No. 1

Notification of Amendments to specifications

The following corrections/amendments are now required to be carried ~~in~~ out in the documents as below:-

Document Detail :- OCT 3-943-72

OFPM Regn.No. :- I 1195

Details of Amendments:-

Sl.No. Details

1. Ref: Table No.1 of page 4 of 20, in the column of Nickel -

Delete:- 2.50 - 2.00

Add :- 1.50 - 2.00

2. Ref: Table No.3 of page 6 of 20, in the column of Tensile strength:

Delete:- kgf/mm

Add :- kgf/mm^2

3. Ref: Table No.4 of page 7 of 20, in the column of grade of material:

Delete: ﻢ T

Add : ﻢ ٢

Also delete ﻢ T appearing in pages 7 and 17 and add ﻢ ٢ in its place.

Mr Somasundaram
M. Spl ITI Staff
To
AF/P.D.O

10/2

Copy to: CI/ICV.

Note How is action being taken on all such letters? Is it complete or not? P1 attend.

ADM/DS

DCI(SED)

10/2/87