



UPGRADE DESIGN NHL 100



FEATURES AND PECULIARITY OF THE PRODUCT NHL - MNHL 100

Rebuilding the modularity of the product in order to minimize the number of kits for the assembly of the complete gearbox has been achieved.

The MHL range was the first SITI range which the concept of flexibility and modularity to the highest degree had been applied to, and which has been further refined in the current design review process.

These flexibility and modularity concepts, partly complementary and partly mutually associated one to the other, are the largest real strong point, which allows us to mark a major step in our favor in our comparison to all the competition.

LEXIBILITY: With this term, in its wide sense, we mean above all the ease and speed by which a user
can switch from one version to another one, in other words to change the unit into a different version, as far as the following features are concerned:

- availability in the foot-mounting or flange-mounting output version;
- changing the gear ratio;
- transforming a PAM unit to a solid input shaft version or vice-versa;
- changing the PAM size on a unit;
- adding accessory devices;
- changing a two-stage version to a three-stage unit.

Flexibility can allow all SITI distributors as well as the end users to minimize their inventory; the same SITI can take advantage of an extreme benefit.

ODULARITY: This term refers to the capacity of the gearbox to be designed and built for modules, or for functional subassemblies, which can be manufactured and assembled in the form of modular units.

In other words, the gear unit consists of several sub-groups that can be easily assembled together in different ways, to give form and substance to all existing versions.

Like the flexibility, modularity represents an extreme advantage for the whole distribution network and for SITI, too. These modules or sub-groups are usually defined kit or set.

In the redesign activity it has been further refined and optimized the concept of modularity reaching the expected purpose, i.e. to have a unique output set while ensuring a range of ratios able to cover the old SITI versions, as well the corresponding products of the main competition.

The OUTPUT KIT throughout the MNHL range, identifies the main component of the gear unit, since it comprises well over half of the components of the complete gearbox and consequently is the most expensive set. Especially for this reason SITI has set the goal of optimizing this set resulting in **only one kit.**

The output kit consists of the gearbox housing complete with already mounted output shaft, wheel, bearings and shaft seals, and with the intermediate shaft output pinion. In other words, the output kit includes all the final reduction stage, which is common to both the versions with two reduction stages and with three reduction stages

The result of this involves a huge advantage, since the already mounted output kit, alone constitutes not less than 70% of an entire gear unit, and is common to all the possible standard versions. In other words, it is always the same:



- for all the reduction ratios
- for the versions with two reduction stages and the versions in three reduction stages
- for both foot-mounting and flange-mounting versions.

INPUT KIT: MNHL100 consists of several versions. With the term "Input set" it is intended to refer to the totality of components that are located at the inlet of the motion and which allow the connection with the driving mechanism, both if it is an electric motor and an external transmission; therefore, it does not include gears and reduction stages, but only shafts, covers, bearings and other related accessories.

Specifically for the MNHL range, the versions available are the following:

- solid input shaft (in this case, units are called NHL and not MNHL); used when there is an inlet transmission, and not the direct connection with a motor.
- Hollow input shaft for traditional PAM versions; it is the classic version with hollow input shaft and input flange for direct connection (plug-in) to electric motors standardized IEC B5 or B14.

FIRST REDUCTION KIT: It consists of the first reduction gear pairs (we are considering at the moment this concept for a two-stage reduction gearbox, but we will see how well it can be extended, with no conceptual changes, to versions with three stages of reduction). Therefore, each set consists of a pinion, a wheel and one or more conversion shafts, needed to connect the input pinion to the input shaft.

INTERMEDIATE KIT (FOR ACCOMPLISHING THE THREE-STAGE VERSION): Compared to the corresponding versions with two-stage reduction, the output kit is only one, as we have previously stated above. On the other hand, it is definitely peculiar to the three-stage versions the intermediate kit, that consists in:

- a pair of helical gears, which accomplish the second (or intermediate) one of the three reduction ratios;
- two tapered roller bearings, which are the ones that sustain the intermediate shaft. In order to push the modularity at the highest level, it has been arranged that the intermediate ratio of the three-stage reduction gearbox is always the same.









HE INTERCHANGEABILITY: In the new version even changes have been accomplished in order to make the gearbox as much interchangeable as possible with the corresponding products of the competition. The main changes include the addition of the output shaft with a diameter Ø110 (j6), in addition to the standard Ø100 (j6), and the height of these last ones from the mounting base to 355 mm (345mm in the old version).



