

COVERED PLUNGER

We can repair and revive old used plungers under special methods of DAIWA DIESEL Co. Ltd. By using Ni-based self-flushing alloy, we can reduce following problems against plungers and as the result of it, we can offer you much longer life of plungers than original one, which were supplied by engine manufacturers, and also in reasonable costs.

Our plunger's superiorities can be confirmed especially in severe fuel oil conditions.

We named our revived plungers as "COVERED PLUNGER"

We categorized above-mentioned problems into following three patterns.

These problems usually promote each other and we confirm damage caused by them simultaneously.

1. Corrosive wear

It caused by a chemical reaction comes from sulphur, water etc. in fuel oil.

2. Abrasive wear

It caused by hard particles in Fuel Oil such as Alumina and Silica.

This is the most popular wear mechanism of plungers.

3. Adhesive wear

Fuel oil lubricates barrels and plungers, but if barrels touched with plungers directly, it makes local welding and finally it comes to stick of plungers.

COVERD PLUNGER lessens above-mentioned problems by using Ni-based self-flushing alloy.

1. Against corrosive wear

Following table shows durability of each material in particular chemical condition.

You can see Ni-based self-flushing alloy has excellent performances against chemical condition especially in H₂SO₄.

table 1 Corrosion Resistance

Chemical	Density %	Temp.	Ni-based self-flushing alloy	Co-based self-flushing alloy	SUS 304
H ₂ SO ₄	5	25	A	B	B
HCl	5	25	A	A	A
NaOH	10	Boil	A	A	A

- A: under 5mil/yr can be used
 - B: 5 ~ 50mil/yr can be used in limited situation
 - C: above 50mil/yr cannot be used
- mil: 10-3in.

2. Against abrasive wear

“Abrasive Test” was carried out with sandpapers and “Sand-erosion Test” was carried out with wet Al-sand.

Both results show high durability against abrasive wear of Ni-based self-flushing alloy.

Fig. 1 Abrasive Test

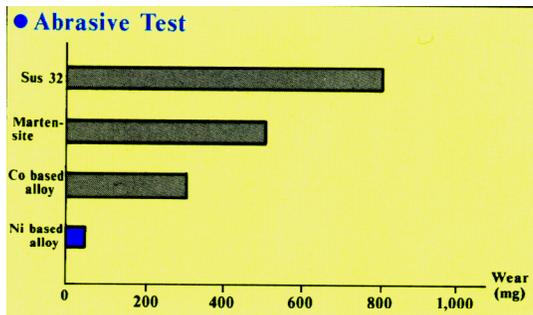
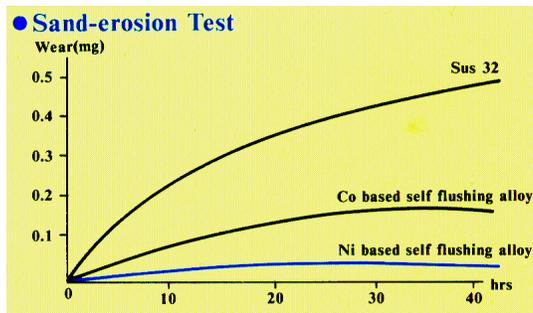


Fig. 2 Sand-erosion Test



3. Against Adhesive wear

“Adhesive Test” was carried out as follows;

Test piece of each material (size of 5 by 5mm cubic) pushed to the rounding steel wheel (outer dia. 69mm, inner dia. 59mm) with 2.0kg/cm² pressure and measured wearing of each material when rounding speed of wheel was increased.

Fig 3 shows the result of this test and we can see adhesive wear is arise remarkably in case of Fe piece according as steel wheel rounding speed to be increased.

However, In case of Ni piece, adhesive wear to be saturated in lower value.

Other materials in the table, such as Al, Zn etc. are impossible to use as plungers because we cannot get sufficient hardness from them.

It is said that same and/or close materials get together well so they are apt to have adhesive wear between them compare with in case of between different materials.

