MATERIALS USED BY OPENA IN MANUFACTURING OF VARIOUS TYPES OF INSTRUMENTATION

TERMINOLOGY:

AISI These are the initials for the American Iron and Steel Institute. AISI has identified the various formulations of steel and catalogued using a number system. Many of the materials used in surgical instrumentation have AISI numbers, i.e. AISI 304 or AISI 410.

ASTM These are the initials for the American Society of Testing and Materials. They establish standards and specifications for many materials, both metallic and non-metallic. Some materials will have an AISI number as well as an ASTM number.

Austenitic Series 300 Stainless Steels are Austenitic or non-hardenable or non-magnetic. The carbon content is as low as 0.08 percent that means these metals cannot be heat hardened and will not hold a strong cutting edge. However, it may be 'work hardened' through machining or forming. The presence of almost 18 percent chromium and 8 percent nickel makes these metals highly corrosion resistant and guarantee a brilliant shine. The term 18-8 stainless is sometime used to describe this series.

Martensitic Series 400 Stainless Steel alloys are magnetic type and heat hardenable. These have relatively high carbon and low chromium percentages, along with traces of manganese (Mn), silicon (Si), sulphur (S), phosphorous (P), nickel (Ni) Molybdenum (Mo) etc endowing the metal with specific properties. Their use is a necessity wherever strength and temper are required. The degree of hardness depends largely on the carbon level. This series is used in most O.R quality instruments, cutting and non-cutting, because it has a high tensile strength, can hold edge for a long time and is corrosion resistant. However, as there is little or no nickel in this series it is susceptible to corrosion if not looked after properly.

INTERNATIONAL STANDARDS:

BS 5194: Part 1
DIN 58298
ISO 7153-1

STAINLESS STEELS:

This is a relatively modern British innovation that has become in universal use for steel instruments. It reaches the factories in the form of bars and sheets. Looking at these lengths of rough and dark gray material, one wonders how it will be fashioned into beautifully finished instruments. Such a transformation reveals craftsmanship at its best.

STAINLESS STEEL TYPE AISI 304 This material is easy to machine and form. Instruments or components that do not need to be hardened, such as speculums, retractor blades, hollow handles, hospital hollow wares, nuts, screws and pins etc, are usually made from this grade.

STAINLESS STEEL TYPE AISI 316L It is a very high purity alloy. 'L' stands for low carbon. It is also called SMO. It is a preferred material for making most orthopaedic implants, such as plates and screws, nails, staples, prostheses and aneurysm clips etc. Certain instruments that have prolonged contact with implants also utilize this material to avoid transfer of dissimilar metal particles which could cause galvanic corrosion reaction on the implants. It is however important to know that metal implants and prostheses can sooner or later fail since no metal has yet been developed that will equal the revitalizing durability of living bone.

STAINLESS STEEL TYPE AISI 410 This is a most commonly used grade for the manufacture of non-cutting instruments. Typical examples are hemostats, assorted forceps, retractors and so on. It is easy to work with and has Rockwell Hardness in the range of C-40 to C-45. It is a misconception that this grade is inferior in any way as it clearly complies with the British, German and International Standards for application in surgical instruments.

STAINLESS STEEL TYPE AISI 420 & 440 These are useful grades for cutting instruments such as scissors, knives, chisels, ronguers, bone cutters, bone drills and taps etc. AISI 420 can get Rockwell Hardness in the range of C-48 to C-50 but if hardness around C-55 is required then grade AISI 440 with more carbon is appropriate.

TITANIUM:

Type ASTM F67 - Commercially Pure grades 1,2 and 4. It has the same strength as steel but weighs only 60 percent of the steel. It is highly corrosion resistant but very difficult to work with. Some microsurgery instruments, mandibular implants and weight bearing hip prostheses are made from it. Its biocompatibility is far more superior than any other currently employed implant material. It can be finished in a distinct blue colour but repeated autoclaving may give it a reddish tinge.

TUNGSTEN CARBIDE:

GRADE GC20 This is the hardest man made material, sometime also referred to as diamond. It has a Rockwell of C-86. Cemented carbide is often called hard metal. Its inserts are sintered in the jaws of high wearing instruments such as needle holders, scissors and wire cutters. Traditionally these instruments are partly gold-plated for recognition.