- 1. H355 (previous H345)
- 2. D.100 j6 standard Optional D.110 j6 added in the new version
- 3. Added bolting pattern for center distance = 380 it is kept even the bolting pattern for center distance=440
- 4. Hp=62 (previous 90)



IMPROVEMENTS

ELICAL GEARS: In the redesign of the product, a great deal of the design has focused in the optimization of the gears which have all been recalculated, optimizing the basic parameters that lead to having a high performance of the meshing, like the specific sliding, helix angles, a thicker face covering, and so forth. As a consequence of this, all machining tolerances have been optimized both in relation to toothing and to the level of center distances on the housing; in addition to this, all control processes and testing methods of the entire product line have been revised, in order to obtain a great consistency between the theoretical and practical values.

GEAR MATERIALS: All gears are made of case-hardening steel (type 20MnCr5), and are subjected to case-hardening, quenching and stress relieving heat treatments. In the review of the project it has been made a further step ahead by going to draw the output wheel from a hot forged semi-finished piece; considering the size of that gear, a forged material leads to considerable advantages:

- Greater mechanical resistance due to the arrangement of the fibers and the compacting of the material.
- Less weight because it can use smaller pieces to the same mechanical resistance.
- Elimination of internal defects due to the great compression of the material which is obtained by molding.
- Much lower distortion in the process of heat treatment, once more due to the greater compactness of the fibers, which impacts on a better quality gear. Still in reference to this point, the heat treatment process has been optimized in order to reduce to a minimum the distortions. The expectations of these improvements are to obtain a product able to give the best performance, both at the level of operating parameters, efficiency, noise, level of temperature as well as the reduction of the backlash.



In the redesign and calculation of all the gearboxes, the latest most advanced technologies currently available on the market have been used, enabling to model the entire system and evaluate the performance of the individual components in their operating wholeness.



W PERFORMANCE: New performance data based on the accomplished improvements.

UPGRADE NHL 100

| i | 2800 | | | 1400 | | | 900 | | | |
|---------|--------|-------|-------|--------|-------|-------|--------|-------|-------|-------|
| | n2 | M2 | kW1 | n2 | M2 | kW1 | n2 | M2 | kW1 | RD |
| 2 STAGE | | | | | | • | | | | |
| 5,033 | 556,27 | 10000 | 600,5 | 278,14 | 10500 | 315,3 | 178,80 | 11000 | 212,3 | 0,97 |
| 5,631 | 497,25 | 10000 | 536,8 | 248,63 | 10500 | 281,8 | 159,83 | 11000 | 189,8 | 0,97 |
| 6,314 | 443,47 | 10000 | 478,8 | 221,74 | 10500 | 251,4 | 142,55 | 11000 | 169,3 | 0,97 |
| 7,700 | 363,64 | 10000 | 392,6 | 181,82 | 10500 | 206,1 | 116,88 | 11000 | 138,8 | 0,97 |
| 9,728 | 287,83 | 10500 | 326,3 | 143,92 | 11000 | 170,9 | 92,52 | 11000 | 109,9 | 0,97 |
| 10,714 | 261,33 | 10500 | 296,2 | 130,67 | 11000 | 155,2 | 84,00 | 11000 | 99,8 | 0,97 |
| 12,179 | 229,91 | 10500 | 260,6 | 114,96 | 11000 | 136,5 | 73,90 | 11000 | 87,8 | 0,97 |
| 15,021 | 186,41 | 10500 | 211,3 | 93,20 | 11000 | 110,7 | 59,92 | 11500 | 74,4 | 0,97 |
| 16,205 | 172,78 | 10500 | 195,9 | 86,39 | 11000 | 102,6 | 55,54 | 11500 | 69,0 | 0,97 |
| 20,852 | 134,28 | 10500 | 152,2 | 67,14 | 11000 | 79,7 | 43,16 | 11500 | 53,6 | 0,97 |
| 24,881 | 112,54 | 10500 | 127,6 | 56,27 | 11000 | 66,8 | 36,17 | 11500 | 44,9 | 0,97 |
| 26,939 | 103,94 | 9500 | 106,6 | 51,97 | 10000 | 56,1 | 33,41 | 10500 | 37,9 | 0,97 |
| 29,313 | 95,52 | 8500 | 87,7 | 47,76 | 9000 | 46,4 | 30,70 | 9500 | 31,5 | 0,97 |
| 3 STAGE | | | | | | | | | | |
| 30,745 | 91,07 | 11000 | 109,8 | 45,54 | 12000 | 59,9 | 29,27 | 12000 | 38,5 | 0,955 |
| 35,911 | 77,97 | 11000 | 94,0 | 38,99 | 12000 | 51,3 | 25,06 | 12000 | 33,0 | 0,955 |
| 40,103 | 69,82 | 11000 | 84,2 | 34,91 | 12000 | 45,9 | 22,44 | 12000 | 29,5 | 0,955 |
| 47,963 | 58,38 | 11500 | 73,6 | 29,19 | 12000 | 38,4 | 18,76 | 12500 | 25,7 | 0,955 |
| 54,658 | 51,23 | 11500 | 64,6 | 25,61 | 12000 | 33,7 | 16,47 | 12500 | 22,6 | 0,955 |
| 63,028 | 44,42 | 12000 | 58,5 | 22,21 | 12500 | 30,4 | 14,28 | 12500 | 19,6 | 0,955 |
| 73,789 | 37,95 | 12000 | 49,9 | 18,97 | 12500 | 26,0 | 12,20 | 13000 | 17,4 | 0,955 |
| 80,411 | 34,82 | 12000 | 45,8 | 17,41 | 12500 | 23,9 | 11,19 | 13000 | 16,0 | 0,955 |
| 88,137 | 31,77 | 12000 | 41,8 | 15,88 | 12500 | 21,8 | 10,21 | 13000 | 14,6 | 0,955 |
| 97,267 | 28,79 | 10000 | 31,6 | 14,39 | 10500 | 16,6 | 9,25 | 11000 | 11,2 | 0,955 |
| 108,224 | 25,87 | 9000 | 25,5 | 12,94 | 9500 | 13,5 | 8,32 | 10000 | 9,1 | 0,955 |
| 121,615 | 23,02 | 8000 | 20,2 | 11,51 | 8500 | 10,7 | 7,40 | 9000 | 7,3 | 0,955 |