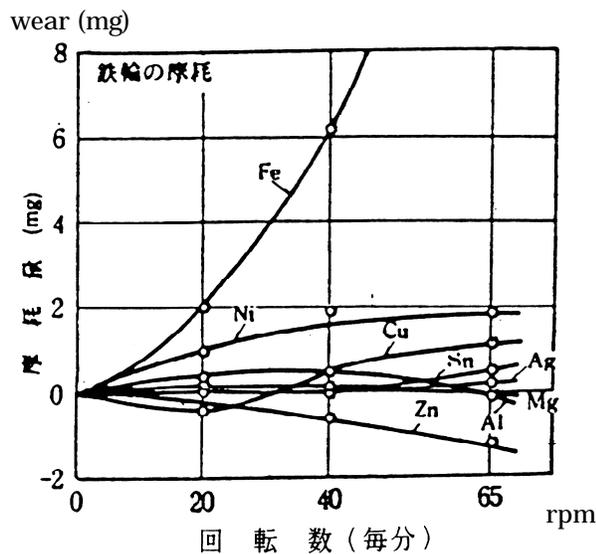
As we mentioned above, we use Ni-based alloy for plungers against steel barrels. However, original plungers are made of steel for steel barrels. We suppose engine manufacturers have not consideration about adhesive wear of plungers.

We have good examples of this matter.

We know White Metal can be used as bearing for crankshaft of engines and it has good performances. White Metal is not so hard but it durable long period as bearing under heavy conditions.

And also, Gunmetal is used as bearing for stainless steel pump shaft etc. with good performances. If we use steel for this bearing, shaft to be stuck immediately.

Fig. 3 Adhesive Test



4. COVERED PLUNGER is made precisely

Fig.5 and 6 show circularity (out-of-roundness) of head part of each plunger.

Fig.5 is genuine plunger and Fig.6 is COVERED PLUNGER.

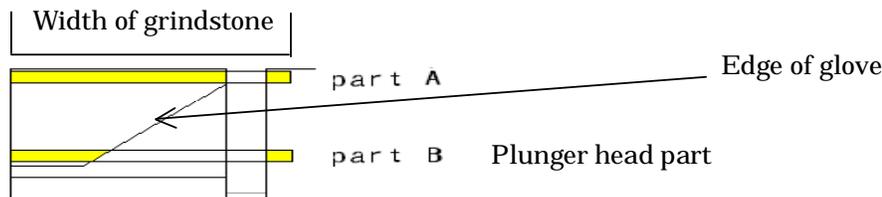
We can see 1.5μm of deformation at the glove part of genuine plunger (Fig.5). It means this plunger has 3.0μm of deformation in dia.

As you can see, however, COVERED PLUNGER (Fig.6) has not such big deformation compare with genuine plunger.

Normal plungers (include genuine plungers) to be finished with grindstone as final procedures after their groove are carved and this procedure makes their deformation.

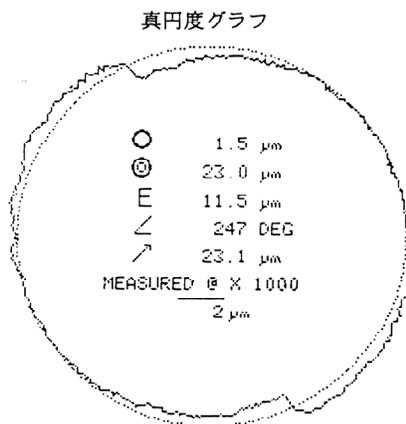
When we grind plungers, plungers to be pressed to grindstones continuously in same certain stress. However, at the glove part, pressure between plungers and grindstones varies according as ring glove's shape. Part B of Fig.4 gets much bigger pressure than Part A, and so, Part B to be grinded much deeper than part A because pressure area of part B is narrower than part A (Yellow part shows pressure area).

Fig. 4 grinding procedure of normal plunger (at the head part)



In case of COVERED PLUNGER, we grind surface of plungers before carve their groove. It means we grind simple round bars and after that we carve their groove as final procedures. By using Electrolytic Grinding Machine, we can carves ring glove at final stage and it make possible to attain high circularities at the head part of COVERED PLUNGER as shown in Fig.6.

Fig. 5 Circularity of Normal plunger



ID: 11-APR-94

Fig. 6 Circularity of COVERED PLUNGER



RTH ID: 11-APR-94

RTH

As the result of it, it can be said that if clearance of above normal plunger is showed as 7µm, actual clearance is 10µm. But COVERED PLUNGER's clearance is precisely 7µm.