OTHER MATELS:

There are also many non-ferrous materials that are used in instruments for their specific properties. They may be easier to machine or form and more suitable for procedures or budget.

STERLING SILVER It is 92.5 percent pure silver (Ag). Current uses include trachea tubes, probes for eyes and haemostatic clips. Silver will turn black with oxide. This does not interfere with the function of the instrument. A bit of rub with or without silver polish or elbow grease will bring the original shine back. These instruments should be handled carefully as they are expensive as well as delicate.

GERMAN SILVER An alloy of silver and nickel that is less expensive and is used as an alternative to Sterling Silver. It is also more durable and does not turn black after autoclaving.

BRASS AND COPPER Free cutting brass type 360 and nickel-copper Class A or B are easily formed, moulded and welded therefore useful for making instruments that are otherwise hard to make from steel or require malleable features. Certain instruments made traditionally in these soft metals are proctoscopes, malleable uterine sounds and retractor blades, catheters and cannulas. In order to enhance surface wear these are usually plated.

ALUMINUM There are many hard and soft grades. With its excellent heat dissipation capacity along with durability and lightweight it is employed for making the container system for sterilization and storage. Falcon offer a durable yet economical system, please see our catalogue. Aluminum requires a protective layer by hard anodizing that can also be in different colours for identification. Some instrument handles, mallet heads and splints are also made of aluminum.

NON-METAL MATERIALS:

Rubber, Plastic, Silicon and Tufnol are increasingly used in a wide variety of application, both reusable and disposable. Some of the useful characteristics are toughness, flexibility, resilient, resistant to chemicals, insulating, no moisture absorption, heat deformation, high impact strength, easy fabrication and low cost etc. In fact the possibilities are endless. Plastic items are gradually enabling a new wave of convenience and cost reduction in the operating room, a trend that will undoubtedly continue to grow with the passage of time. The use of latex rubber, however, has been discouraged because it contains certain protein that is said to cause skin allergy to some patients and hospital staff. No significant hazards are expected from silicon products under normal conditions of handling and use.

PLATING:

Carbon steel and non-ferrous metals instruments are protected from staining or discolouring by plating of various types. Until the advent of stainless steel most surgical instruments were plated. However many instruments are still more economical or effective to make plated. Mixing of plated instruments with stainless steel instruments in the reprocessing cycle should be avoided as it may result in transference of chrome to stainless that will look like stains. All plated instruments should be routinely checked to ensure there is no cracks or worn areas in the surface. In recent years the use of ultrasonic cleaning has hastened the demise of plated instruments as it tends to strip the plating from the base metal.

SILVER PLATING - Instruments or components made of copper or brass can be plated with silver by electrodeposited coating. To enable the final silver deposit to adhere it will follow a primary coating of silver strike solution, nickel or copper plating. The silver plating shall not be less than 0.0010 inch in thickness. It is especially suitable on malleable instruments because the layer of silver plating is so thin it does not crack or chip when instrument is bent. Silver plating may turn black with silver oxide and may be given a good rub to get the shine back.

NICKLE PLATING Nickel adheres very well to carbon steel and is not removed easily. The surface is made free from all flaws or defects which will be detrimental to the final finish. Cutting edges are ground to remove all plating. There are not many instruments made with carbon steel these days, except perhaps for veterinary use or some general-purpose scissors. Moisture will act rather quickly to first stain and then corrode these instruments.

CHROME PLATING Carbon steel, copper and brass are all base metals that can be chrome plated. Finish on all edges and surfaces shall be uniform and free from burrs, sharp edges (except where required), crevices, grind marks, rough areas, cracks and overlaps. Chrome plating often has a layer of copper or nickel underneath and therefore protects instruments longer from corrosion and discolouration.

BLACK CHROME PLATING Black finish makes work easier under microscope or extra lighting because of lack of glare. Until recently, the black or ebonized finish was achieved by dipping in a sodium salt solution and then baking in oven. These salts, however, have now been reclassified as very toxic and therefore unsafe to use. There are also some very strong disinfectants also now available that can strip this type of black finish completely. Falcon has therefore abandoned this process and may only be able to offer instruments ebonized in Europe if necessary.