| i | 100/2 PAM | | | | | | | | | | | |
|---------|-----------|-----|-----|-----|-----|-----|--|--|--|--|--|--|
| 5,033 | | | 200 | 225 | 250 | 280 | | | | | | |
| 5,631 | | | 200 | 225 | 250 | 280 | | | | | | |
| 6,314 | | | 200 | 225 | 250 | 280 | | | | | | |
| 7,700 | | | 200 | 225 | 250 | 280 | | | | | | |
| 9,728 | | | 200 | 225 | 250 | 280 | | | | | | |
| 10,714 | | | 200 | 225 | 250 | 280 | | | | | | |
| 12,179 | | | 200 | 225 | 250 | 280 | | | | | | |
| 15,021 | | | 200 | 225 | 250 | 280 | | | | | | |
| 16,205 | | | 200 | 225 | 250 | 280 | | | | | | |
| 20,852 | 160 | 180 | 200 | 225 | 250 | | | | | | | |
| 24,881 | 160 | 180 | 200 | 225 | 250 | | | | | | | |
| 26,939 | 160 | 180 | 200 | 225 | 250 | | | | | | | |
| 29,313 | 160 | 180 | 200 | 225 | 250 | | | | | | | |
| | 100/3 PAM | | | | | | | | | | | |
| 30,745 | | 160 | 180 | 200 | 225 | | | | | | | |
| 35,911 | | 160 | 180 | 200 | 225 | | | | | | | |
| 40,103 | | 160 | 180 | 200 | 225 | | | | | | | |
| 47,963 | | 160 | 180 | 200 | 225 | | | | | | | |
| 54,658 | | 160 | 180 | 200 | | | | | | | | |
| 63,028 | | 160 | 180 | 200 | | | | | | | | |
| 73,789 | | 160 | 180 | | | | | | | | | |
| 80,411 | | 160 | 180 | | | | | | | | | |
| 88,137 | | 160 | 180 | | | | | | | | | |
| 97,267 | | 160 | 180 | | | | | | | | | |
| 108,224 | 132 | 160 | | | | | | | | | | |
| 121,615 | 132 | 160 | | | | | | | | | | |







Curva continua: rotazione sinistra (Continuous curve: Counterclockwise motion) Curva a tratti: rotazione destra (Dashed curve: Clockwise motion)

Output shaft Ø110