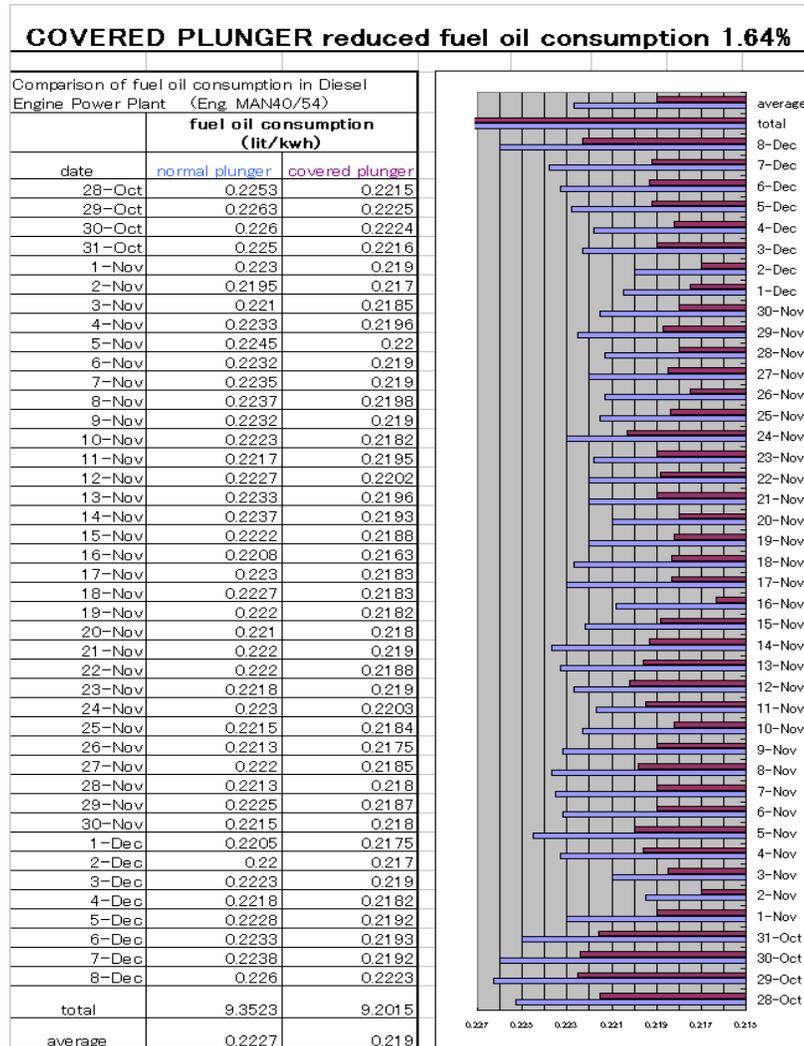
- COVERED PLUNGER has high efficiency and establishes low fuel consumption.

Due to above mentioned good circularity, COVERED PLUNGERS can reduce fuel oil consumption.

Our customer measured fuel oil consumption of COVERED PLUNGERS and genuine plungers in his shore generating plant. This test was carried out continuously and simultaneously during 40days.

Fig. 8 shows the result of this test and we can find COVERED PLUNGER achieved about 1.64% of fuel oil saving.

Fig. 8 The Results of Fuel Oil Consumption test



6. EAIPP Rule (Rule of Engine Internal Air Pollution Prevention)

We recondition old damaged plunger as COVERED PLUNGERS and return them to each vessel, so they can receive their original plungers from us. It means there remain engraved mark on each plunger.

In this reason, our methods of reconditioning (COVERED PLUNGERS) have no problems against the rule.

We confirmed it with NIPPON KAIJI KYOKAI (NK).

However, as far as we know, other companies' method is against the rule.

Because they change plungers to new one which they prepared, and set them to original barrels, and so, there remain no engraved marks on plungers.

In this reason, you cannot use their plungers if your vessel has constructed after the year of 2000.

7. Conclusions

By using COVERED PLUNGERS, you can obtain following merits without any problems against the rule.

- 1) High reliability
- 2) High performance
- 3) Lower fuel consumption
- 4) Reasonable price

- End -